스마트시티의 메타버스 운영과 홍보 정책 분석

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Analysing the Metaverse in Smart City Management and Promotional Policies

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[요   약]

본 연구의 목적은 도시관리를 위한 메타버스 플랫폼 적용에 대한 시민들의 인식에 영향을 미치는 요인을 탐색하고 보다 나은 홍보 정책을 위한 시사점을 제공하는 것입니다. 연구 문제는 1) 도시 브랜드, 정의적 요인, 인지적 요인, 맞춤형 제공, 상호작용적 요인, 비용 절감적 요인, 시민 관계적 요인, 홍보적 요인이 전체태도에 어떠한 영향을 미치는가? 2) 요인이 삶의 질에 어떠한 영향을 미치는가? 그리고 3) 요인이 홍보 정책에 어떠한 영향을 미치는가? 본 연구는 유명한 조사기관의 도움을 받아 온라인 설문조사를 실시하였다. 가설을 검증하기 위해 적용요인, ANOVA, 회귀분석을 적용하였다. 결과로, 메타버스 적용에 대한 전체태도에 도시 가치, 정의적 요인, 상호작용적 요인, 비용 절감적 요인, 시민 관계적 요인, 홍보적 요인이 유의하게 영향을 미치는 것으로 나타났다. 전체태도, 만족도, 충성도의 효과가 삶의 질에 영향을 미치는 반면, 다른 도시로의 확장, 메타버스 적용의 가능성, 도시관리가 홍보 정책에 영향을 미치는 것으로 나타났다.

[Abstract]

This study aims to explore the factors that affect citizens' perception of the application of the metaverse platforms for city management and to provide implications for better promotional policies. The research questions include 1) how city brand, affective factor, cognitive factor, customized offer, interactive factor, cost-saving factor, citizen relationship factor, and promotional factor affect overall attitude? and 2) how factors affect quality of life? and 3) how factors influence promotional policies? This study conducted an online survey with the assistance of a well-known research firm. To test hypotheses, applied factor, analysis of variance (ANOVA), and regression analysis were applied. The results indicated that the city value, affective factor, interactive factor, cost-saving factor, citizen relationship factor, and promotional factor significantly influenced overall attitudes toward metaverse application in Seoul Metropolitan City. Overall attitude, satisfaction, and loyalty affected quality of life. Additionally, expansion to other cities, metaverse prospects, and city management shaped promotional policies.

Ⅰ. Introduction

A study by [1] argued that the image of a city can be more significant than its reality and noted that marketing techniques are frequently employed to transform a city into a post-industrial center of tourism, culture, and redevelopment. A study by [2] stated that the dimension of city marketing is divided into key segments including residents, visitors, and investors and tested this framework on policymakers in a region, using them as the unit of analysis. A study by [3] emphasized that city marketing involves promoting and selling cities, towns, or regions to a specific target markets. According to [4], the research domain of city branding has been a topic of ongoing debate across various academic disciplines, each of which has examined the phenomenon using diverse methods, conceptual frameworks, and empirical approaches. A study by [5] addressed that a city attraction hypothesis posits that global intercity competition revolves around a city's ability to attract the highest possible value from global flows of resources and investments to promote urban development. A study by [5] also highlighted that attraction strategies can take several major forms, which may be used individually or in combinations,such as providing premises, offering incentives, and disseminating information. A study by [1] examined the significance of city marketing in urban governance decisions and investigated its relationship with urban tourism planning. According to [6], the promoting cities to become smart primarily stems from the problems caused by rapid urbanization, which often deteriorates the quality of life in large urban areas. According to [7], smart city marketing has become a tool to understand citizens' needs and a driving force in creating a new market.

According to [8], industry 4.0, or the Fourth Industrial Revolution, is driven by innovative technologies. A study by [8] stated that this evolution has ensured that marketing activities align with technological advancements and address consumers' current needs. A study by [9] emphasized the key enabling technologies for the metaverse, highlighting the primary benefits of adopting this technology and the opportunities it presents for smart city applications. Among the applications of the Fourth Industrial Revolution, this study investigated citizens' perceptions of the application of the metaverse. According to [10], the rapid development of digital technology may accelerate society's transition into the virtual world, blurring the boundaries between the physical and digital realms and fostering the growth of the metaverse. A study by [11] highlighted the need to focus research on a specific area within the metaverse to enhance both user-recognized aspects and technical developments. A study by [46] emphasized the potential success of the metaverse by applying Novelty, Convenience, and Usefulness (NCU) theory, widely recognized criteria for evaluating new technologies. A study by [47] highlighted the impact of the Unified Theory of Acceptance and Use of Technology (UTAUT), proposed by [48], in examining user satisfaction and intention to use. the metaverse platform. A study by [49] also applied UTAUT framework to explore the relationship between personality characteristics and intention to use the metaverse.

This study explores the perception and application of the metaverse in city management, focusing on its influences on overall attitude, quality of life, and promotional policies. Specifically, this study examines how citizens perceive the use of the metaverse in city management and how this application enhances their quality of life. Proposed factors affecting overall attitude include city value, affective factor, cognitive factor, customized offer, interactive factor, cost-saving factor, citizen relationship factor, and promotional factor. Furthermore, this study explored the impact of overall attitude, satisfaction, and loyalty on quality of life. The impacts of expansion for other cities, the prospects of the metaverse, and city management on better promotional policies were also analyzed. Among the applications of the metaverse in cities, this study measured its effects specifically within Seoul Metropolitan City. It explored Seoul's innovative use of metaverse technologies in city management and promotional policies, highlighting the transformative potential of advanced technology.

Ⅱ. Literature Review on Technology Applications for Cities

2-1 The Role of High-Technology in City Marketing

According to [12], the concepts of city marketing,

city branding, and place marketing involve recognizing, positioning, promoting, and selling cities, towns, regions, and countries to target markets by creating and maintaining a positive city image. A study by [13] developed a framework that links the concepts of place branding, place image, and place reputation, focusing on the antecedents and outcomes of place branding in the context of an emerging country. According to [14], city branding is emerging as an internationally recognized research domain characterized by a high degree of multidisciplinary engagement and rapid proliferation across various fields.

A study by [15] highlighted that while marketing has a long tradition of studying the adoption of new technologies, less attention has been given to how new technologies lead to innovations in marketing techniques, tools, and strategies. A study by [15] also emphasized the transformative impact of new technologies on marketing practices, enabling the development of novel approaches to engage consumers, analyze data, and enhance overall marketing effectiveness and called for more research into understanding these innovations and their implications for the future of marketing. A study by [16] addressed the concept of place branding in cities and its relationship to high-technology industry growth. A study by [16] explored how effectively branded cities can attract and sustain high-tech industries, leading to economic growth and increased competitiveness. According to [17], municipal governments are using digital technology and real-time data to optimize city operations as part of the smart cities movement. A study by [17] also mentioned that the South Korean city plans to use artificial intelligence for water waste management and employ an Artificial Intelligence (AI) chatbot for public communication by handling questions and complaints. According to [18], the metaverse represents a convergence of rapidly evolving technologies. A study by [9] also emphasized that the metaverse has the potential to revolutionize many areas of smart cities.

2-2 Application of the Metaverse for Cities

A study by [19] stated that the metaverse aims to merge the virtual and real worlds. The metaverse, a collective virtual shared space created by the convergence of virtually enhanced physical reality and physically persistent virtual space, is revolutionizing various industries and applied in cities. According to [20], the metaverse could provide a platform for virtual travel, allowing users to virtually visit and explore a wide variety of real-world destinations and potentially interact with virtual representations of other people and objects within those destinations. A study by [21] discussed how cities are beginning to explore the benefits of the metaverse for governmental operations and community support. According to [21], as new technologies advance, we can envision an idealized version of the metaverse – a self-sustaining and persistent virtual world that exists independently, while also intertwining with the physical world.

According to [22], the concept of a smart city, which uses information technology in city management, is expected to evolve into a metaverse city in the future. A study by [23] emphasized that the metaverse presents numerous opportunities to advance smart cities as it gains prominence in the 2020s, offering a potential direction for the new generation of the Internet. A study by [19] noted that the metaverse provides digitalization approaches that can enhance citizens' social communities. A study by [19] also offered a comprehensive overview of the potential and implemented applications of the metaverse in the context of cities and municipalities. A study by [22] provided a deeper understanding of adopting the metaverse concept in smart cities and the fundamental technologies that support it.

2-3 Cases of the Metaverse for Global Cities

The Seoul Metropolitan Government is the first local government in Korea to establish a metaverse platform, which has emerged as a contactless communication channel in the post-pandemic era, enables the government to provide a new concept public service through its administration [24]. According to [17], Seoul's metaverse platform will host a variety of public functions, including a virtual mayor's office, spaces for the business sector, a fintech incubator, and a public investment organization. By embracing virtual city planning, smart infrastructure, virtual governance, and immersive promotional strategies, Seoul is setting a benchmark

for other cities globally. The continued integration of the metaverse will likely enhance urban living, boost economic growth, and position Seoul as a leader in technological advancement and smart city development. Seoul, a leading global city known for its technological advancements, is harnessing the potential oft he metaverse to enhance city management and promotional policies. By utilizing the metaverse for virtual city planning, Seoul allows city planners to create and manipulate digital twins of urban areas.

A study by [25] reported that a Shanghai city department has set up a five-year development plan, which included encouraging the use of the metaverse in public services, business offices and other areas. According to [26], Shanghai has been recognized as a top global metaverse city, with smart applications in the areas of tourism, urban development, and medical services. [27] reported that Shanghai plans to develop its culture and tourism metaverse projects into an industry by integrating metaverse technologies into the city's real-world tourist attractions, so visitors will be able to interact with sites through augmented reality, have avatars as tourist guides, and receive other metaverse-based services. According to [18], Singapore, being one of the best places in the world to do business, attracts top metaverse companies to establish their headquarters there. A study by [28] addressed that combined with the UAE's goal to reach net-zero emissions by 2050, Dubai is recently pioneering metaverse initiatives. A study by [29] noted that Santa Monica is the first city in the U.S. to access the metaverse through its app, aiming to achieve beneficial purposes such as reducing crime.

III. Hypotheses Development

3-1 Impact of City Value on Overall Attitude

A study by [30] emphasized that the metaverse is expected to have a positive and propulsive effect on the future smart cities. A study by [31] provided a detailed a review of the impact of digital twins and digitalization on cities and assessed the progression of urban development and the standardization of their management practices to promote the expansion and adoption of digital twins in smart cities. According to

[32], one of the most evolving concepts over the past two decades is smart cities, which have been defined and formulated by numerous research efforts and organizational initiatives. A study by [33] emphasized the term "Citiverse" as an innovative concept, redefining the metaverse within the context of smart cities. According to [6], smart city marketing has been driven by smart city solution providers and city authorities, utilizing technologies to open numerous easy and accessible communication channels. This study posits that adopting the metaverse in city management will lead citizens to perceive an enhancement in the city's value and image.Based on the consideration, this study hypothesized the effect of city value on overall attitude.

H1: The influence of metaverse applications on city value and its effect on overall attitude.

3-2 Impact of Affective Factor on Overall Attitude

Using the application of metaverse platform, the [24] announced that this initiative is a key strategy to make Seoul a "future emotional city," as suggested by Mayor Oh in Seoul Vision 2030. According to the From Seoul Metropolitan Government [24], starting in 2023, Seoul's leading festivals, such as the Seoul Lantern Festival, will be held in the metaverse to ensure they can be enjoyed by people around the world (https://seoul.go.kr). A study by [17] noted that the virtual public services offered through the metaverse platform by the Seoul Metropolitan Government will handle citizen concerns using avatars, eliminating the need of physical visits to city hall. A study by [30] applied the concept of hedonicity in their research on the city metaverse, measuring consumer perceptions of feeling, attractiveness, and fun based their usage. Based on the consideration, this study hypothesized the effect of affective factor on overall attitude.

H2: The influence of metaverse applications on affective factor and its effect on overall attitude.

3-3 Impact of Cognitive Factor on Overall Attitude

The avatar public officials in the metaverse offer convenient consultations and civil services that were previously available only through the civil service center at Seoul City Hall [24]. A study by [30] applied

the concept of utilitarian in their research on the city metaverse, measuring perceived informativeness, easy to use, and usefulness based on user experience. According to [34], the elements of the virtual world include the terms words world, reality, information, and online. This study posits that adopting the metaverse in city management will provide citizens with useful information and valuable contents. Based on the consideration, this study hypothesized the effect of cognitive factor on overall attitude.

H3: The influence of metaverse applications on cognitive factor and its effect on overall attitude.

3-4 Impact of Customized Offers on Overall Attitude

A study by [35] researched the prospects and challenges of the metaverse in higher education and highlighted the benefits of using the metaverse in this context, including personalized learning. A study by [36] discussed how metaverse allows variations in how people select and customize their in-world representations using avatar interactions. A study by [37] researched the motivations and trend in avatar customization among metaverse users, providing valuable insights for the development of metaverse avatar content services. This study posits that adopting the metaverse in city management will provide citizen with customized services and information based on preferences, as well as through the use of avatars. Based on the consideration, this study hypothesized the effect of customized offers on overall attitude.

H4: The influence of metaverse applications on customized offers and their effect on overall attitude

3-5 Impact of Interactive Factor on Overall Attitude

A study by [23] emphasized that the metaverse provides immersive and interactive virtual environments, enabling residents to engage with the city and its services in new and exciting ways. A study by [18] highlighted immersion as a key characteristic of the metaverse, where users enter a 3D world that surrounds them sensorily. Another important characteristic is interoperability, which allows for the seamless transition of user experiences and objects across multiple platforms [18]. According to [9], the metaverse is a collection of immersive and interconnected digital spaces where users can interact within computer-generated environments. [38] highlighted that the metaverse presents a new paradigm for customer experience and impacts on general societal interactions. According to [39], metaverse is the next disruptive technology poised to impact society by enabling immersive experiences in both virtual and physical environments. Based on the consideration, this study hypothesized the effect of interactive factor on overall attitude.

H5: The influence of metaverse applications on interactive factor and its effect on overall attitude.

3-6 Impact of Cost-Saving Factor on Overall Attitude

According to [40], as society progresses towards a more technologically advanced future, it is crucial to consider the potential social, economic, and environmental impacts of these changes. [33] noted that as the metaverse extends its reach intothe core of smart cities, their research explores the significant economic and social effects it introduces. A study by [31] addressed that the digital economy has emerged as the primary economic form over the last decade and its rapid progression has become a key force in restructuring global resource distribution and reshaping global economic structure. This study posits that adopting the metaverse in city management will benefit citizens by reducing costs such as information search expenses and consulting fees related to various social aspects.Based on the consideration, this study hypothesized the effect of cost-saving factor on overall attitude.

H6: The influence of metaverse applications on cost-saving factor and its effect on overall attitude.

3-7 Impact of Citizen Relationship Factor on Overall Attitude

A study by [40] noted that the metaverse has the potential to transform the way people live, work, and interact with one another. [33] highlighted that the metaverse has the potential to revolutionize how we interact with digital environments across work, entertainment, commerce, and social relationships. A study by [34] stated that the applications of advanced technologies have contributed to the increasing digitization of the real world, thereby breaking the

boundaries between the physical and virtual worlds. According to [36], metaverses are virtual worlds where people interact with each other and their environment, using the metaphor of the real world but without its physical limitations. This study posits that adopting the metaverse in city management will benefit the relationship between the Seoul Metropolitan Government and its citizens through improved communication regarding social issues, concerns, and events. Based on the consideration, this study hypothesized the effect of citizen relationship factor on overall attitude.

H7: The influence of metaverse applications on citizen relationship factor and its effect on overall attitude.

3-8 Impact of Personalized Factor on Overall Attitude

According to the [24], the master plan includes 20 promotional tasks across seven areas – economic,educational, cultural and tourism, communication, urban development, administrative, and infrastructure – reflecting trends and demands for metaverse service in both the public and private sectors. A study by [31] emphasized that promoting the integration of the real world with the digital world is crucial for providing advanced technical support in the construction of the digital twins. This study posits that adopting the metaverse in city management will help enhance city marketing and competitiveness. Based on the consideration, this study hypothesized the effect of promotional factor on overall attitude.

H8: The influence of metaverse applications on promotional factor and its effect on overall attitude.

3-9 Impact of Attitude, Satisfaction, and Loyalty on Quality of Life

According to [41], *an attitude is an individual's disposition to respond favorably or unfavorably to an object, person, institution, or event, or to any other discriminable aspect of the individual's world* (p.241). Customer satisfaction, supported by satisfaction theories, refers to the level of fulfillment expressed by the customer after the service delivery process [42]. A study by [43] researched satisfaction with virtual object manipulation in the metaverse and found that satisfaction with this aspect can significantly influence overall satisfaction with the application. A study by

[44] emphasized the positive effects of a social metaverse on mood management, life satisfaction, and usage intentions, using active users of a social metaverse platform Zepeto as their study sample. A study by [23] noted that virtual simulations can be used to test and refine city planning strategies, while augmented reality applications enhance the overall user experience in various aspects of city life. According to [40], the trend of the fourth industrial revolution is unfolding in cities due to the pursuit of the smart city agenda, which aims to use technology to improve urban services and enhance the quality of life for residents. According to [6] emphasized that a city should always be capable of identifying and effectively resolving its key development challenges to improve the quality of life for its citizens. According to [7] stated that the momentum for developing smart cities come from the implementation of digital innovations provided by market actors, who use smart services aimed at making life easier for citizens. Based on the consideration, this study hypothesized the effect attitude, satisfaction, and loyalty on quality of life.

H9a: Attitude toward the metaverse applications influences quality of life.

H9b: Satisfaction with the metaverse applications influences quality of life.

H9c: Loyalty toward the metaverse applications influences quality of life.

3-10 Impact of Expansion to Other Cities, Prospect, and City Management on Promotional Policies

A study by [23] researched the metaverse in the context of smart cities and noted that the concept of a smart city aims to enhance convenience and improve the efficient management of urban areas through innovation. A study by [10] discussed the future prospects for the metaverse, stating that it will accelerate and potentially become an important part of future life. A study by [10] also emphasized that this development will promote the careful integration of the entity economy and the digital economy. A study by [30] reviewed the concept of the city metaverse and its related technological applications in consumer experiences and consumer behaviors and discussed strategies to increase access to and encourage more in-depth use among people. Based on these considerations, this study hypothesized that the

expansion of the metaverse to other cities, along with the metaverse's prospects, and its application in city management will impact promotional policies.

H10a: The expansion of metaverse application to other cities influences promotional policies.

H10b: The prospect of metaverse application influences promotional policies

H10c: The use of metaverse applications for city management influences promotional policies

Ⅳ. Methodology

This study conducted an online survey with the assistance of Korea Research International, a reputable research firm with a long-standing history since its establishment in [45]. As a global research company, it is trusted by over 500 businesses as a preferred research partner [45]. The questionnaire includes major questions along with warm-up and demographic questions. The major questions focus on factors that influence attitude, satisfaction, loyalty, and perceptions of the metaverse, as well as policies related to the application of high technology in city management. A 5-point Likert scale was applied for major questionnaire items. Stratified sampling was applied, taking demographics into account.The survey was distributed to citizens of Seoul, South Korea, to gather their perceptions on the application of metaverse platforms. Seoul is the focus of this study as the city is utilizing the metaverse for virtual city planning, enabling city planners to create and manipulate digital twins of urban areas. Data was collected from 396 respondents. The survey was utilized back translation to ensure accuracy. Participation in the survey was anonymous and voluntary, with informed consent obtained from all participants. All data was stored confidentially and used solely for research purposes. Factor analysis, Analysis of Variance (ANOVA), and multiple regression analysis was used to test the main hypotheses of the study. All respondents indicated that they have heard of the metaverse. Among them, 29.7% reported being very familiar with the metaverse, 54.7% stated they are familiar with it, and 15.6% said they are not very familiar with it. 61.4% of respondents indicated that they have experienced the metaverse. Regarding the application of the metaverse

offered by the Seoul metropolitan City, 6.0% reported being very familiar with it,18.4% stated they are familiar with it, and 28.2% said they are somewhat familiar with it. This study conducted Cronbach's alpha to check reliability. The results of as follows: 0.877 for city value, 0.874 for affective factor, 0.886 for cognitive factor, 0.807 for customized offer, 0.848 for interactivity factor, 0.885 for cost-saving factor, 0.870 for citizen relationship factor, and 0.883 for promotional factor. Table 1 summarizes demographics of the respondents.

Table 1. Demographics of respondents

		#	%
Gender	Male	194	49.0
	Female	202	50.0
Age	20-29 years old	96	24.2
	30-39 years old	98	24.7
	40-49 years old	100	25.3
	50-59 years old	102	25.8
Education	High school	53	13.3
	In College	41	10.4
	Bachelor's Degree	159	65.5
	Graduate Degree	43	10.8
Annual Income	Below 2,000,000 won	36	9.1
	Between 2,000,000- 10,000,000 won	130	32.8
	Between 10,000,000- 50,000,000 won	73	18.3
	Between 50,000,000- 200,000,000 won	158	39.9

V. Data Analysis

This study conducted factor analysis to extract scale items based on constructs. Principal component analysis was used for extraction, with maximum iterations for convergence, and factors with eigenvalues greater than 1 are extracted. VARIMAX with Kaiser Normalization was applied as the rotation method, also with maximum iterations for convergence. Table 2 summarizes the component matrix, including factor loadings. The questionnaire items were developed as follows: i) City Value: Items were developed to measure how citizens perceive the application of the metaverse as increasing the value of the city, ii) Affective Factor: Items were developed to

measure how citizens perceive the usage of the metaverse as playful and fun for the city iii) Cognitive Factor: Items were developed to measure how citizens perceive the usage of the metaverse as informative for the city, iv) Customized Offer: Items were developed to measure how citizens perceive personalized services provided from the application of the metaverse for the city, v) Interactive Factor: Items were developed to measure how citizens perceive the interactive and immersive technology provided by the application of the metaverse for the city, vi) Cost-Saving Factor: Items were developed to measure how citizens perceive the application of the metaverse as a cost-saving measure for the city, vii) Citizen Relationship Factor: Items were developed to measure how citizens perceive the application of the metaverse in building relationships with the public sector, and viii) Promotional Factor: Items were developed to measure how citizens perceive the application of the metaverse as a tool to enhance communication between the city and its residents and visitors.

Table 2. Component Matrix for City Value, Affective Factor, Cognitive Factor, Customized Offer, Interactive Factor, Cost-Saving Factor, Citizen Relationship Factor, & Promotional Factor

	Component							
	1	2	3	4	5	6	7	8
CV1	.91							
CV3	.89							
CV2	.88							
AF2		.90						
AF1		.89						
AF3		.88						
CF1			.91					
CF2			.90					
CF3			.89					
CO2				.92				
CO1				.91				
IF3					.89			
IF2					.88			
IF1					.87			
CS1						.91		
CS3						.90		
CS2						.89		
CR1							.89	
CR3							.88	
CR2							.85	
PM1								.91
PM2								.90
PM3								.89

*CV: City Value; AF: Affective Factor;
CF: Cognitive Factor; CO: Customized Offer;
IF: Interactive Factor; CS: Cost-Saving Factor;
CR: Citizen Relationship Factor; PM: Promotional Factor

This study conducted multiple regression analysis to test hypotheses. Factor scores were used in the regression analysis. The independent variables included city value, affective factor, cognitive factor, customized offer, interactive factor, cost-saving factor, citizen relationship factor, and promotional factor, while the dependent variable was overall attitude. The ANOVA results showed that the overall model is significant with $F = 169.153$ at $p < 0.01$ and an R-square = 0.815 (adjusted R-square = 0.810). As shown in Table 3, the results indicated that the city value, affective factor, interactive factor, cost-saving factor, citizen relationship factor, and promotional factor significantly influenced overall attitudes toward metaverse application in Seoul Metropolitan City. Therefore, H1, H2, H5, H6, H7, and H8 were accepted. Among the significant results, the promotional factor had the greatest effect size on overall attitude, followed by the citizen relationship factor, affective factor, city value, interactive factor, and cost-saving factor. Overall, the effect sizes were strongest for the promotional factor and citizen relationship factor.

Table 3. Effects of proposed factors on overall attitude

Independent Variables => Dependent Variables	Standardized Coefficient (t-value/sig)
City Value => Overall Attitude	.097 (2.320**)
Affective Factor => Overall Attitude	.111 (2.124**)
Cognitive Factor => Overall Attitude	.070 (1.354)
Customized Offer => Overall Attitude	.001 (.016)
Interactive Factor => Overall Attitude	.088 (1.864*)
Cost-Saving Factor => Overall Attitude	.081 (1.702*)
Citizen Relationship Factor => Overall Attitude	.217 (3.972***)
Promotional Factor => Overall Attitude	.289 (6.253***)

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ denote statistical significance

This study also conducted multiple regression analyses to test the effect of overall attitude, satisfaction, and loyalty on the quality of life regarding the application of the metaverse application for city management. The results of ANOVA showed that overall model is significant, with $F = 409.875$ at $p < 0.01$ and an R-square = 0.807 (adjusted R-square = 0.805). As shown in Table 4, the effect sizes were as follows: the effect size of citizen satisfaction on quality of life was 0.371, the effect size of loyalty on quality of life was 0.292, and the effect size of overall attitude

on quality of life was 0.292. Therefore, hypotheses 9a, 9b, and 9c were accepted.

Table 4. Effects on quality of life

Independent Variables => Dependent Variables	Standardized Coefficient (t-value/sig)
Overall Attitude => Quality of Life	.292 (6.373***)
Customer Satisfaction => Quality of Life	.371 (7.541***)
Loyalty => Quality of Life	.292 (6.757***)

*** $p < 0.01$ denote statistical significance

Furthermore, this study conducted a regression analysis to test the effect of expansion to other cities, the prospect of metaverse application, and city management on the preparation of better promotional policies. The results of ANOVA showed that the overall model is significant, with $F = 429.636$ at $p< 0.01$ and an R-square = 0.718 (adjusted R-square = 0.710). As shown in Table 5, the effect sizes were as follows: the effect size of citizen satisfaction on promotional policy was 0.478, the effect size of prospect of metaverse application on promotional policy was 0.306, and the effect size of city management on promotional policy was 0.147. Therefore, hypotheses 10a, 10b, and 10c were accepted.

Table 5. Effects on promotional policy

Independent Variables => Dependent Variables	Standardized Coefficient (t-value/sig)
Expansion to Other Cities => Promotional Policy	.147 (2.940***)
Prospect => Promotional Policy	.305 (5.724***)
City Management => Promotional Policy	.478 (10.915***)

*** $p < 0.01$ denote statistical significance

VI. Conclusion

This study explores the application of metaverse technologies in city management, highlighting the innovative approaches and potential benefits. The purpose of this study is to investigate the factors that influence overall attitudes, quality of life, and promotional policies regarding the adoption of the metaverse in city management. Specifically, this study focuses on the application of these technologies in Seoul Metropolitan city, based on perspectives of its residents. Seoul is a pertinent case as the city is

actively utilizing the metaverse for virtual city planning, allowing planners to create and manipulate digital twins of urban areas. This study proposed various factors including city value, affective factor, cognitive factor, customized offer, interactive factor,cost-saving factor, citizen relationship factor, and promotional factor to measure their effects on overall attitudes toward the metaverse application in city management. Additionally, this study measures the effects of attitude, citizen satisfaction,and loyalty on quality of life, as well as the impacts of metaverse application expansion to other cities, the prospect of the metaverse, and city management on promotional policies.

The results of this study revealed that the impacts of city value, affective factor, interactive factor, cost-saving factor, citizen relationship factor, and promotional factor on overall attitude were significant. Among these, the promotional factor had the highest effect size on overall attitude, followed by affective factor, city value, interactive factor, and cost-saving factors. Therefore, this study found that citizens perceive the role of the metaverse as a tool to enhance communication between the city and its residents and visitors as highly important. The study also found that citizens view the use of the metaverse as playful and fun for the city, and as a means of increasing the city's value. The study also found that citizens perceive the interactive and immersive technology provided by the application of the metaverse as beneficial for the city and view it as a cost-saving measure. However, the study found that the roles of the metaverse as an informative tool for the city and in providing personalized services do not have a significant impact on overall attitude. Furthermore, the results of this study found that the effects of citizen satisfaction on quality of life are highly significant, followed by the effects of loyalty and overall attitude. The results of this study found that the effects of city management on promotional policy are highly significant, followed by the effects of prospects toward the metaverse and its expansion to other cities.

The results of this study offer significant managerial and policy implications for the Seoul Metropolitan Government. Seoul's innovative use of metaverse technologies in city management and promotional policies showcases the transformative potential of high

technology. By adopting virtual city planning, smart infrastructure, virtual governance, and immersive promotional strategies, Seoul is setting a global benchmark. The online integration of the metaverse is expected to enhance urban living, drive economic growth, and establish Seoul as a leader in technological advancement and smart city development. The city could enhance its promotions by utilizing public advertising and integrated media services, combining mobile platforms and e-governance to raise awareness of metaverse services among citizens. Development of public promotional messages tailored to different age cohorts could help improve both awareness and outreach. Furthermore, highlighting and developing additional benefits of using the metaverse to enhance quality of life will improve both its usage and usefulness. This study also found that the development of effective promotional policies will enhance the implementation of the metaverse for city marketing.

To optimize the application of the metaverse in city management, it is essential to focus on enhancing citizen engagement through immersive experiences and improving feedback mechanisms. The study also suggests strategies to enhance the roles of the metaverse as an informative tool for the city and in providing personalized services. The city might consider creating virtual information hubs within the metaverse where citizens can access detailed and up-to-date information about city services, policies,and planning initiatives. Additionally, the city could use data analytics to provide personalized recommendations relevant to each citizen. Virtual assistants or chatbots could be implemented on a real-time basis to offer immediate support and information. By implementing these strategies, the metaverse can become a more effective and personalized tool for disseminating information and delivering services, enhancing its overall impact on city management. Additionally, better promotional policies should be developed to enhance citizen awareness of the metaverse application in city management. This study has limitations and provides implications for future research. Future studies might consider increasing the sample size and comparing the application of metaverse in other cities.

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