JPS Journal of Policy Studies

J. Policy Stud. 2025;40(3):1-27
https://doi.org/10.52372/jps.e680
pISSN 2799-9130 eISSN 2800-0714

Article

Blueprints for tomorrow's smart cities in South Korea: conceptual definition and timeline forecast from a policy delphi study

Seung-Yoon Shin[1], Ahra Lee[2], Choong-Sik Chung[3]

[1]*Software Policy and Research Institute, Seongnam, Korea*
[2]*Graduate School of Public Administration, Seoul National University, Seoul, Korea*
[3]*Department of Public Administration, Kyungsung University, Seoul, Korea*

Received: March 8, 2024
Revised: August 25, 2024
Accepted: September 29, 2024

Corresponding author
Choong-Sik Chung
Tel: +82-51-663-4528
E-mail: cschung@ks.ac.kr

ORCID
Seung-Yoon Shin
https://orcid.org/0009-0007-5612-8870
Ahra Lee
https://orcid.org/0009-0009-3196-3217
Choong-Sik Chung
https://orcid.org/0000-0002-4815-0775

Competing interests
No potential conflict of interest relevant to this article was reported.

Funding sources
This work was supported by the Ministry of Education of the Republic of Korea and the National Research Foundation of Korea (NRF-2021S1A5C2A03087287).

Acknowledgements
Not applicable.

Availability of data and material
Upon reasonable request, the datasets of this study can be available from the corresponding author.

Abstract

This paper delineates the smart city (SC) concept in a South Korean context and, based on this conceptual definition, it forecasts the expected implementation timeline of the country's SC pilot projects. Through the use of a three-round policy Delphi methodology, a consensus on the SC concept was reached, with an emphasis on a citizen-centric paradigm. The Delphi panelists predict that South Korea's SC projects will be completed by 2030. However, the realization of its full-service SC capabilities is expected by 2035. These findings highlight the need for SC policies to prioritize citizens' satisfaction and quality of life rather than only focusing on technological efficiency. Moreover, this study advocates using phased goal-setting in SC projects to emphasize the importance of integrating urban infrastructure with citizens' daily lives. Based on these key findings, this study draws policy implications that can help SC policy practitioners.

Keywords: smart city, citizen-centered city, policy Delphi, digital transformation, digital governance

Introduction

Amid the rapid growth of urban populations, national and local governments are faced with many urban challenges, including pollution, energy consumption, traffic congestion, and public safety concerns (Chen et al., 2019; Harrison et al., 2010). In response, more governments worldwide are advocating smart city (SC) initiatives to effectively address urban issues and foster new avenues of growth in the era of digital transformation (Paskaleva, 2013; van Twist et al., 2023). As a result, the SC market is expected to be the fastest-growing one over the next decade (Markets and markets, 2021).

The South Korean government has identified SC as a key national growth strategy that leverages the country's advanced information and communication technology (ICT) infrastructure to actively

promote SC policies. The concept of SC, which leverages ICT for innovation, has long been recognized as a catalyst for economic development in South Korea (Yigitcanlar et al., 2018; Yun & Leem, 2016; Yun & Lee, 2019). The government has designated certain areas in Sejong and Busan City as flagship projects for SC development that received national support in 2018. These ongoing projects aim to develop urban areas where residents can interact with intelligent infrastructure such as big data, artificial intelligence, autonomous vehicles, drones, virtual reality, and other cutting-edge technologies (Ministry of Land, Infrastructure, and Transport of Korea, 2018).

The history of promoting SCs in South Korea is long. In 2008, the country started projects for an early version of an SC called U-City. This project aimed to improve the efficiency of urban services by integrating advanced ICTs into urban facilities, and it has continued under the name of SCs until now (Hwang, 2020a; Kim, 2015). This long history of Korea's SC initiatives based on U-City has contributed to South Korea's recognition as a leading global SC (Ju et al., 2021). According to the International Institute for Management Development's (IMD) Smart City Index Report in 2023, Seoul was selected as one of the six "super champions" among the SCs.

Although Korea introduced SC very early through its U-City project and has been a leader in SC development for a decade, the country's efforts have several limitations (Choi et al., 2020; Yang et al., 2020). Scholars and research institutions have criticized Korea's SC policy for focusing too much on hardware-oriented innovations, such as the integration of ICT into the urban infrastructure, without a well-articulated SC concept that embodies core values (Choi, 2018; KIPA, 2020; KISDI, 2010; Myeong et al., 2021). In contrast, several European countries have consistently and successfully promoted SC policies based on a well-articulated SC concept that emphasizes urban renewal, solving existing urban problems, and increasing citizen engagement (Bakıcı et al., 2013; Riva Sanseverino et al., 2018). The problem with South Korea's technology-centered SC approach, which lacks core social values, could negatively impact the promotion of sustainable SC policies and the establishment of successful SC models from a long-term perspective.

From this perspective, our research team sought to develop and establish a Korean SC concept that includes core values and components, such as improving citizens' quality of life by addressing urban challenges and promoting civic engagement. We gather the diverse opinions of South Korea's SC experts to clearly establish the SC concept that Korea aims for, thereby guiding the direction of Korea's SC policies. The articulation of the SC concept is expected to contribute significantly to the coherent and successful promotion of SC policies in Korea.

In addition, we attempt to forecast the expected timeline for the actual implementation of Korea's national SC projects based on the developed SC concept's definition. Korea's national pilot SC project, which was announced and initiated in 2018, is expected to be completed around 2023. However, construction has been delayed due to delays in land acquisition and administrative procedures. As the construction of the pilot projects has been gradually delayed, the concepts and goals of these projects, which are shared among stakeholders, are in danger of becoming unclear. Many stakeholders eagerly await the successful implementation of Korea's national SC pilot projects, but the realization of these projects seems somewhat distant. Therefore, this study aims to define the SC concept that Korea aspires to and that is based on the opinions of Korean SC experts. Based on this definition, the study attempts to predict when the representative SCs of Sejong and Busan

https://doi.org/10.52372/jps.e680

City, which are planned as Korea's SC models, can be realized, using the insights of these experts. To guide our investigation, we posed two main research questions:

RQ1: How can the smart city that Korea aims for be defined?
RQ2: When will Korea's smart city project be implemented?

Our team used a three-round policy Delphi method to address these questions. Based on the insights gained from the Delphi rounds, this paper proposes the SC concept in the Korean context and forecasts the expected implementation timeline based on this conceptual foundation.

The following sections of this article are a literature review of the definition of the SC concept and the background of Korean SC policy (Section 2), an explanation of our research methodology (Section 3), a presentation of the Delphi results on the research questions (Section 4), and a discussion of the policy implications of our findings along with concluding remarks (Section 5).

Literature Review and Theoretical Backgrounds

Approaches for smart city concept

The concept of an SC has become more widespread in the last decade. However, there has yet to be a consensus on a single definition of SC both in academia and industry (Albino et al., 2015; Mora et al., 2017; van Twist et al., 2023). Hall (2000) defines SC as "a city that monitors and integrates the conditions of all of its critical infrastructures, including roads, bridges, tunnels, rails, subways, airports, seaports, communications, water, power, even major buildings, can better optimize its resources, plan its preventive maintenance activities, and monitor security aspects while maximizing services to its citizens." Giffinger et al. (2007) conceptualizes SC as "a city well performing in a forward-looking way in economy, people, governance, mobility, environment, and living, built on the smart combination of endowments and activities of a self-decisive, independent and aware citizen." The reason for the diversity of academic definitions of SC can be attributed to the fact that the SC concept includes all social, cultural, and physical elements so that it can be understood differently depending on the parts to be emphasized (Ju et al., 2020).

In their critical review of the previous studies on the conceptualizations of SCs, Greco & Cresta (2015) noted that the existing studies approach the SC concept in three ways. First, the technology-centered approach defines SC by strongly emphasizing hardware aspects, such as new technologies and infrastructure, making ICT the core of SCs (Cairney & Speak, 2000; Washburn et al., 2009). Second, the human-centered approach gives significant weight to social and human capital in defining SCs. Third, the integrated approach seeks continuous urban growth and innovation by integrating technology with human and social capital (Campbell, 2013; Greco & Cresta, 2015; Moss Kanter & Litow, 2009).

However, one of the main characteristics identified in recent emerging SC literature regarding the definition of the SC concept is the emphasis on the importance of SC governance and stakeholder participation. SC governance values shared agreements among stakeholders and the consensus-building process (Albino et al., 2015; Fernandez-Anez et al., 2018). In particular, civic engagement

and citizen-centered decision-making among stakeholders are highly emphasized (Castelnovo et al., 2015; Dameri, 2013; Fernandez-Anez et al., 2018; Kim & Kim, 2021; Vieira et al., 2023; Yun & Lee, 2019). Fernandez-Anez et al. (2018), who proposed a conceptual model of an SC, state that the citizen-centric approach is the heart of SC governance by placing citizens at the center of their SC conceptual model. Lim et al. (2023) explain that active citizen participation in the planning stages of SCs can identify citizens' needs and contribute to the development of better urban services. They also argue that for these positive effects to be strengthened and maintained, cities should support citizen participation with a communication platform based on the ICT infrastructure (Lim et al., 2023). Accordingly, the higher the SC development stage, the more emphasis should be placed on citizen participation (Lim et al., 2023).

Summarizing the above discussion, this study posits that for Korea's SC to be successfully implemented, it is crucial to not only adopt a technology-based SC concept that enhances the efficiency of urban services by integrating cutting-edge ICTs into urban infrastructure but also to adopt an SC concept centered on citizen values. Therefore, we aim to develop an SC definition based on the integrated approach discussed by Greco & Cresta (2015) that emphasizes the human pillar, specifically the "citizen," among the two conceptual pillars of technology and human.

The importance of a well-defined SC concept and forecasting its expected implementation timeline

Establishing clear policy objectives is one of the essential factors for successful policy outcomes (Schumann, 2016; Van Meter & Van Horn, 1975). When policy objectives are complex, incongruence with the objectives can occur in policy implementation, resulting in a misalignment between the policy objectives of higher-level organizations and the operational priorities of frontline agencies (Meyers et al., 2001). In addition, how policy objectives are viewed and defined can have a significant impact on their clarity. This clarity is particularly important for policies that involve a wide range of stakeholders, as precise and unambiguous policy goals significantly influence the effectiveness of communication and implementation activities across organizations (Van Meter & Van Horn, 1975).

In this respect, a well-defined SC concept can influence the establishment of policy objectives related to SC and, ultimately, the outcomes of SC policies. This aspect is considered to be even more pronounced in large-scale SC projects involving multiple stakeholders (Barrutia et al., 2022).

In general, SC projects involve a variety of stakeholders, including central and local governments, private companies, and citizens, making communication and collaboration among them crucial (Clement et al., 2022; Komninos et al., 2019; Lim et al., 2023; Snow et al., 2017). For effective communication and collaboration, it is important for stakeholders to share common goals and values (Ansell & Gash, 2008). In this regard, a shared and clear SC concept can eliminate the ambiguities in the common understanding among stakeholders during the SC project and provide a consistent direction for the project. This contributes to effective communication and collaboration among stakeholders.

The purpose of this article is to present a well-defined SC concept for South Korea, taking into account the values and goals that the nation's SCs pursue, and to address the lack of an in-depth

https://doi.org/10.52372/jps.e680

discussion on the conceptualization of SCs in Korea.

This study also aims not only to develop a definition that reflects the direction of South Korea's SCs but also to predict when the ongoing SC projects in South Korea will be successfully implemented based on this definition. The importance of forecasting the expected implementation timeline for the Korean SC project is as follows. First, it is necessary to efficiently manage the resources involved in SC projects. Since SC projects generally involve large national budgets (Lam & Yang, 2020), predicting the completion time that can achieve the intended direction of South Korea's SCs allows for the proper allocation and management of accompanying resources (Ordu et al., 2021). This can be particularly helpful in establishing budget plans, thereby contributing to the efficient management of resources related to the projects (Raine & Baxter, 1979). In addition, it can help prepare for follow-up activities or related projects that will take place after the SC projects. If the true meaning of SC is not realized through the existing projects, predicting the expected implementation timeline can serve as crucial information for policy makers, enabling them to prepare and plan follow-up projects or policies that complement the results of the existing projects.

Empirical context: SC policies in South Korea

South Korea initiated the U-City project relatively early, an initial version of the SC project, focusing primarily on hardware innovation through the integration of ICT into urban infrastructure. The U-city project was actively promoted until 2013, reflecting the widespread consensus on the importance of efficient city management via ICT in Korea. However, it faced significant criticism for its hardware-centric approach and neglect of the demand side, including residents' needs and quality of life (Sung, 2022). Additionally, it was critiqued for its top-down development process and oversight of the social and cultural infrastructure (Lim et al., 2023; Yigitcanlar, 2015).

Despite these criticisms, the U-city project played a pivotal role in laying the groundwork for domestic SC technological infrastructure and facilitating the proliferation of local SCs in Korea. Nevertheless, the zenith of the domestic U-city project was short-lived, with the ICT business model often subcontracted to city corporations, proving insufficient as a catalyst for qualitative urban innovation.

The paradigm of Korea's SC policy underwent a significant shift with the amendment of the Act on the Promotion of Smart City Development and Industry (hereinafter referred to as the Korea Smart City Act) in 2017. This Act delineates an SC as "a sustainable city where various city services are provided on the foundation of urban infrastructure developed by the convergence and integration of construction technologies, information, and communication technologies, etc., aiming to enhance its competitiveness and livability." A notable shift post-2017 is the South Korean government's enhanced focus on fostering an urban environment conducive to innovation, addressing urban challenges, and improving citizens' quality of life. This contrasts with the erstwhile U-City policy, which concentrated on establishing urban infrastructure and services, whereas the current SC policy prioritizes resolving urban issues and fostering innovative industries.

In January 2018, the South Korean government unveiled two SC pilot projects in Busan and Sejong cities, aspiring to set a global benchmark for "world smart cities." These pilot sites were chosen within the Sejong 5-1 living area, and a section of Busan City centered on the Semulmeori

area. The foundational concept of these SC projects was outlined in July 2018, with a detailed implementation plan finalized by December 2018 and publicly announced in February 2019. The government's vision for these national pilot SCs encompasses three strategic directions: (1) serving as a test bed for emerging technologies, (2) addressing urban challenges and enhancing quality of life, and (3) cultivating an innovative industrial ecosystem.

Former President Moon Jae-in perceived SCs as a vehicle for economic growth by leveraging emerging fourth industrial revolution (4IR) technologies, and as crucial factor for enhancing citizens' quality of life (Intralink, 2019). With this backdrop, SCs were prioritized on the presidential agenda, and the 4IR Committee, a presidential committee, spearheaded this national initiative, backed by significant political and financial support (Relevant department consolidation, 2018).

At this point, the success of the SC pilot projects is now critical for South Korea, which seeks to overcome the shortcomings of the U-city project and establish a successful new SC reference model. A successful SC model holds significance for the South Korean government by promising to secure future growth engines through the dissemination of their SC model.

Yet, despite extensive budgetary and political backing, South Korea's SC concept remains underdeveloped (Han et al., 2018; Hwang, 2020a), and the national SC project has progressed. The lack of a clear conceptual definition of SC, which should precede policy objective setting, may adversely affect the overall implementation of SC policy.

In response, this paper aims to contribute to the clear goal-setting of Korea's SC policy and ensure its sustainability. Moreover, clearly defining SC policy objectives is expected to establish more concrete standards for future SC policy implementation.

Research Method

Policy Delphi

We selected the policy Delphi as the primary research method to accomplish our research objectives. The policy Delphi is a derivative of the Delphi methods, recognized as a prevalent technique for forecasting and consolidating the judgments of experts within the field of social sciences (Preble, 1983; Prokesch et al., 2015; Tiberius et al., 2022; von Der Gracht, 2012).

Turoff (1970) defines the policy Delphi as "an organized method for correlating views and information pertaining to a specific policy area and for allowing the respondents representing such views and information the opportunity to react to and assess differing viewpoints" (p. 153). This method serves as an intuitive forecasting process for methodically aggregating, exchanging, and refining informed opinions concerning a specific issue (Rayens & Hahn, 2000). Generally, intuitive forecasting is employed for complex problems lacking well-defined policy alternatives and where empirical data for forecasting are absent (Dunn, 1994; Rayens & Hahn, 2000).

While Turoff (1970, 1975) provided guidelines for the policy Delphi, no standardized approach exists for implementing this method in practice (de Loë et al., 2016; von der Gracht, 2008). Nevertheless, certain widely recognized characteristics of this method, according to de Loë et al. (2016), are, first, the panelists should be knowledgeable about the issue and engage in an anonymous, multi-round, structured dialogue on the questions. Second, the process should unfold

https://doi.org/10.52372/jps.e680

over two or more stages, starting with a questionnaire that is either open-ended or more narrowly focused. The number of stages may vary from two to five (Critcher & Gladstone, 1998). Third, the initial stage's responses are synthesized and presented back to the panelists for evaluation. Ratings are commonly employed to review ideas, with more detailed evaluations often sought thereafter (de Loë et al., 2016). Finally, the fourth and any subsequent stages refine the group's feedback and may introduce new lines of inquiry (de Loë et al., 2016).

The Delphi methodology has been widely used in recent SC research. For example, Angelidou et al. (2022) explored how the domains of SCs, smart transport, and smart energy would evolve by 2030 through literature findings and predicted the likelihood of these findings materializing by 2030 using the Delphi survey. Li et al. (2022) used the Delphi method to identify key factors that facilitate policy transfers among SC. Meanwhile, Kuo et al. (2022) used the Delphi methodology to develop indicators for evaluating the resilience of SCs.

Meanwhile, due to the complex characteristics of SC projects, some studies have combined the Delphi method with other methodologies. Wu & Chen (2021) proposed a structured method for SC policy selection, employing a three-phase process (Delphi, analytic hierarchy process, zero-one goal programming model) and used a modified Delphi in the first phase to determine decision elements by surveying panel members. Okafor et al. (2023) applied a mixed-method approach, including the Delphi method and quantitative surveys, to analyze the success factors and levels of smart mobility systems in Nigeria. They gathered expert opinions through the Delphi method to identify these success factors.

In general, SC-related research addresses complex issues across broad categories, such as technology, society, and the environment, necessitating the consideration of opinions from experts in various fields. For this reason, the policy Delphi method, which incorporates diverse experts' perspectives to predict the future, is deemed the most suitable methodology for addressing this research problem.

Selection process and profiles of Delphi expert panelists

As in the traditional Delphi process, the selected participants should be well-versed and experienced in the research topic. The number of participants, called a panel of experts, should not exceed 30 (Sekayi & Kennedy, 2017). However, considering the possibility that the questionnaire response rate may not meet expectations, we aimed to select 30 experts in the SC field to ensure comprehensive and professional perspectives. These experts were comprised of 10 individuals each from academia, research, and industry.

Each expert was selected through the following process. We identified 10 academic experts who had participated in research projects related to the SC national pilot city projects (Sejong 5-1 Living Zone and Busan Eco-Delta City). They had at least five years of experience in SC-related research and education. They were deemed qualified as panelists because they had been recruited as experts for several government projects. They were all professors, and most of them specialized in public administration and policy studies with a specific focus on ICT policy. Their average length of service was 18.7 years.

In the research field, we selected researchers who had either participated in SC policy projects

or served as advisors. Generally, all of these experts have a Ph.D. and have significant experience working in the field. They also work at national research institutes in South Korea. Their doctoral degrees are in public administration, policy studies, urban planning, and engineering, with an average length of service of 16.4 years.

The industry experts were selected from among the practitioners in SC technology based on recommendations from academic and research experts. They were all involved in SC-related industries and held a position of manager or higher. They mainly specialized in urban planning and engineering, with some having backgrounds in public administration. Their average length of service was 15.4 years.

Design and process of policy Delphi

Policy Delphi round composition

Similar to the classical Delphi method, which consists of multiple rounds, we employed a three-round policy Delphi method. In the first round, we gathered the panelists' diverse perceptions through unstructured, open-ended questions. Subsequently, their responses were categorized and transformed into a structured questionnaire for the second and third rounds. We also presented statistical analyses in the form of frequency analysis tables, histograms, and dispersion graphs to provide feedback to the panelists.

Structure of policy Delphi questions

Regarding the establishment of the SC concept, the first round of our policy Delphi method involved presenting the definition of an SC as outlined in the Korean Smart City Act to the panelists. We solicited their definitions of an SC. In the second round, we requested that the panelists enumerate the keywords that consistently emerged in the SC concept definitions, arranging these keywords by their perceived importance. In the third round, we relayed the outcomes of the second round to the panelists, asking them to reassess the priority rankings of the keywords. The modified policy Delphi method was also employed to forecast the implementation year of SCs in Korea.

Unlike the traditional Delphi approach, which typically begins with open-ended questions to gather ideas before progressing to more specific inquiries in later rounds, our method introduced a unique approach in the first round. The panelists were asked to evaluate whether two pilot projects were expected to be executed effectively by 2030, selecting between two outcomes, success or failure,[1] In and elaborating on their choice. In the second round, the panelists were asked to specify an implementation year (e.g., 2025, 2030, etc.) and elaborate on their selection. Finally, in the third round, the results from the second round were presented back to the panelists, who were then requested to provide their final input on the expected implementation year.

Policy Delphi process

The policy Delphi process began on August 17, 2021, and concluded on October 15, 2021. The

[1] In this study, the authors did not define the success or failure of SCs. Instead, they encouraged evaluating SCs' success and failure by referencing the components of the IMD Smart City Index, which assesses the performances of global SCs annually. The detailed contents of IMD's index are shown in Appendix 1.

https://doi.org/10.52372/jps.e680

first round's questionnaire was disseminated via email to the 30 panelists on August 17, 2021, with a notification sent via text message requesting their responses. The original deadline for responses was set for August 31, but it was subsequently extended by five days to enhance the response rate, resulting in 28 experts ultimately responding (Table 1).

Based on these initial responses, we formulated and disseminated a refined questionnaire for the second round to the 28 panelists on September 24, 2021. The deadline for this round was September 30, and 27 experts provided responses.

After summarizing the second round's outcomes, we proceeded to the final round, dispatching questionnaires to the 27 panelists on October 8, 2021. The deadline for the third round was October 15, with 26 experts responding. Following the completion of the third round, the research team conducted several meetings to classify and analyze the outcomes of the three policy Delphi rounds. The consensus among the panelists regarding the forecast year was deemed to have been achieved after the third Delphi round, thus concluding the process at this stage.

Analysis of the Results

A total of 26 experts, out of an initial panel of 30, participated up to the third round of the Delphi study. Subsequently, the outcomes of the Delphi process concerning the definition of the SC concept are presented, followed by a detailed exposition of the predictions regarding the implementation timeline of the SC initiative.

Defining a smart city

Results for the first round

In the first round, 28 panelists answered and defined SC according to their viewpoints referring to the SC definition in the Korean Smart City Act. As a result, we obtained various opinions regarding the definition of an SC from the three sectors: academia, research, and industry. Table 2 shows the representative responses from these three sectors.

The keywords that appeared in common in the definitions were "the use of intelligent technology," "improvement of citizens' quality of life," "improving a city's competitiveness," "sustainable city," "public platform city," "city governance," "urban infrastructure," "citizen-centered city," "sustainable eco-friendly city," "participatory policy decision," "solving urban problems," "improving the efficiency and equity of citizens' lives," "providing public service without discrimination," and "solving urban problems by utilizing intelligent technology."

Table 1. Information of policy Delphi panelists' composition by round

	Round 1		Round 2		Round 3	
	No.	Percent (%)	No.	Percent (%)	No.	Percent (%)
Academia	11	39.29	10	37.04	9	34.62
Research	10	35.71	10	37.04	10	38.46
Industry	7	25.00	7	25.93	7	26.92
Total	28	100	27	100	26	100

Table 2. Results from the first round

Field	Definition
Academia	An intelligent and governable urban system that redesigns administrative practices and procedures based on highly intelligent ICT and social networks, shares knowledge and information among governments, businesses, local residents and local communities, and provides a public platform for continuous productive and democratic value- added transactions.
	A new city that accumulates and judges information for urban operation using ICT technology and operates urban infrastructure in a planned and responsive manner with information and communication technology as an operating system to improve the quality of life of urban people.
	A city that has established an intelligent governance and eco-friendly urban foundation that can solve urban problems using sustainable digital technology means from the perspective of citizens and constantly create new growth engines that improve the quality of life.
	A smart city is a city that uses intelligent information technology as a core technology in a series of processes to improve citizens' quality of life by proactively identifying various administrative needs of citizens and presenting the most efficient solutions through democratic decision-making processes.
Research	A smart city is a sustainable urban platform that efficiently manages assets and resources based on urban infrastructure built by converging construction and information and communication technology and provides services created through citizens' participation in policy design and experiments.
	A smart city provides safer and more convenient services by converging various information and communication technologies to improve the quality of life of urban residents. To this end, it is necessary to establish the latest information and communication infrastructure and provide new urban-based services using various technologies. In this process, equal universal services should be provided to all residents living in the city without discrimination.
	A city that uses intelligent information technology to respond sensitively to the needs of its citizens and to improve the quality of life of its citizens by innovatively solving urban problems.
Industry	It refers to the integration of intelligent information technology throughout the city. In other words, it can be said that it is a city where intelligent information technology is applied to all fields such as administration, economy, and education as well as buildings, transportation, and the environment. Intelligent information-related technologies are permeated into citizens' lives, including the physical environment.
	It can be defined as a city that solves urban problems and improves residents' quality of life by using the technologies of the 4IR such as big data, network, and artificial intelligence. If the existing city was a method of expanding resource consumption and infrastructure construction to solve urban problems, intelligent cities can be said to be cities that use the 4IR technology to maintain existing urban infrastructure while increasing efficiency and solving problems.
	Smart cities connect virtual and real worlds based on intelligent information technology represented by the 4IR to continuously simulate and derive real cities from digital virtual cities to help citizens do what they want and improve city management capabilities.

ICT, information and communication technology; 4IR, emerging fourth industrial revolution.

Overall, the panelists in academia, research, and industry generally defined SC as cities that emphasize intelligent technologies. However, while those in academia and research highlighted the citizen-centered aspects of SCs, industry panelists generally placed more emphasis on technical aspects. The reasons why industry experts prioritize technology over citizen-centered aspects can be interpreted as follows. Experts in the industrial sector tend to recognize that technological innovation plays a crucial role in creating new business models and markets (Kim et al., 2023). Moreover, they are likely to feel more acutely than those in other sectors that technological innovation significantly enhances a company's or a society's competitiveness. Therefore, it is highly probable that they value the impact technology brings to the industry more than the qualitative aspects, such as improving the quality of life for citizens.

Results for the second round

In the first round, the researchers identified the keywords that were frequently mentioned in the definitions of SC. These summarized results were then presented to the panelists in the second round. A total of 27 panelists were asked to select and rank the keywords they deemed most critical for constructing SC concepts, assigning rankings from first to third. The ranking scores were

https://doi.org/10.52372/jps.e680

allocated as follows: 5 points for the first rank, 4 points for the second rank, and 3 points for the third rank.

Table 3 displays the comprehensive outcomes of the second round. The majority of respondents in this round prioritized "the use of intelligent technology" as the foremost keyword. More specifically, the use of big data, artificial intelligence, and the Internet of Things was highlighted. The second most commonly suggested keyword was "improvement of citizens' quality of life," followed by "sustainable city" as the third. Additionally, keywords such as "public platform city," "addressing various urban issues," and "sustainable, eco-friendly city" were also identified as essential.

As shown in Table 4, all three sectors commonly viewed "the use of intelligent technology" and "improvement of citizens' quality of life" as the primary keywords that need to be included in conceptualizing an SC. Except for these two common keywords, each field selected different keywords that they considered essential. The panelists in academia selected "citizen-centered city," those in research selected "public platform city," and those in industry selected "sustainable city" as the important keywords.

Results for the third round

Upon presenting the outcomes of the second round to the panelists, our research team requested that they re-evaluate and rank the three most pertinent keywords in order of importance, referencing the results from the second round. Based on their responses from the third round, the

Table 3. Results for the second round (n=27)

Rank	Necessary keywords for defining SC	Total score
1	The use of intelligent technology	89
2	Improvement of citizens' quality of life	57
3	Sustainable city	27
4	Public platform city	21
5	Sustainable eco-friendly city	20
	Solving various urban problems	
6	Improving the efficiency and equity of citizens' lives	15
7	Citizen-centered city	14
8	Solving urban problems by utilizing intelligent technology	12
9	Participatory policy decision	10
10	The democratic decision-making process of citizens	9
	City governance	
	Improving city competitiveness	
Total		312

SC, smart city.

Table 4. Necessary keywords for defining smart cities ranking by field

	Academia	Research field	Industry
1	The use of intelligent technology	The use of intelligent technology	The use of intelligent technology
2	Improvement of citizens' quality of life	Improvement of citizens' quality of life	Sustainable city
3	Citizen-centered city	Public platform city	Improvement of citizens' quality of life

terms prioritized from first to fifth were "the use of intelligent technology," "improvement of citizens' quality of life," "sustainable city," "solving the urban problems," and "public platform city." The final results are shown in Table 5.

In synthesizing the final outcomes, we define an SC as "The sustainable city that applies intelligent technology to all urban areas, solving various urban problems based on public platforms and improving citizens' quality of life."

Forecasting the expected implementation year of smart city projects

Results for the first round

The outcomes from the first round revealed varied perspectives among the 27 panelists on the potential implementation of SCs by 2030. Among the panelists, the opinions on successes and failures were almost divided, and the panelists' opinions were not in agreement overall. Specifically, 11 out of 27 respondents believed in the successful implementation of the SC initiatives, 13 anticipated failure, and 1 abstained from making a prediction. Within the academic sector, a higher incidence of optimistic forecasts was noted (success: 7, failure: 3, pending: 1), whereas the research sector predominantly expressed pessimistic views (success: 3, failure: 6, pending: 1). Similarly, the industrial sector demonstrated a tendency toward negative outcomes (success: 1, failure: 4, pending: 1). This result was attributed to the fact that experts in the fields (research and industry) who have actually experienced and been in charge of SC projects may have experienced more obstacles in the field of SC projects. These initial findings are shown in Table 6.

The 11 experts who envisioned a successful implementation by 2030 highlighted the rapid advancement and exemplary infrastructure of Korea's ICT as pivotal factors that could expedite the success of Korean SCs. Additionally, a sentiment of optimism was discerned, with some experts suggesting that Korea could prioritize a citizen-centered approach over a supplier-driven model, learning from the shortcomings of previous U-City initiatives. These opinions included the belief

Table 5. Results for the third round (n=26)

Rank	Keywords	Total score
1	The use of intelligent technology	102
2	Improvement of citizens' quality of life	72
3	Sustainable city	46
4	Solving the urban problems	23
5	Public platform city Sustainable eco-friendly city	19
6	Citizen-centered city	12
7	City governance	10
8	Improving the efficiency and equity of citizens' lives	7
9	The democratic decision-making process of citizens	6
10	Solving urban problems by utilizing intelligent technology Participatory policy decision Improving city competitiveness	3
	Total	325

https://doi.org/10.52372/jps.e680

Table 6. Results for the first round (n=27)

Category	Total	Academia	Research	Industry
Success	11	7	3	1
Failure	13	3	6	4
Pending	3	1	1	1

that two Korean SC projects will be finalized around 2030.

Conversely, the 13 experts who forecasted unsuccessful outcomes for Korea's SCs by 2030 contended that the experimental policies in both cities might culminate in incomplete executions. They critiqued the excessive focus of Korea's SC projects on developing new urban areas through supplier-centric initiatives. They argued that unless there is a significant shift toward policies embracing a citizen-centered perspective, the current SC endeavors are unlikely to flourish within the next decade.

The three experts, pending judgment on the potential success or failure of the projects, posited that the actual evaluation of success would be viable only when citizens begin residing in and actively evaluating these newly constructed cities. They emphasized that the assessment of a city's success should be conducted by its actual inhabitants, suggesting that the ultimate measure of an SC project's success should transcend urban infrastructure or the adoption of intelligent technologies, focusing instead on the genuine life experiences of the residents (Myeong et al., 2021). The detailed opinions of the first round are shown in Table 7.

Results for the second round

In the second round, we queried the panelists regarding their predictions for the feasible years of SC project implementation in Korea. The predominant response pointed toward the year 2035, with five panelists considering implementation achievable by 2030. Predictions for the earliest and latest years of implementation ranged from 2023 to 2040, respectively. Furthermore, three panelists indicated the difficulty in forecasting a precise year for implementation. Fig. 1 illustrates the aggregated outcomes of the second round.

Predicted implementation year of Korean SC project (second round)

Experts positing that SC implementation could be feasible by 2030 suggested that a minimum of three years would be required to develop the urban infrastructure, followed by an additional two years for residential facility construction, and a further one to two years for initiating service demonstrations.

According to the strategic plan for Korean SCs, relocation into the city is proposed for 2023, yet these experts anticipate an additional one to two years for the city's full operational functionality. Subsequently, they envisaged an additional period exceeding one to two years for residents to fully engage with and benefit from intelligent technologies.

Conversely, experts forecasting a 2035 implementation timeline opined that despite Korea's rapid advancement in ICT, the integration and vibrant activation of urban services using intelligent technologies within a SC context would necessitate a longer timeframe. They projected an

Table 7. Panelists' responses on predicting success of smart city (SC) implementation

Opinions	Comments
Success	I think the elasticity of technology and the acceptability and efficacy of residents of ICT technology applied to intelligent cities are high (academia).
	Korea's diverse set of success factors (level and speed of technological development of the 4IR in Korea, citizens' desire for a citizen-centered city, government drive, active participation of private operators) (academia).
	Since Korea already has a lot of experience in promoting SCs (U-City, etc.), chances of success are high (academia).
	I think it will be successful because of the business feasibility based on cooperation between the private and public sectors. It is judged that the results of SC policies that differ from the previous ones can be produced. This national demonstration city will be the center of services felt by citizens in that consumer-centered services will be introduced through private participation with profitability in mind (industry).
	Local government representatives have high leadership and interest and are actively promoting it by establishing a dedicated organization for SCs to connect the private sector and the administration (industry).
Failure	It was wrong for the Ministry of Land, Infrastructure and Transport to be in charge of the main ministry promoting SCs. As in the case of the United Kingdom, it should have been promoted in connection with the local economy through the establishment of SPC. In addition, the method of ritualizing technology standards and evaluating technology through private consultative bodies is a global trend. The central government and local governments should focus on budget and administrative support, and on post-evaluation and audit (academia).
	SCs are likely to fail like U-City. However, the U-City and other technical keys lie in the data. It is the sum of the data of non-purposes rather than the value-based purposefully fit data. Eventually, SCs will partially absorb the development of technologies and services in verified markets such as transportation, medical care, and education into the public sector (industry).
	Still, cities are focused on the latest facilities and infrastructure, and the intelligence of urban operating systems is rarely considered. It is unclear who should draw the blueprint for the SCs, and it is difficult to expect a challenging and experimental SCs in a situation where the responsibility has been handed over to the private-centered SPC (academia).
	Even if it goes well, it will not be satisfied with the concept of SCs in the future. All of them are organized at the level of listing services by detailed fields such as mobility, health care, education, energy, and cultural shopping, and the concept of an SC is not an immutable concept, as a continuous reinterpretation of it is necessary (research).
	For the success of SCs, factors of various dimensions must be promoted smoothly, but currently, two national demonstration cities are facing various constraints. Since these problems require long-term improvement in terms of technology, policy, legal, and environmental aspects, it is expected that the two national demonstration cities in 2030 will be difficult to implement properly as intelligent cities (research).
Pending	SCs are just starting construction, and it is too early to judge success or failure. I think it will be possible to evaluate it to a limited degree of success if it focuses on what has been promoted so far. If the achievement is successfully carried out as planned, it can be an intelligent city implementation (research).
	It is practically impossible to build urban infrastructure to move in residents within the government's term. However, it is expected that intelligent cities will gradually form and become "new towns" in 2030, and SC policies can produce tangible results (academia).

ICT, information and communication technology; 4IR, emerging fourth industrial revolution; SPC, statistical process control.

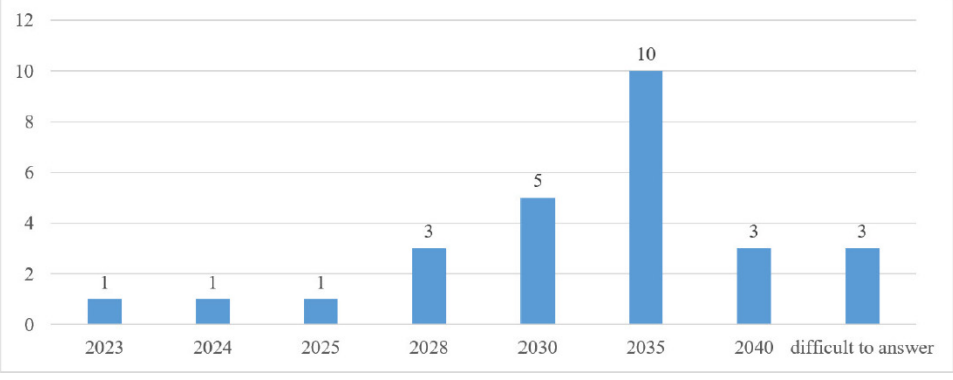

Fig. 1. Predicted implementation year of Korean SC project (second round). SC, smart city.

approximate five-year period post-2030 construction completion to adequately address and fulfill the residents' needs.

Panelists predicting a 2040 timeframe for SC implementation contended that establishing a comprehensive SC infrastructure and ensuring residents' enjoyment of city services would span approximately 20 years. They reinforced their argument by referencing the ongoing development of the Sejong City case, which persists even a decade after its initiation. Therefore, they reasoned that

https://doi.org/10.52372/jps.e680

a 10-year timeframe would be insufficient, estimating that at least 20 years post-construction would be necessary for residents to fully reap the benefits of SCs.

Results of the predicted year by fields (second round)

Fig. 2 shows the second results for each field. The majority of the academia panelists answered 2035, and the majority of the research field panelists answered 2035 and 2040. The majority of industry field panelists selected 2035. Except for the panelists who responded "it was difficult to answer," the average year of the response values by the fields was calculated: The average value of the research field was 2034, and those of academia and industry fields were 2031. In general, the panelists from the research field were predicting the latest SC implementation year.

Results for the third round

Finally, 26 experts participated in the final round. In this third round, we reiterated the questions from the second round after presenting its outcomes to the panelists. The consensus emerged with 13 experts forecasting SC implementation by 2035 and eight predicting 2030. Consequently, based on the third round of Delphi results, the anticipated timeline for the implementation of South Korea's SC initiatives is projected to be around 2030 to 2035. Fig. 3 shows the overall results of the third round.

Predicted implementation year of SC project in Korea (third round)

Fig. 4 details the response distribution across various fields. Within the research domain, 60% of the experts anticipated SC projects' fruition by 2035, with 44% of academics aligning with this prediction. Similar to the second-round outcomes, experts in the research sector exhibited the most conservative estimates regarding SC implementation timelines.

Results of the predicted year by the fields (third round)

The third-round feedback identified 2028 as the nearest expected year for SC implementation,

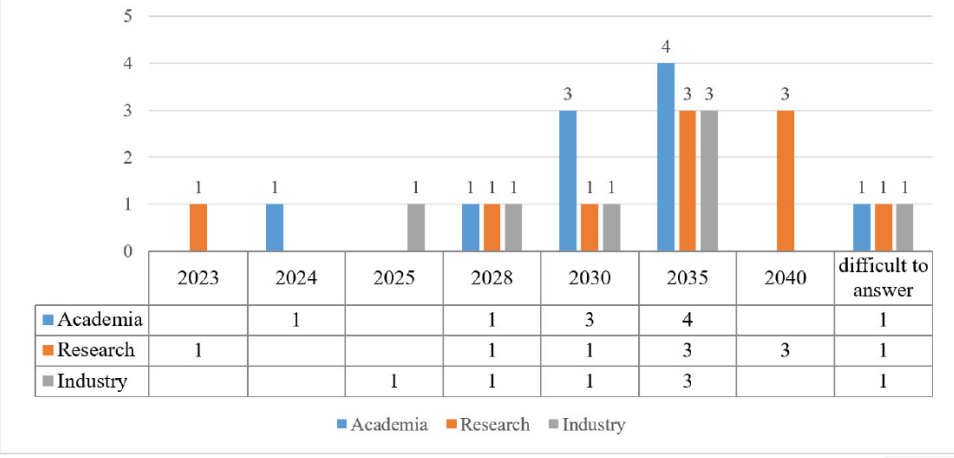

Fig. 2. Results of the predicted year by fields (second round).

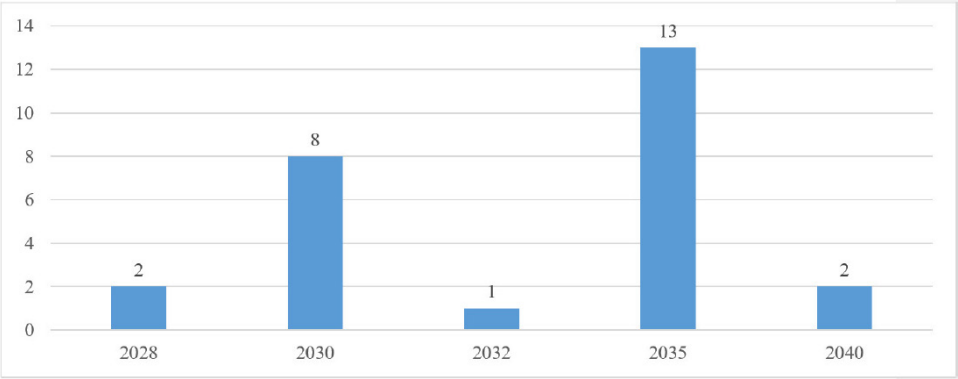

Fig. 3. Predicted implementation year of SC project in Korea (third round). SC, smart city.

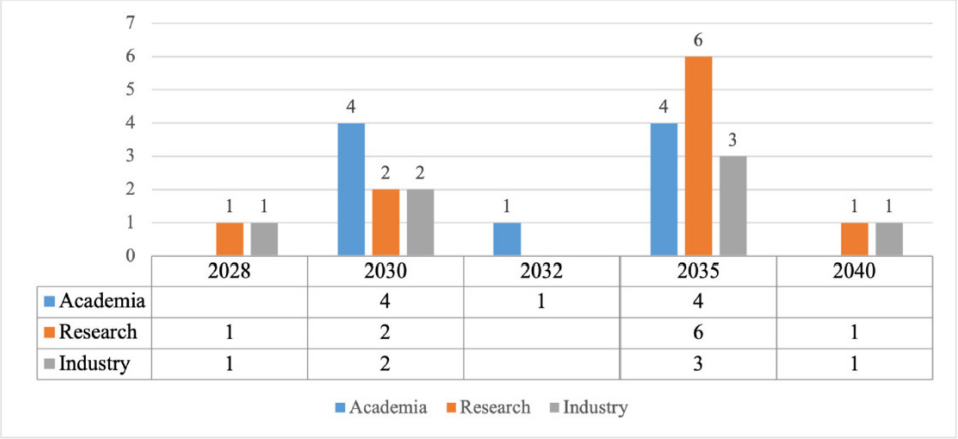

Fig. 4. Results of the predicted year by the fields (third round).

noting a revision from earlier projections for 2023, 2024, and 2025. Due to the nature of policy Delphi, each group is pressured to move to the median as they repeat the round, so the distribution value converges further to the median. Likewise, in this result, the distribution converges to the median value.

As we can see in Fig. 5, the implementation of Korea's SC national pilot project will be completed around 2030. When analyzing the contents of these results comprehensively, the realization of intelligent services in SCs will be activated from around 2035.

Discussion

The present study's findings can be used to paradigm shift SC policy in South Korea and other countries that have pursued technology-driven and supplier-oriented SC policies. South Korea holds a leading position in the fields of digital government and SCs (Choi & Kim, 2021; Chung, 2020). Despite this reputation, South Korea's SCs are heavily focused on urban infrastructure innovation based on advanced technology, showing relative limitations regarding intrinsic values such as addressing urban regeneration and enhancing civic engagement and the quality of citizens'

https://doi.org/10.52372/jps.e680

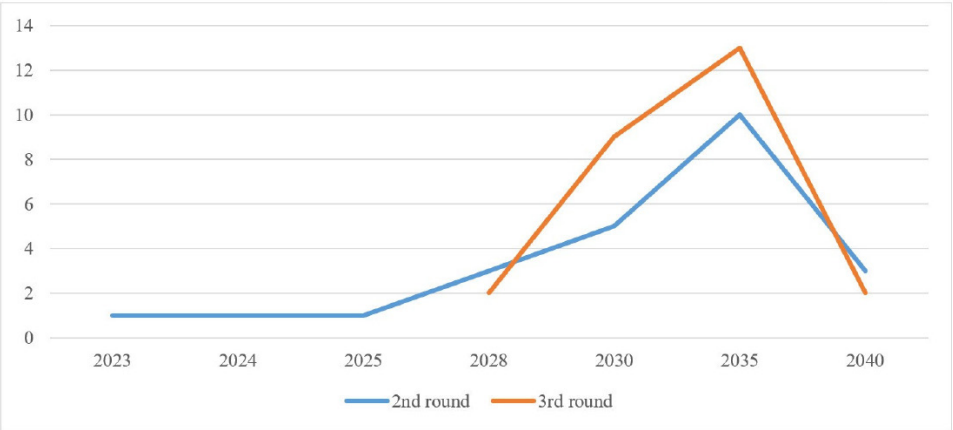

Fig. 5. Response changes from the second to third round.

lives. This shortfall is attributed to foundational misinterpretations of SC concepts within South Korean policy frameworks.

Therefore, this study attempted to develop the definition of an SC that Korea should pursue through the perspective of experts related to SCs in Korea. In addition, according to the developed definition, we tried to forecast the expected implementation year of the national SC pilot projects in Korea. Following our Delphi study, the completion of the national pilot projects is anticipated by 2030, with full-service realization potentially extending to around 2035.

Based on our research findings, several policy implications are recommended for the future success of SC policies. This study addresses the need to redefine the concept of a SC from being technology-centric to being citizen-centric. With their extensive urban development history, European countries emphasize urban regeneration in their SC initiatives (Garau et al., 2017; García-Fuentes et al., 2017; Mora & Bolici, 2015). Conversely, Asian countries, including South Korea, perceive SCs as a means to enhance national competitiveness and are focused on urban infrastructure and hardware innovation (Jiang et al., 2023; Naprathansuk, 2017).

In South Korea, both past U-City promotions and current SC policies have predominantly focused on new town development, including apartment complexes, framing SC as a new city construction concept (Jang, 2017). This study's findings underscore the necessity of broadening the SC concept toward improving citizens' quality of life, transitioning from construction and ICT adoption to a focus on sustainability and citizen-centric values.

In the past, the inception of SC policies was heavily influenced by the prominence of world-class ICT companies, leading to a predominant focus on the introduction and utilization of ICT (Angelidou, 2017; Grossi & Pianezzi, 2017). This resulted in the adoption of the SC concept from renowned foreign ICT firms by many national governments, promoting SC initiatives centered around technological and supplier-centric approaches. However, it has become evident that such technology-focused strategies no longer yield the intended outcomes (Angelidou, 2017; Glasmeier & Nebiolo, 2016; Marvin & Luque-Ayala, 2013).

Thus, the contemporary paradigm for SC necessitates a transition from a technology-centric to a citizen-centric approach. While the application of ICT remains a critical element in the development of SC policies, the emphasis needs to shift toward prioritizing the needs and satisfaction of the

citizenry over just technological deployment. The true measure of an SC's success should be gauged by the enhancement of citizen satisfaction rather than the efficiency of ICT implementation alone.

This study also raises the necessity of setting phased goals under a clear SC concept to successfully implement an SC. The proposed completion timeline written by the South Korean government regarding the national pilot SC project is based on the construction of SC infrastructure and services. This approach still reveals the limitations of South Korea's government-led and supplier-centric approach, primarily focused on urban infrastructure development.

However, SC projects are often long-term endeavors, typically requiring more than 10 years, and it is important to ensure that the integration of urban infrastructure and services into citizens' daily lives extends beyond only construction.

According to the findings of this study's Delphi survey, South Korea's national pilot project, which emphasizes infrastructure development, is expected to be completed by 2030. However, the full integration of SC services into the lives of citizens is projected to occur five years later around 2035. These findings underscore the necessity of setting phased goals when designing future SCs.

Rather than only considering the completion of an SC infrastructure and services from a supplier-centric perspective as the endpoint, the completion point should also account for when these services meaningfully enhance citizens' quality of life. In other words, this phased goal-setting can significantly improve the effectiveness of SC projects.

To achieve this, the implementing bodies of SC projects, including city governments and relevant public-private councils, need to monitor how the intended objectives of the SC project are being realized in citizens' lives. For instance, they can assess citizen satisfaction and usage rates of newly implemented services or use methodologies such as behavioral data analysis and social media analytics. Through continuous monitoring, feedback, and follow-up actions, the sustainability of SCs can be strengthened, and the accountability of those responsible for SC policies can be assured.

Conclusion

The purpose of this article was to develop an SC concept for South Korea to strive for, based on the opinions of Korean SC experts. In addition, we attempted to predict the completion timeline of the ongoing national SC pilot projects in South Korea based on the developed SC concept definition.

Through multiple rounds of policy Delphi, this study identified key elements of an SC definition such as "using smart technology," "improving the quality of life of citizens," and "sustainable city." The consensus definition describes an SC as "a sustainable city that applies intelligent information technology in all areas of the city to solve various urban problems based on public platforms and improve the quality of life of citizens." In terms of the expected timeline for SC implementation, the results showed that the infrastructure and service development of Korea's SC projects are expected to be completed by 2030, and SC services are expected to be integrated into the lives of citizens by 2035.

With these key findings, this research presents the following academic and practical contributions. First, this study establishes a concept of SC that is appropriate for the Korean context based on the opinions of Korean SC experts. By reviewing and evaluating Korea's SC concepts,

https://doi.org/10.52372/jps.e680

this paper can serve as a foundation for the development of SC concepts that take into account the unique characteristics of other countries or regions.

Second, using the policy Delphi method, this study collected and presented diverse opinions of experts on SC in Korea and detailed the process of consensus building. It is a methodological contribution to support policies in complex socio-technical systems such as SC, and it can serve as an important reference for future research on related agendas.

Third, this research predicted the completion time of the national SC pilot project in South Korea. It contributes to the study of SC development scenarios that take into account technological and policy changes over time.

The practical contribution of this research is threefold. First, the SC concepts derived from this study can help clarify the direction of SC projects and prioritize problem-solving in SC projects that require long-term construction. In particular, for projects with long construction periods or significant delays, such as the Korean SC project, it may be necessary to establish and share clearer concepts of an SC among stakeholders.

Furthermore, the expected implementation timeline derived in this paper provides concrete guidance for policymakers and urban planners. In particular, the roadmap for the development of an SC infrastructure and services targeted for 2030 and 2035 will be an important reference for practitioners to formulate and implement medium- to long-term plans.

Lastly, this paper can also provide lessons for other countries trying to build SC. For example, South Korea is moving toward becoming a world leader in the SC field, but it has experienced a number of trials and errors, such as establishing the SC concept that downplays qualitative values and focuses only on hardware innovation. This study can shed light on the importance of an SC concept and definition that focuses on the sustainability and intrinsic value of SCs by conveying Korea's case to other developing countries trying to introduce SCs.

Despite the above-mentioned contributions, this study has several limitations. First, although this study established an SC concept based on the opinions of Korean SC experts, it is possible that the expert panelists were not fully representative of all stakeholders in Korean SCs. For example, the conceptual definition of a "citizen-centered smart city" would have been more legitimate if the Delphi panelists had included citizens who plan to live in SCs.

Second, although this study predicts the completion of the Korean SC project using the policy Delphi method, it is only an estimate based on current information and technological developments. Many factors, such as future technological advances, policy changes, and changes in social needs, may affect the outcome of the forecasts.

Third, this study estimated the forecast year of the Korean national pilot project of SC using the policy Delphi method, but the reliability of the forecast of the completion time could be further improved if a quantitative forecasting method was used in conjunction with it.

Finally, while this study considers the clarity of the SC concept as a major factor in the success of SC projects, it could not take into account the various factors that can affect the success of SCs. For example, political, institutional, and managerial factors might affect the success of SCs.

Based on the above limitations, the following topics can be considered for further research. For example, interviews or surveys could be conducted with citizens who plan to live in the national

pilot SC to further strengthen the concept of a citizen-centered SC in Korea. Then, after the completion and implementation of the national SC project, the factors that may affect the actual construction of the SC can be verified based on hard data. In addition, a follow-up study can be conducted to analyze the gap between the completion and implementation of the SC project predicted in this study and the actual completion of the project to analyze why this gap occurred. Based on this, it will be possible to identify barriers and facilitators to successful SC implementation.

References

Albino, V., Berardi, U., & Dangelico, R. M. (2015). Smart cities: Definitions, dimensions, performance, and initiatives. *Journal of Urban Technology*, *22*(1), 3-21. https://doi.org/10.1080/10630732.2014.942092

Angelidou, M. (2017). Smart city planning and development shortcomings. *TeMA - Journal of Land Use, Mobility and Environment*, *10*(1), 77-94. https://doi.org/10.6092/1970-9870/4032

Angelidou, M., Politis, C., Panori, A., Bakratsas, T., & Fellnhofer, K. (2022). Emerging smart city, transport and energy trends in urban settings: Results of a pan-European foresight exercise with 120 experts. *Technological Forecasting and Social Change*, *183*, 121915. https://doi.org/10.1016/j.techfore.2022.121915

Ansell, C., & Gash, A. (2008). Collaborative governance in theory and practice. *Journal of Public Administration Research and Theory*, *18*(4), 543-571. https://doi.org/10.1093/jopart/mum032

Bakıcı, T., Almirall, E., & Wareham, J. (2013). A smart city initiative: The case of Barcelona. *Journal of the Knowledge Economy*, *4*(2), 135-148. https://doi.org/10.1007/s13132-012-0084-9

Barrutia, J. M., Echebarria, C., Aguado-Moralejo, I., Apaolaza-Ibáñez, V., & Hartmann, P. (2022). Leading smart city projects: Government dynamic capabilities and public value creation. *Technological Forecasting and Social Change*, *179*, 121679. https://doi.org/10.1016/j.techfore.2022.121679

Cairney, T., & Speak, G. (2000). *Developing a 'smart city': Understanding information technology capacity and establishing an agenda for change*. Centre for Regional Research and Innovation, University of Western Sydney.

Campbell, T. (2013). *Beyond smart cities: How cities network, learn and innovate*. Routledge.

Castelnovo, W., Misuraca, G., & Savoldelli, A. (2015). Smart cities governance: The need for a holistic approach to assessing urban participatory policy making. *Social Science Computer Review*, *34*(6), 724-739. https://doi.org/10.1177/0894439315611103

Chen, Q., Wang, W., Wu, F., De, S., Wang, R., Zhang, B., & Huang, X. (2019). A survey on an emerging area: Deep learning for smart city data. *IEEE Transactions on Emerging Topics in Computational Intelligence*, *3*(5), 392-410. https://doi.org/10.1109/TETCI.2019.2907718

Choi, C., Choi, J., Kim, C., & Lee, D. (2020). The smart city evolution in South Korea: Findings from big data analytics. *The Journal of Asian Finance, Economics and Business*, *7*(1), 301-311. https://doi.org/10.13106/jafeb.2020.vol7.no1.301

Choi, J. K. (2018). A study on legal issues for smart city realization: Focused on smart city law and smart healthcare service. *Chung_Ang Law Review*, *20*(3), 43-81.

https://doi.org/10.52372/jps.e680

Choi, J., & Kim, H. M. (2021). Chapter 4 - State-of-the-art of Korean smart cities: A critical review of the Sejong smart city plan. In H. M. Kim, S. Sabri, & A. Kent (Eds.), *Smart cities for technological and social innovation* (pp. 51-72). Academic Press.

Chung, C. (2020). *Developing digital governance: South Korea as a global digital government leader*. Routledge.

Clement, J., Manjon, M., & Crutzen, N. (2022). Factors for collaboration amongst smart city stakeholders: A local government perspective. *Government Information Quarterly*, *39*(4), 101746. https://doi.org/10.1016/j.giq.2022.101746

Critcher, C., & Gladstone, B. (1998). Utilizing the Delphi technique in policy discussion: A case study of a privatized utility in Britain. *Public Administration*, *76*(3), 431-449. https://doi.org/10.1111/1467-9299.00110

Dameri, R. P. (2013). Searching for smart city definition: A comprehensive proposal. *International Journal of Computers & Technology*, *11*(5), 2544-2551. https://doi.org/10.24297/ijct.v11i5.1142

de Loë, R. C., Melnychuk, N., Murray, D., & Plummer, R. (2016). Advancing the state of policy Delphi practice: A systematic review evaluating methodological evolution, innovation, and opportunities. *Technological Forecasting and Social Change*, *104*, 78-88. https://doi.org/10.1016/j.techfore.2015.12.009

Dunn, W. N. (1994). *Public policy analysis: An introduction*. Prentice Hall.

Fernandez-Anez, V., Fernández-Güell, J. M., & Giffinger, R. (2018). Smart city implementation and discourses: An integrated conceptual model. The case of Vienna. *Cities*, *78*, 4-16. https://doi.org/10.1016/j.cities.2017.12.004

Garau, C., Balletto, G., & Mundula, L. (2017). A critical reflection on smart governance in Italy: Definition and challenges for a sustainable urban regeneration. In A. Bisello, D. Vettorato, R. Stephens, & P. Elisei (Eds.), *Smart and sustainable planning for cities and regions. SSPCR 2015. Green energy and technology* (pp. 235-250). Springer.

García-Fuentes, M. Á., Quijano, A., de Torre, C., García, R., Compere, P., Degard, C., & Tomé, I. (2017). European cities characterization as basis towards the replication of a smart and sustainable urban regeneration model. *Energy Procedia*, *111*, 836-845. https://doi.org/10.1016/j.egypro.2017.03.246

Giffinger, R., Fertner, C., Kramar, H., & Meijers, E. (2007). City-ranking of European medium-sized cities. *Centre of Regional Science, Vienna UT*, *9*(1), 1-12.

Glasmeier, A. K., & Nebiolo, M. (2016). Thinking about smart cities: The travels of a policy idea that promises a great deal, but so far has delivered modest results. *Sustainability*, *8*(11), 1122. https://doi.org/10.3390/su8111122

Greco, I., & Cresta, A. (2015). A smart planning for smart city: The concept of smart city as an opportunity to re-think the planning models of the contemporary city. In O. Gervasi, B. Murgante, S. Misra, M. L. Gavrilova, A. M. A. Coutinho Rocha, C. Torre, D. Taniar, & B. O. Apduhan (Eds.), *International Conference on Computational Science and Its Applications* (pp. 563-576). Springer.

Grossi, G., & Pianezzi, D. (2017). Smart cities: Utopia or neoliberal ideology? *Cities*, *69*, 79-85. https://doi.org/10.1016/j.cities.2017.07.012

Hall, R. E., Bowerman, B., Braverman, J., Taylor, J., Todosow, H., & Von Wimmersperg, U. (2000). *The vision of a smart city* (No. BNL-67902; 04042). Brookhaven National Lab. (BNL).

Han, S. H., Shin, Y. S., Yu, I. J., & Lee, J. Y. (2018). A study on the Korea smart city certification index and demonstration authentication. *Journal of the Korea Academia-Industrial Cooperation Society*, *19*(1), 688-698. https://doi.org/10.5762/KAIS.2018.19.1.688

Harrison, C., Eckman, B., Hamilton, R., Hartswick, P., Kalagnanam, J., Paraszczak, J., & Williams, P. (2010). Foundations for smarter cities. *IBM Journal of Research and Development*, *54*(4), 1-16. https://doi.org/10.1147/JRD.2010.2048257

Hwang, J. S. (2020a). Technical characteristics of smart cities and platform interoperability. *Communications of the Korean Institute of Information Scientists and Engineers*, *38*(6), 8-10.

Hwang, J. S. (2020b). The evolution of smart city in South Korea: The smart city winter and the city-as-a-platform. In Y. M. Joo & T. B. Tan (Eds.), *Smart cities in Asia* (pp. 78-92). Edward Elgar.

Intralink. (2019). *Smart cities South Korea*. Market Intelligence Report.

Jang, H. Y. (2017). A study on priority analysis for activating the convergence smart city service. *The Journal of the Korea Contents Association*, *17*(8), 152-161. https://doi.org/10.5392/JKCA.2017.17.08.152

Jiang, H., Geertman, S., & Witte, P. (2023). The contextualization of smart city technologies: An international comparison. *Journal of Urban Management*, *12*(1), 33-43. https://doi.org/10.1016/j.jum.2022.09.001

Ju, Y., Lee, E., & Seo, W. (2020). Analysis of smart city research trends. *Korean Journal of Regional Informatization*, *23*(2), 147-170.

Ju, Y., Kim, Y., Oh, J., & Suh, W. (2021). A study on the priorities of initiatives for the implementation of smart cities: An analysis on the perception of public officials. Journal of Korean Association for Regional Information Society, 24(1): 95-125.

Kim, C., & Kim, K. (2021). The institutional change from e-government toward smarter city; comparative analysis between Royal Borough of Greenwich, UK, and Seongdong-gu, South Korea. *Journal of Open Innovation: Technology, Market, and Complexity*, *7*(1), 42. https://doi.org/10.3390/joitmc7010042

Kim, J., Lee, S. H., & Jin, Y. H. (2023). A study on identifying promising technology fields for the creation of deep-tech unicorns: An analysis of a survey of technology commercialization experts. *Technology Management*, *8*(2), 115-138.

Kim, J. S. (2015). Making smart cities work in the face of conflicts: Lessons from practitioners of South Korea's U-City projects. *Town Planning Review*, *86*(5), 561-585. https://doi.org/10.3828/tpr.2015.33

Komninos, N., Kakderi, C., Panori, A., & Tsarchopoulos, P. (2019). Smart city planning from an evolutionary perspective. *Journal of Urban Technology*, *26*(2), 3-20. https://doi.org/10.1080/10630732.2018.1485368

Korea Information Society Development Institute (KISDI). (2010). *U-City service activation plan*. KISDI.

Korea Institute of Public Administration (KIPA). (2020). *A study on the government innovation plan for sustainable smart city operation*. KIPA.

https://doi.org/10.52372/jps.e680

Kuo, N. W., Sharifi, A., & Li, C. E. (2022). Smart cities and urban resilience: Insights from a Delphi survey. In *Resilient smart cities: Theoretical and empirical insights* (pp. 119-138). Springer International.

Lam, P. T. I., & Yang, W. (2020). Factors influencing the consideration of public-private partnerships (PPP) for smart city projects: Evidence from Hong Kong. *Cities*, *99*, 102606. https://doi.org/10.1016/j.cities.2020.102606

Li, L., Taeihagh, A., & Tan, S. Y. (2022). What factors drive policy transfer in smart city development? Insights from a Delphi study. *Sustainable Cities and Society*, *84*, 104008. https://doi.org/10.1016/j.scs.2022.104008

Lim, Y., Edelenbos, J., & Gianoli, A. (2023). Dynamics in the governance of smart cities: Insights from South Korean smart cities. *International Journal of Urban Sciences*, *27*(supp1 1), 183-205. https://doi.org/10.1080/12265934.2022.2063158

Markets and markets. (2021). *Smart cities market*. Markets and Markets. https://www.marketsandmarkets.com/Market-Reports/smart-cities-market-542.html

Marvin, S., & Luque-Ayala, A. (2013). *Smart urbanism: Utopian vision or false dawn?* Routledge.

Meyers, M. K., Riccucci, N. M., & Lurie, I. (2001). Achieving goal congruence in complex environments: The case of welfare reform. *Journal of Public Administration Research and Theory*, *11*(2), 165-202. https://doi.org/10.1093/oxfordjournals.jpart.a003498

Ministry of Land, Infrastructure, and Transport of Korea (MOLIT). (2018). *Smart city promotion strategy*. MOLIT.

Mora, L., & Bolici, R. (2015). Urban regeneration in the digital era: How to develop smart city strategies in large European cities. *Techne. Journal of Technology Fro Architecture and Environment*, *5*(2), 110-119.

Mora, L., Bolici, R., & Deakin, M. (2017). The first two decades of smart-city research: A bibliometric analysis. *Journal of Urban Technology*, *24*(1), 3-27. https://doi.org/10.1080/10630732.2017.1285123

Moss Kanter, R., & Litow, S. S. (2009). *Informed and interconnected: A manifesto for smarter cities* (Harvard Business School General Management Unit Working Paper No. 09-141). Harvard Business School.

Myeong, S., Kim, Y., & Ahn, M. J. (2021). Smart city strategies—Technology push or culture pull? A case study exploration of Gimpo and Namyangju, South Korea. *Smart Cities*, *4*(1), 41-53. https://doi.org/10.3390/smartcities4010003

Naprathansuk, N. (2017). A national pilot project on smart city policy in Thailand: A case study on Phuket Khon Kaen Chiangmai province. *European Journal of Multidisciplinary Studies*, *2*(6), 338-347. https://doi.org/10.26417/ejms.v6i1.p337-346

Okafor, C. C., Aigbavboa, C., & Thwala, W. D. (2023). A Delphi approach to evaluating the success factors for the application of smart mobility systems in smart cities: A construction industry perspective. *International Journal of Construction Management*, *23*(8), 1289-1298. https://doi.org/10.1080/15623599.2021.1968567

Ordu, M., Demir, E., Tofallis, C., & Gunal, M. M. (2021). A novel healthcare resource allocation decision support tool: A forecasting-simulation-optimization approach. *Journal of the*

Operational Research Society, *72*(3), 485-500. https://doi.org/10.1080/01605682.2019.1700186

Paskaleva, K. (2013). E-governance as enabler of the smart city. In M. Deakin (Ed.), *Smart cities: Governing, modelling and* analysing the transition (pp. 45-63). Routledge.

Preble, J. F. (1983). Public sector use of the Delphi technique. *Technological Forecasting and Social Change*, *23*(1), 75-88. https://doi.org/10.1016/0040-1625(83)90072-0

Prokesch, T., von der Gracht, H. A., & Wohlenberg, H. (2015). Integrating prediction market and Delphi methodology into a foresight support system — Insights from an online game. *Technological Forecasting and Social Change*, *97*, 47-64. https://doi.org/10.1016/j.techfore.2014.02.021

Raine, J. W., & Baxter, R. S. (1979). Forecasting financial resources in regional planning. *Town Planning Review*, *50*(2), 204. https://doi.org/10.3828/tpr.50.2.n61m4138r374831v

Rayens, M. K., & Hahn, E. J. (2000). Building consensus using the policy Delphi method. *Policy, Politics, & Nursing Practice*, *1*(4), 308-315. https://doi.org/10.1177/152715440000100409

Relevant Department Consolidation. (2018). *Establishment status and future plan of smart city & demonstration cities (draft)*. The Government of the Republic of Korea.

Riva Sanseverino, E., Riva Sanseverino, R., & Anello, E. (2018). A cross-reading approach to smart city: A European perspective of Chinese smart cities. *Smart Cities*, *1*(1), 26-52. https://doi.org/10.3390/smartcities1010003

Schumann, A. (2016). *Using outcome indicators to improve policies: Methods, design strategies and implementation*. OECD.

Sekayi, D., & Kennedy, A. (2017). Qualitative Delphi method: A four round process with a worked example. *The Qualitative Report*, *22*(10), 2755-2763. https://doi.org/10.46743/2160-3715/2017.2974

Snow, C. C., Håkonsson, D. D., & Obel, B. (2017). A smart city is a collaborative community: Lessons from smart Aarhus. *California Management Review*, *59*(1), 92-108. https://doi.org/10.1177/0008125616683954

Sung, C. (2022). *A comparative case study on the government-business relations in smart city policy process* (Master's thesis). Seoul National University.

Tiberius, V., Gojowy, R., & Dabić, M. (2022). Forecasting the future of robo advisory: A three-stage Delphi study on economic, technological, and societal implications. *Technological Forecasting and Social Change*, *182*, 121824. https://doi.org/10.1016/j.techfore.2022.121824

Turoff, M. (1970). The design of a policy Delphi. *Technological Forecasting and Social Change*, *2*(2), 149-171. https://doi.org/10.1016/0099-3964(70)90004-9

Turoff, M. (1975). The policy Delphi. In H. A. Linstone & M. Turoff (Eds.), *The Delphi method: Techniques and applications* (pp. 84-100). Addison-Wesley.

van Meter, D. S., & Van Horn, C. E. (1975). The policy implementation process: A conceptual framework. *Administration & Society*, *6*(4), 445-488. https://doi.org/10.1177/009539977500600404

van Twist, A., Ruijer, E., & Meijer, A. (2023). Smart cities & citizen discontent: A systematic review of the literature. *Government Information Quarterly*, *40*(2), 101799. https://doi.org/10.1016/j.giq.2022.101799

Vieira, M., Rua, O. L., & Arias-Oliva, M. (2023). Impact of open innovation in smart cities: The case

study of Köln (Germany). *Journal of Open Innovation: Technology, Market, and Complexity*, *9*(2), 100068. https://doi.org/10.1016/j.joitmc.2023.100068

von der Gracht, H. A. (2008). The Delphi technique for futures research. In H. A. von der Gracht (Ed.), *The future of logistics: Scenarios for 2025* (pp. 21-68). Gabler Verlag Wiesbaden.

von der Gracht, H. A. (2012). Consensus measurement in Delphi studies: Review and implications for future quality assurance. *Technological Forecasting and Social Change*, *79*(8), 1525-1536. https://doi.org/10.1016/j.techfore.2012.04.013

Washburn, D., Sindhu, U., Balaouras, S., Dines, R. A., Hayes, N., & Nelson, L. E. (2009). Helping CIOs understand "smart city" initiatives. *Growth*, *17*(2), 1-17.

Wu, Y. J., & Chen, J. C. (2021). A structured method for smart city project selection. *International Journal of Information Management*, *56*, 101981. https://doi.org/10.1016/j.ijinfomgt.2019.07.007

Yang, J., Kwon, Y., & Kim, D. (2020). Regional smart city development focus: The South Korean national strategic smart city program. *IEEE Access*, *9*, 7193-7210. https://doi.org/10.1109/ACCESS.2020.3047139

Yigitcanlar, T. (2015). Smart cities: An effective urban development and management model? *Australian Planner, 52*(1), 27-34. https://doi.org/10.1080/07293682.2015.1019752

Yigitcanlar, T., Kamruzzaman, M., Buys, L., Ioppolo, G., Sabatini-Marques, J., da Costa, E. M., & Yun, J. J. (2018). Understanding 'smart cities': Intertwining development drivers with desired outcomes in a multidimensional framework. *Cities*, *81*, 145-160. https://doi.org/10.1016/j.cities.2018.04.003

Yun, J. J., & Leem, Y. T. (2016). Editorial: The smart city as an open innovation knowledge city. *International Journal of Knowledge-Based Development*, *7*(2), 103-106.

Yun, Y., & Lee, M. (2019). Smart city 4.0 from the perspective of open innovation. *Journal of Open Innovation: Technology, Market, and Complexity*, *5*(4), 92. https://doi.org/10.3390/joitmc5040092

Appendices

Appendix 1. An Example of a Round 1 Questionnaire (Narrative Questions)

A. *Defining a Smart City*: Referring to various existing definitions of smart cities, can you redefine the concept of a smart city (SC)?

B. *Prediction of Smart City Implementation Year:* Do you think that the two national pilot cities (Sejong 5-1 Living Zone and Busan Eco-Delta City) will be properly implemented as smart cities by 2030? Please elaborate on the reasons for your opinion on whether the policy for promoting smart cities will succeed or fail. Please refer to the following SC evaluation indicators presented by IMD (2020) when responding to this question regarding success and failure.

Appendix 2. An Example of a Round 2 Questionnaire

A. *Defining a Smart City*: Based on the results of the first round, the key terms used in the definition of a SC are as follows (Appendix Table A1). Among the key terms presented above, which three terms do you believe must be included in the definition of a SC, in order of importance?

Please indicate the terms that must be included in the definition of a SC. Please select from a. to p. Please also include the reasons for your response.

B. *Prediction of the Smart City Implementation Year*: In your opinion, in what year do you think the two pilot SC projects in South Korea will be implemented (i.e., the level at which ICT is applied to the city and citizens benefit from it)? Please include the reasons for your response as well.

Appendix 3. An Example of a Round 3 Questionnaire

A. *Defining a Smart City*: From the key terms provided above (Appendix 2), what three terms do you believe must be included in the definition of a SC, in order of importance.

B. *Prediction of the Smart City Implementation Year*: When referring to the summarized statistics below, in what year do you think the two pilot SC projects in South Korea will be implemented (i.e., the level at which ICT is applied to the city and citizens benefit from it)?

https://doi.org/10.52372/jps.e680

Appendix Table A1. Key terms used in the definition of a smart city

a. Utilization of intelligent information technology
b. Improvement of citizens' quality of life
c. Enhancement of urban competitiveness
d. Sustainable city
e. Public platform-based city
f. Governance-based urban system
g. Urban infrastructure
h. Citizen-centered city
i. Sustainable eco-friendly city
j. Democratic decision-making process for citizens
k. Participatory policy design
l. Solving various urban problems
m. Improving efficiency and equity of citizens' lives
n. Providing universal services without discrimination
o. Ensuring participation of current and future generations
p. Solving urban problems using 4IR technologies