Well-being of Citizens in Smart Cities in Malaysia and China

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Abstract

Smart cities present a potential remedy as crowded and complex metropolitan regions increase in the digital era. A measurement of whether establishing a smart city would be compatible with Sustainable Development Goals 3 and 11 is undertaken to enhance its inhabitants' well-being. A total of 105 and 134 citizens of the smart cities in China and Malaysia, respectively, received online surveys. The data was analyzed using structural equation modeling (SEM). The results offer empirical evidence that reinforces the theoretical underpinnings of smart city development. Additionally, the findings emphasize citizen satisfaction in improving residents' well-being, acting as a mediator.

Keywords: Smart cities; Citizen satisfaction; Well-being; SDG 3 & 11

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1.0 Introduction

The population of the world has been steadily increasing in both urban and rural areas, according to the 2022 Global Population Review, and it will approach 8 billion people by mid-November. The Eastern and South-Eastern Asia region will account for the highest share of global population in 2023, with 2.35 billion people or 29% (United Nations Population Fund, 2023). The industrialization of economies in many countries has led to a steady movement of rural populations towards metropolitan areas.

When a larger portion of the population migrates to a city, it leads to urbanization (Tan et al., 2021). Accordingly, approximately 80% of the world's emissions of carbon dioxide, as well as 75% of its energy consumption, are attributed to cities (Lazaroiu & Roscia, 2012). The European Commission developed the "smart city" sustainable urban paradigm in response to these challenges.

Projected population growth is anticipated to persist in both China and Malaysia throughout the twenty-first century. Consequently, the continued proliferation of "smart cities" in China and Malaysia may have diverse adverse implications for urban dwellers. In view of this accelerated expansion, this study is to investigate and evaluate a specific scale that gauges the impact of smart city development on the well-being of citizens. The assessment primarily centers on the extent to which these initiatives align with Sustainable Development Goals (SDG) 3, which prioritizes "good health and well-being," and SDG 11, which underscores the importance of "sustainable communities and cities."

This study endeavors to investigate and compare the determinants of citizen well-being in Malaysia and China. Furthermore, it delves into the mediating influence of citizen satisfaction (CS) on the association between perceived smart public services (PSPS), perceived smart infrastructure (PSI), perceived smart environment protection (PSEP), and well-being within the framework of smart cities.

1.1 Problem Statement

The rapid population growth in recent years has brought about substantial transformations in the overall landscape of smart cities. To cater to citizens' aspirations for improved living standards and increased economic prosperity, various countries have undertaken smart city initiatives aimed at safeguarding the well-being of their inhabitants. Such endeavors appear technically feasible and relevant as an integral part of the digital society development process. The development of smart cities is supported by some academic studies and empirical evidence, particularly those that place a high value on residents' well-being. As more cities encounter urbanisation issues, these challenges become increasingly severe. It has not yet been fully evaluated and documented how the efforts to create smart cities have affected and contributed, despite their introduction and expansion in many different countries. Hence, this study is anticipated to make a valuable contribution by addressing these inquiries and providing a comprehensive justification of the intricate effects associated with the development of smart cities.

1.2 Objectives of Study

This study is to investigate how citizens' perceptions of smart city initiatives, specifically pertaining to PSI, PSPS, and PSEP, influence their overall well-being. Furthermore, this research aims to evaluate the direct influence of PSI, PSPS, and PSEP on citizens' well-being, while also investigating the mediating role of CS in shaping their quality of life.

2.0 Literature Review

2.1 Smart Cities in Malaysia

The concept of a "Smart City" holds significant importance in Malaysia, as evidenced by comprehensive initiatives such as the 11th Malaysian Plan, National Physical Plan 3, and National Urbanization Policy 2. These initiatives are further supported by various frameworks and blueprints. The Malaysia Smart City Framework (MSCF) is particularly noteworthy as it serves as a national guideline for smart city development and planning throughout the country. The MSCF focuses on three key pillars: promoting a competitive economy, ensuring environmental sustainability, and enhancing the overall quality of life. Various stakeholders, including urban managers, government agencies, federal ministries, corporate executives, academics, and other relevant groups, actively collaborate to address urban challenges and strive towards creating more sustainable and livable cities, guided by the principles of the MSCF (MyGovernment, 2023).

By adopting such strategies, Malaysian cities can enhance their competitiveness and contribute significantly to achieving SDGs. City planners recognize that smart cities offer viable solutions to challenges related to waste management, crime, pollution, and energy consumption. Notably, Putrajaya and Iskandar Puteri, two Malaysian cities with smart city initiatives, have developed specific plans that prioritize regional and local implementations (Samsudin et al., 2022).

Numerous smart city initiatives have been implemented in Malaysia. In accordance with Nasir et al. (2018), Melaka residents view smart meters as an effective means of educating people about smart living and energy-saving technologies. An e-hailing app encourages locals in Sarawak to collect or remove trash based on their location to reduce river pollution (Rohana et al., 2019). Plans for revitalising urban public spaces were released at the Georgetown World Heritage Site to ensure that the general public would receive all the benefits of having a public space (Omar et al., 2018). These programmes are essential because, in Malaysia, Eusuf et al.'s (2018) research found a direct link between environmental quality and urban dwellers' quality of life.

Despite these efforts, there have been some unfavourable implementation and acceptability issues. Programmes run by the Melaka Green Technology City State including the 2+1 Recycling Programme, Green Transportation, and Melaka without Plastic Bags and Polystyrene have relatively low public engagement rates (Abdullah, 2018). It has been found that bicycle sharing is not particularly appealing to commuters taking public transportation as a method of reducing urban pollution (Rosnan & Abdullah, 2018).

The adoption of smart and sustainable mobility practices in Malaysia is impeded by several significant challenges, including climate change, safety concerns, security issues, and inadequate infrastructure. Despite the provision of common amenities for "people with disabilities" (PWDs) at Malaysian public transport hubs, research has shown that these facilities are not functional and do not effectively cater to the needs of PWDs (Zainol et al., 2018).

It is crucial to look into the well-being of urban people because smart cities are where the majority of urban residents live. Malaysian university administrators who live in urban settings are more financially secure (Harith & Noon, 2015). The progress of regional Smart City initiatives in Putrajaya and Iskander Puteri cannot currently be assessed accurately through measuring tools or indicators (Samsudin et al., 2022). Smart cities will also be sustainable if citizens are willing to get involved in smart city activities, claim Chong et al. (2022).

2.2 Smart Cities in China

China has displayed a strong dedication to the advancement of smart cities. The initiative began in 2009 when Beijing took the lead in establishing smart cities, leading to the adoption of the "Smart Beijing" concept by various local government units, including "Smart Nanjing" and "Smart Guangzhou". Over time, the construction of smart cities has expanded significantly. The development of smart cities has gained prominence in the national economy since the introduction of the 12th Five-Year National Plan in 2010. In the fifth section of the "Outline of the People's Republic of China 14th Five-Year Plan for National Economic and Social Development and Long-Range Objectives for 2035," the Chinese government has proposed an accelerated focus on the creation of a digital China to adapt to globalization and the full integration of digital technology into society and daily life. The objective is to drive innovation in public services and societal operations, ultimately fostering a digital lifestyle that benefits all (State Council of the People's Republic of China, 2021).

During the "20th National Congress of the Communist Party of China" in October 2022, President Xi Jinping announced the country's commitment to a new urbanization model centered on the well-being of its people. To promote the development of livable, resilient, and smart cities, the State Council of the People's Republic of China has introduced measures to expedite the granting of permanent urban residency to eligible individuals migrating from rural to urban areas. These initiatives demonstrate the government's dedication to fostering the growth and construction of smart cities in the modern era.

The strategic implementation of new smart cities is rapidly gaining momentum in China as a transformative approach to urban development and governance. It is projected that by the year 2022, approximately 64.7% of the Chinese population will be residing in urban areas (National Bureau of Statistics of China, 2022). Consequently, there has been a notable surge in the construction of smart towns across the country. In 2019, a significant number of 700 cities, encompassing county cities, were proposed or established, with all of them surpassing the subprovincial level and 95% exceeding the prefectural level (Hu,

2019). As the momentum continued, the scale expanded to 800 in 2021, leading to the emergence of numerous smart city clusters (Huang et al., 2021). A number of significant advancements have been made as a result of this rapid development (Zhang et al., 2022). They include improving information resources, implementing effective governance practices, creating conducive environments, promoting reform measures, and fostering innovation. In China, smart cities are recognized as an important strategy for driving economic development, facilitating industrialization, and enhancing city competitiveness (Wang & Deng, 2022).

2.3 Perceived Smart Infrastructure

The inherent connectivity and features of ICT-enabled smart infrastructure offer an opportunity for a paradigm shift towards social, environmental, and economic sustainability, allowing for more timely progress (Savastano et al., 2023). By implementing smart infrastructure, governmental and administrative entities can acquire improved capacities in monitoring, accessing, and managing infrastructure services and natural resources. By integrating a range of complementary technologies, smart infrastructure is equipped to provide sustainable infrastructure services in a more efficient manner. Additionally, smart infrastructure holds promise in tackling the obstacles arising from aging infrastructure and population expansion (Berglund et al., 2020).

The concept of PSI refers to infrastructure that people believe is intelligent, such as water and electric grids, transportation networks, and logistical systems. The optimal approach involves integrating cutting-edge emerging technologies into infrastructure development and adopting novel procurement strategies to facilitate sustainable growth while enhancing safety, health, and management in smart cities (Jayasena et al., 2022). Consequently, the first hypothesis of this study is formulated as follows:

H1. Perceived smart infrastructure significantly influences citizens' well-being.

2.4 Perceived Smart Public Service

The incorporation of intelligent technology into public services is gaining increasing importance, particularly in the implementation of smart city concepts. Various architectural designs can be employed to materialize the vision of smart cities. These smart cities encompass a wide array of cyber-physical systems that leverage intelligent devices and technologies, spanning sectors such as education, healthcare, and construction services (Khalil et al., 2022).

PSPS refers to the cognitive evaluation conducted by urban residents regarding the provision of intelligent public services. Indicators of this intelligence include virtual medicine, electronic social security, e-learning, and project management, among others, which are widely utilized as benchmarks for evaluation purposes.

Keeping health and equity in cities requires access to energy, transportation, shelter, and communication (Buttazzoni et al., 2020). Smart healthcare is crucial to the success of a smart city. 2019 (Xie et al.) It is discussed how social security technologies can be used

to improve the security, functionality, and intelligence of smart cities. Understanding, recognising, and overcoming the difficulties that society faces are also made possible through education (Visvizi et al., 2018). Smart city initiatives are also reliant on education to help individuals engage more fully (Hudson et al., 2019). Digital and smart technology will be introduced and integrated into residential and neighbourhood settings, improving people's daily living conditions and surroundings. The IoT-enabled smart city paradigm can be supported by networks of advanced sensors and devices that serve as a basis for providing essential data (Gao et al., 2021).

Hence, the second hypothesis in this study is:

H2. Perceived smart public service significantly influences citizens' well-being.

2.5 Perceived Smart Environment Protection

The concept of PSEP entails the utilization of advanced approaches to safeguard the urban environment. This involves leveraging smart technologies to mitigate air pollutants, monitor environmental conditions, and optimize waste disposal processes.

Minimizing pollution through information and actions becomes increasingly important as smart cities develop. An important component of a city's social infrastructure is garbage management. Research has been done on intelligent garbage management techniques, including online and contactless ones. Environmental engineering has emphasised the importance of using technology to govern intelligent waste management in the process of collecting, treating, and recycling waste. Examples of this technology include virtual reality, traceability systems, self-driving cars, and remote control (Onoda, 2020). Smart environmental pollution monitoring systems with real-time tracking capabilities of various contaminants are urgently needed to achieve the critical goal of smart, sustainable cities with zero emissions (Bibri, 2020).

Hence, the third hypothesis in this study is:

H3. Perceived smart environmental protection significantly influences citizens' well-being.

2.6 Citizen Satisfaction

Contentment can be achieved by contrasting one's reality with one's expectations. An indication of satisfaction is the expression of understandable feelings. As one of the themes surrounding smart cities, the role of technology in driving radical change is noteworthy. Scholarly discourse has begun to question the techno-deterministic perspective that has traditionally underpinned discussions surrounding smart cities (Odendaal, 2021). In recent years, a surge in literature has examined civic governance within urban contexts, taking into account the satisfaction of residents. This shift in focus is attributed to growing apprehensions regarding the integration of advanced information and communication technologies in urban planning (Park & Yoo, 2023). Consequently, several hypotheses have been formulated, including:

H4. Perceived smart infrastructure significantly influences citizen satisfaction.

H5. Perceived smart public service significantly influences citizen satisfaction.

H6. Perceived smart environmental protection significantly influences citizens' satisfaction.

H7. Citizen satisfaction significantly influences citizens' well-being.

H8. Citizen satisfaction as a mediator significantly influences the relationship between perceived smart infrastructure and citizens' well-being.

H9: Citizen satisfaction as a mediator significantly influences the relationship between perceived smart public service and citizens' well-being.

H10: Citizen satisfaction as a mediator significantly influences the relationship between perceived smart environmental protection and citizens' well-being.

2.7 Well-being

Human civilization has never ceased to pursue happiness. The highest aim and ultimate goal of human conduct has always been viewed as happiness (Martela & Sheldon, 2019). The significance and ultimate significance of well-being have been extensively studied by philosophers. Epicurus and Aristotle introduced the concept of happiness (O'Keefe, 2014). Early perspectives either considered pleasure as an external value such as virtue or holiness or as the result of an active and wise lifestyle. Aristotle is credited with creating the concept of perfectionism, which holds that living a morally upright life can result in logical satisfaction, or perfectionist happiness, as determined by predetermined standards (McPherson, 2020).

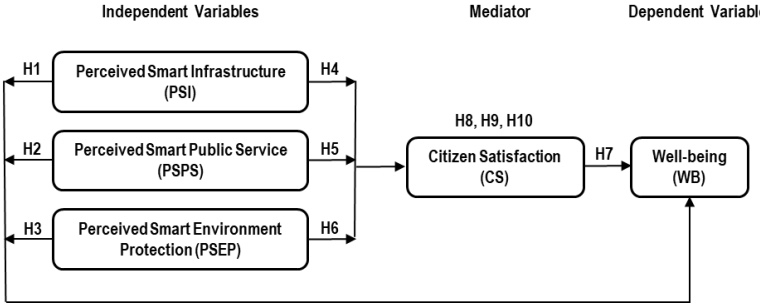

Figure 1: The Research Framework

(Source: Authors)

The ultimate user of the system in smart cities, which operate as social technology systems, is the general populace. Although there is no clear agreement on what smart cities are, most definitions emphasise using ICT to improve residents' quality of life, which is one of their distinguishing features. According to Navarro et al. (2020), urbanization impacts citizens' well-being significantly. An approach based on happiness-driven smart cities has been proposed as a means of guiding smart city development more humanely (Zhu et al., 2022). Literature in several different fields has thoroughly examined the effectiveness of smart cities and their inhabitants' well-being (Guo et al., 2021; Kerstetter et al., 2022).

However, relatively little emphasis has been paid to research on how smart cities affect residents' well-being. Smart cities provide reliable, useful, and convenient information, services, and network interactions that contribute to the sustainability of the city (Lin et al., 2019).

The research framework of this study is illustrated in Figure 1.

3.0 Methodology

A self-administered survey was carried out in Malaysia using Google Forms and in China using Questionnaire Star. The participants were selected through purposive sampling. A total of 245 individuals completed the online survey questionnaires, but only 239 responses were considered valid. Out of the valid responses, 105 were from Malaysia and 134 were from China. The data obtained was analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) to identify the factors contributing to well-being. The concept of smart cities encompasses the notions of PSI, PSPS, and PSEP, as relevant to the research topic. The questionnaire components used in the study are presented in Table 1, and were developed by drawing from the sources listed below.

Table 1: Constructs and the source of items adaptation

Constructs	Studies
PSI	Yu, C., Ye, B., Lin, C., & Wu, Y. J. (2020)
PSPS	Yu, C., Ye, B., Lin, C., & Wu, Y. J. (2020)
PSEP	Yu, C., Ye, B., Lin, C., & Wu, Y. J. (2020)
CS	Chan, F. K., Thong, J. Y., Brown, S. A., & Venkatesh, V. (2021)
Well-being	Pontin, E., Schwannauer, M., Tai, S., & Kinderman, P. (2013)

(Source: Authors)

In both China (70.9%) and Malaysia (56.2%), there was a higher representation of female participants compared to male participants. The majority of respondents in both countries fell within the age range of 21 to 30, with 90% of Chinese respondents being under the age of 30. The survey primarily attracted participants from the student population. In terms of income, the majority of respondents in both Malaysia and China reported monthly salaries below RM8,000. When analyzing the responses for smart cities in Malaysia, it was found that Sarawak contributed the highest number of responses, while the majority of respondents overall were from China. For a comprehensive understanding of the demographic characteristics of the survey participants, please refer to Table 2.

Table 2: Demographic profile for respondents in Malaysia and China

Variable	Item	Malaysia (N=105)		China (N=134)	
		Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
I am currently staying in	Kuala Lumpur / Beijing	14	13.3	3	2.2
	Putrajaya / Shanghai	10	9.5	4	3.0
	Selangor / Zibo	18	17.1	2	1.5

Variable	Item	Malaysia (N=105)		China (N=134)	
		Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
	Johor / Jinan	10	9.5	61	45.5
	Penang / Binzhou	14	13.3	1	0.7
	Sabah / Dezhou	8	7.6	3	2.2
	Sarawak / Dongying	31	29.5	2	1.5
	Guizhou			2	1.5
	Heze			1	0.7
	Jining			8	6.0
	Jinzhou			1	0.7
	Kaifeng			1	0.7
	Laizhou			1	0.7
	Liaocheng			2	1.5
	Linyi			4	3.0
	Qingdao			12	9.0
	Rizhao			1	0.7
	Shenyang			1	0.7
	Shijiazhuang			1	0.7
	Taiyuan			2	1.5
	Taian			10	7.5
	Tianjin			1	0.7
	Weifang			6	4.5
	Xinxiang			1	0.7
	Yantai			2	1.5
	Zhuhai			1	0.7
Age (years)	21-30	53	50.5	121	90.3
	31-40	31	29.5	2	1.5
	41-50	17	16.2	8	6.0
	51-60	1	1.0	1	0.7
	61 and above	3	2.9	2	1.5
Gender	Male	46	43.8	39	29.1
	Female	59	56.2	95	70.9
Highest level of educational attainment	Diploma	26	24.8	10	7.5
	Bachelor	50	47.6	86	64.2
	Master	23	21.9	35	26.1
	DBA/PhD	6	5.7	3	2.2
Marital Status	Single	70	66.7	120	89.6
	Married	35	33.3	14	10.4
Occupation	Academic	14	13.3	6	4.5
	Private	73	69.5	10	7.5
	Government	0	0.0	4	3.0
	NGO	0	0.0	4	3.0
	Student	18	17.1	110	82.1
Management Level	Top Management	12	11.4	2	1.5
	Middle Management	23	21.9	5	3.7
	Executive	16	15.2	3	2.2
	Non-Executive	16	15.2	7	5.2
	Others	38	36.2	117	87.3

Variable	Item	Malaysia (N=105)		China (N=134)	
		Frequency (N)	Percentage (%)	Frequency (N)	Percentage (%)
Household Income level (monthly)	RM 1001 - 3000 / RMB 1001 - 3000	18	17.1	16	11.9
	RM 3001 - 4000 / RMB 3001 - 4000	25	23.8	17	66.0
	RM 4001 - 6000 / RMB 4001 - 6000	24	22.9	25	18.7
	RM 6001 - 8000 / RMB 6001 - 8000	12	11.4	19	14.2
	RM 8001 - 10,000 / RMB 8001 - 10,000	6	5.7	19	14.2
	RM 10,001 - 12,000 / RMB 10,001 - 12,000	2 (1.9)	1.9	12	9.0
	RM 12,001 - 15,000 / RMB 12,001 - 15,000	2	1.9	8	6.0
	Above 15,000 / Above 15,000	1	1.0	15	11.2
	Not Applicable	15	14.3	3	2.2
Ethnicity	Malay / Han	17	16.2	129	96.3
	Chinese / Others	82	78.1	5	3.7
	Indian	3			
	Others	3			
Do you have any children?	Yes	27	25.7	13	9.7
	No	78	74.3	121	90.3

(Source: Authors)

4.0 Results

The outcomes of the measurement model are displayed in Table 3, providing a comprehensive overview of the analysis results. Additionally, the findings from the hypothesis testing are presented in Table 4, shedding light on the significance of the relationships examined. The results of the path analysis and bootstrapping, conducted for both Malaysia and China individually, as well as for the combined analysis of these two countries, are visually depicted in Figures 2 to 7. Notably, the level of CS in China, as indicated by an R^2 value of 0.864, can be attributed to the combined effects of PSI, PSPS, and PSEP.

Table 3: Results of measurement model: Combination of two countries (N=239)

Constructs	Items	Factor loadings	CR	AVE
PSI	6	0.857-0.940	0.952	0.802
PSPS	4	0.752-0.939	0.930	0.787
PSEP	4	0.821-0.956	0.951	0.847
CS	3	0.929-0.946	0.933	0.879
Well-being	9	0.717-0.865	0.941	0.672

(Source: Author)

Table 4: Results of hypothesis testing in Malaysia, China and the combination of two countries

Hypothesis	Relationship	T statistics	P-values	Results
H1	PSI → Well-Being	MAL: 0.224	MAL: 0.412	MAL: Rejected
		CHI: 0.194	CHI: 0.423	CHI: Rejected
		COM: 0.027	COM: 0.489	COM: Rejected
H2	PSPS → Well-Being	MAL: 1.962	MAL: 0.025	MAL: Accepted
		CHI: 0.784	CHI: 0.216	CHI: Rejected

Hypothesis	Relationship	T statistics	P-values	Results
		COM: 1.899	COM: 0.029	COM: Accepted
H3	PSEP → Well-Being	MAL: 1.312	MAL: 0.095	MAL: Rejected
		CHI: 0.453	CHI: 0.325	CHI: Rejected
		COM: 0.238	COM: 0.406	COM: Rejected
H4	PSI →CS	MAL: 0.721	MAL: 0.236	MAL: Accepted
		CHI: 1.339	CHI: 0.090	CHI: Rejected
		COM: 1.326	COM: 0.093	COM: Rejected
H5	PSPS →CS	MAL: 2.458	MAL: 0.007	MAL: Accepted
		CHI: 2.382	CHI: 0.009	CHI: Accepted
		COM: 3.838	COM: 0.000	COM: Accepted
H6	PSEP → CS	MAL: 5.676	MAL: 0.000	MAL: Accepted
		CHI: 5.215	CHI: 0.000	CHI: Accepted
		COM: 7.921	COM: 0.000	COM: Accepted
H7	CS → Well-Being	MAL: 0.170	MAL: 0.433	MAL: Rejected
		CHI: 2.361	CHI: 0.009	CHI: Accepted
		COM: 1.676	COM: 0.047	COM: Accepted
H8	PSI →CS → Well-Being	MAL: 0.090	MAL: 0.464	MAL: Rejected
		CHI: 1.097	CHI: 0.136	CHI: Rejected
		COM: 0.939	COM: 0.174	COM: Rejected
H9	PSPS →CS → Well-Being	MAL: 0.153	MAL: 0.439	MAL: Rejected
		CHI: 1.683	CHI: 0.046	CHI: Accepted
		COM: 1.416	COM: 0.078	COM: Rejected
H10	PSEP → CS → Well-Being	MAL: 0.173	MAL: 0.431	MAL: Rejected
		CHI: 2.087	CHI: 0.018	CHI: Accepted
		COM: 1.692	COM:0.045	COM: Accepted

(Source: Authors)

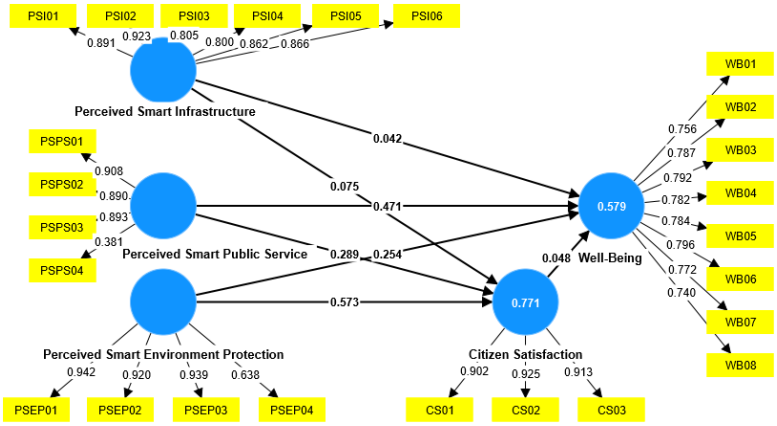

Figure 2: Path analysis results: Malaysia (N=105)

Based on the findings presented in Figure 2, the R^2 value for the relationship between PSI (PSI01-PSI06), PSPS (PSPS01-PSPS04), PSEP (PSEP01-PSEP04), and well-being (WB01-WB08) is 0.579. On the other hand, the R^2 value for CS (CS01-CS03) is 0.771,

which is higher than the effect on well-being. This indicates that the model can explain 77.1% of Malaysian citizens' satisfaction and 57.9% of their well-being.

This bootstrapping study shows that PSPS (PSPS01-PSPS04), PSEP (PSEP01-PSEP04), and PSI (PSI01-PSI06) are related to well-being (WB01-WB08) and that CS (CS01-CS03) has a mediating effect on well-being.

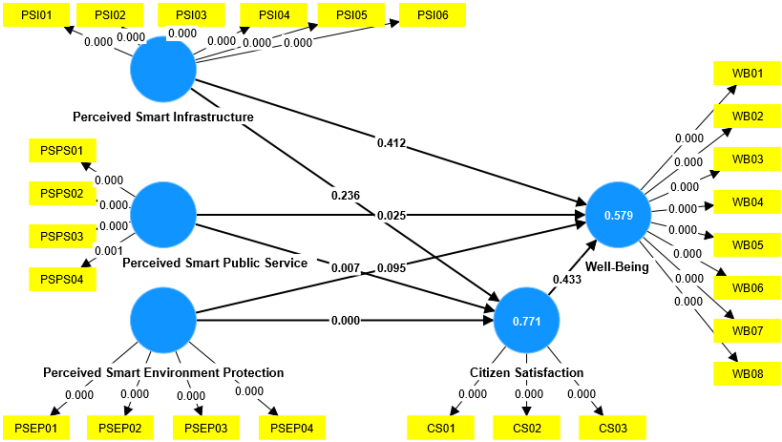

Figure 3: Bootstrapping results: Malaysia (N=105)

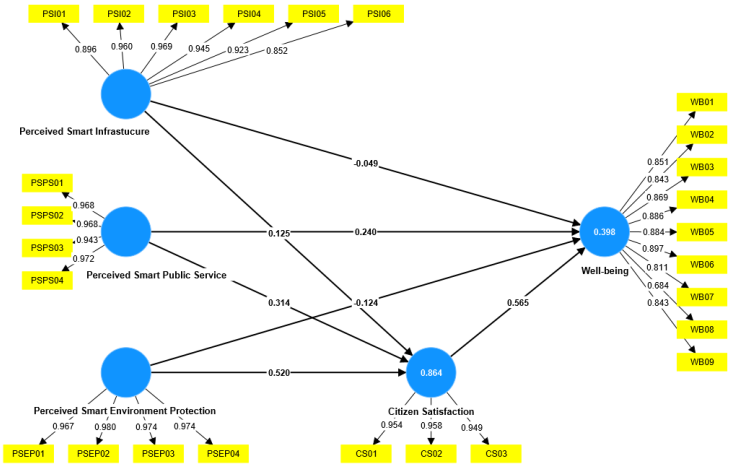

Figure 4: Path analysis results: China (N=134)

As depicted in Figure 4, the coefficient of determination (R^2) for the relationship between PSI (PSI01-PSI06), PSPS (PSPS01-PSPS04), PSEP (PSEP01-PSEP04), and well-being

(WB01-WB08) is 0.398, suggesting a moderate effect. In contrast, the R^2 value for CS (CS01-CS03) is 0.864, indicating a higher level of impact compared to well-being. The model implies that 39.8% of Chinese citizens' well-being can be attributed to the factors examined, while their satisfaction level is influenced by 86.4%.

Additionally, a bootstrapping analysis was conducted to examine the T-values of PSI, PSPS, PSEP, and their mediating effect through CS on well-being in China.

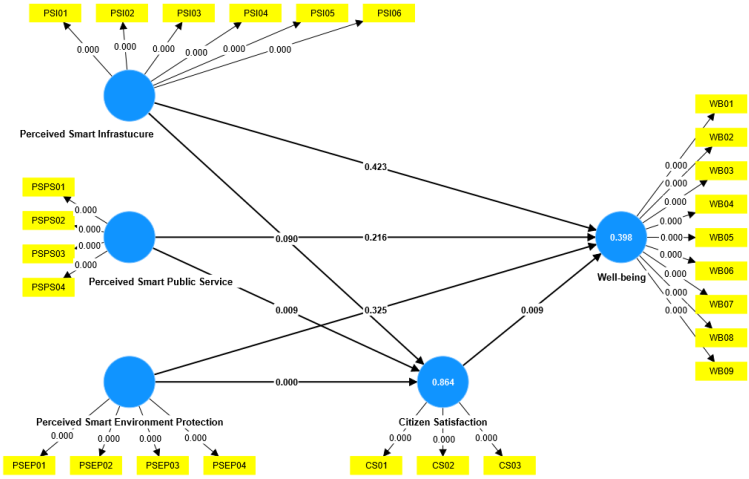

Figure 5: Bootstrapping results: China (N=134)

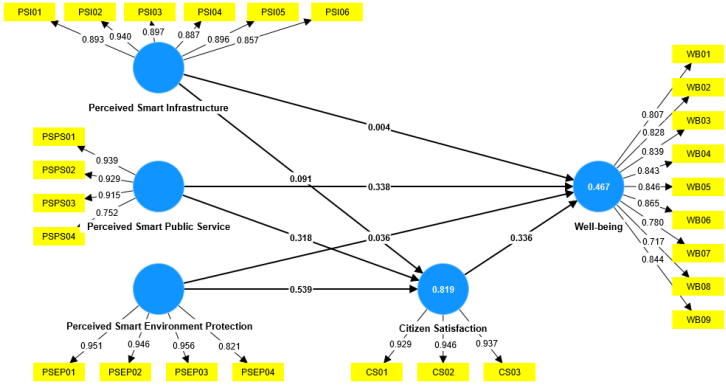

Figure 6: Path results: Combined analysis of two countries (N=239)

In Figure 6, it is observed that CS (CS01-CS03) has a higher R^2 value of 0.81 compared

to the well-being effect. On the other hand, the R^2 value for PSI (PSI01-PSI06), PSPS (PSPS01-PSPS04), and PSEP (PSEP01-PSEP04) in relation to well-being (WB01-WB08) is 0.467. The model suggests that 46.7% of the impact on well-being and 81.9% of CS can be attributed to the combined influence of these factors in Malaysia and China.

Furthermore, bootstrapping analysis was conducted to examine the T-values for PSI, PSPS, PSEP, and CS's mediating effects on well-being in both Malaysia and China.

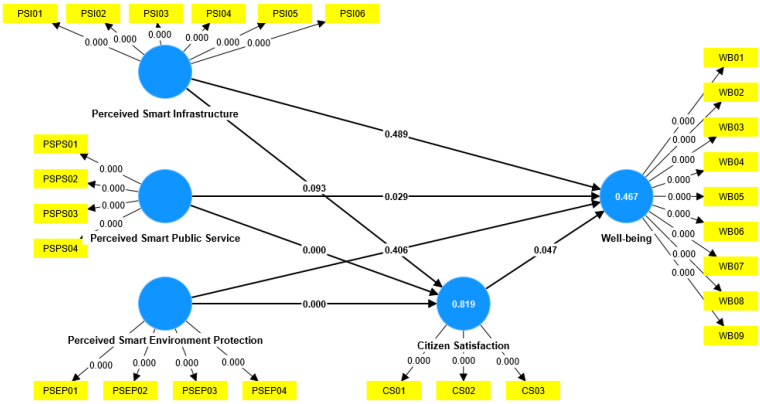

Figure 7: Bootstrapping results: Combined analysis of two countries (N=239)

5.0 Discussion

According to the research, there is no conclusive evidence linking well-being to the infrastructure, public services, or environmental protection of so-called smart cities. However, well-being has a substantial link with these categories when CS serves as a mediator for these dimensions. This suggests that when citizens reach a particular level of happiness, their well-being becomes meaningful and applicable within the framework of smart cities. This finding supports the argument put forth by McPherson (2020) that leading a morally upright life contributes to overall happiness. The perceived smart environment protection is the component that stands out the most in this situation. The well-being of the population of any country will not improve as a result of environmental protection. In Malaysia, only the public services offered by smart cities have a discernible impact on the well-being of their residents. It's also important to note that in neither country can smart infrastructure alone improve citizen well-being. The idea still holds for intelligent environmental conservation. One obvious result is that, even though CS served as a mediator for the impact of smart city infrastructure, the well-being of citizens was unaffected. Citizens perceive such infrastructure as essential and fundamental to their daily lives. However, it should be noted that enhancing infrastructure alone is not enough to improve citizens' well-being in smart cities. According to Khalil et al. (2022), smart public services

play a vital role in enhancing the happiness and well-being of urban residents. The findings of this study support the notion that the provision of quality public services and the preservation of the environment in smart cities directly influence residents' satisfaction. Notably, the combined data for PSEP exhibit a significant correlation between these two constructs (t-value: 7.921).

6.0 Conclusion

The study successfully achieved its objectives, which involved assessing the influence of citizens' PSI, PSPS, and PSEP on well-being. The strong association between the degrees of satisfaction among citizens, which serves as a mediator in influencing the citizens' well-being, was also successfully measured. The PLS-SEM study concludes that neither Malaysian nor Chinese citizens' well-being is directly impacted by smart infrastructure. While upgrading outdated infrastructure to new ones may be referred to as "smart infrastructure," this does not guarantee that its residents would be happier as a result. The use of renewable energy and the decrease in pollution also does not appear to have any direct effects on the happiness or well-being of the residents of either country, according to the results of smart environmental protection. Happiness or well-being is highly subjective and not wholly dependent on the surrounding environment. According to the perception of the inhabitants of both countries, smart public service and environmental conservation have a substantial impact on the degree of CS.

The findings of the study emphasize the significance of systematic PSI, PSPS and PSEP in sustaining the levels of happiness and satisfaction among citizens. Smart city initiatives play a pivotal role in shaping people's emotional well-being as an integral component of the urbanization process, and they have the potential to influence citizen happiness by aligning expectations with reality. However, it is interesting to note that, when considering smart infrastructure, public satisfaction does not appear to impact the well-being of any country. This study presents micro-level statistics that highlight the significance of smart city initiatives in promoting the residents' well-being, aligning with the objectives of SDG 3 and SDG 11. These findings provide empirical evidence for the positive impact of smart city projects on creating sustainable and thriving urban environments.

7.0 Suggestion for Future Research

Because this study focuses on only two Asian nations, demographic factors may have an impact on its results. Additionally, this study only collects quantitative data, which has limited explanatory power and cannot fully account for the study's findings. As a result of funding limitations, this study did not include control variables, which makes the results less trustworthy. Future studies should concentrate on gathering citizen-submitted qualitative data before conducting a questionnaire survey to triple-check the data's generalizability. Data comparison between Asia and Western nations should be a part of smart cities research's future focus. Further investigation is warranted to explore additional dimensions

of well-being, including aspects such as security, health, and happiness among the population. While this study has focused on specific aspects related to smart city initiatives, it is important to comprehensively examine the broader spectrum of well-being indicators to gain a comprehensive understanding of the impact of these initiatives on the overall quality of life in urban settings.

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Article Contribution to Related Field of Study
Given the significance of these factors in urban development, policymakers should prioritize the welfare and happiness of their population. The findings of this study hold relevance for academic researchers as the survey focused on the well-being and satisfaction levels of citizens in areas with limited existing literature. These results contribute to a better understanding of the crucial connection between PSPS and PSEP in relation to residents' well-being in smart cities, encompassing both Malaysia and China. By shedding light on this link, researchers can gain insights into the key aspects that contribute to the overall well-being of residents in smart city contexts in these two nations.

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Appendix Measurement Items

Constructs and Items
Well-being
1. I am happy with my personal and family life.
2. I am happy with my physical health.
3. I am happy with the quality of my sleep.
4. I am happy with my ability to perform daily activities.
5. I am happy with my friendships and personal relationships.

6. I am comfortable about the way I relate and connect with others.
7. I am able to ask for someone's help when I have a problem.
8. I am happy that I have enough money to meet my needs.
9. I feel optimistic about the future.
Perceived smart infrastructure
1. There is a high level of perceived smartness in the transport system in my city
2. There is a high level of perceived smartness in the information infrastructure in my city
3. There is a high level of perceived smartness in the electrical grid in my city.
4. There is a high level of perceived smartness in the water network in my city.
5. There is a high level of perceived smartness in the logistics network in my city.
6. The technology of the Internet of Things (IoT) in my city is developing rapidly
Perceived smart public service
1. There is a high level of perceived smartness in public health services in my city.
2. There is a high level of perceived smartness in social security in my city.
3. There is a high level of perceived smartness in digital education in my city.
4. There is a high level of perceived smartness in the construction services in my city.
Perceived smart environment protection
1. There is a high level of perceived smartness in the pollution control in my city.
2. There is a high level of perceived smartness in the waste management in my city.
3. There is a high level of perceived smartness in the environment monitoring in my city.
4. There is a high level of perceived smartness in the usage of renewable energies in my city.
Citizen satisfaction
1. I am satisfied with the smart city initiatives in my city.
2. I adopt and use new functions generated by smart city initiatives in my city.
3. Smart city initiatives have helped me in my daily life.