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Community Readiness for Smart Cities in Egypt: New Cites as a Case Study

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ABSTRACT

The global trend toward implementing smart cities as a strategy for urban innovation has gained significant momentum in recent years, with countries worldwide, including Egypt, actively embracing this approach. Despite the widespread adoption of smart city initiatives, numerous implementations have encountered challenges. A critical challenge is the need for "smart" citizens who actively participate, interact with, and benefit from new technologies and practices. Furthermore, the lack of citizens' awareness and knowledge of communication technologies impacts the effective functioning of smart city governance. Recognizing the importance of community inclusion in the success of smart city initiatives, this research assesses the community readiness of residents in two new cities in Egypt: El-Sheikh Zayed and Badr. The study employed questionnaires distributed to residents of both cities, differentiating responses based on age groups, average income, education levels, occupation and housing level. By evaluating variables related to community readiness for smart cities—community awareness, perceived usefulness, perceived ease of use, security and privacy, and behavioral intention—this research aims to gain crucial insights into the level of community readiness for such transformations. The findings indicate varying levels of community readiness in the two cities, leading to tailored policy recommendations for qualifying community transformation. In addition, the research emphasizes that smart cities must achieve social inclusion of all citizens, regardless of their demographic and socio-economic characteristics.

KEYWORDS
Smart City – Community Readiness – New City – Digital Divide – Social Awareness.

جاهزية المجتمع لتطبيق المدن الذكية في مصر: دراسة حالة المدن الجديدة

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ملخص البحث

اكتسب الاتجاه العالمي نحو تنفيذ المدن الذكية كإستراتيجية للإبتكار العمراني زخمًا كبيرًا في السنوات الأخيرة، حيث تبنت دول العالم، بما في ذلك مصر، هذا الاتجاه بنشاط ملحوظ. وعلى الرغم من التبني الواسع النطاق لمبادرات المدن الذكية، فقد واجهت العديد من التطبيقات تحديات، ويتمثل التحدي الحاسم في الحاجة إلى مواطنين "أذكياء" يشاركون بنشاط ويتفاعلون ويستفيدون من التقنيات والممارسات الجديدة. وعلاوة على ذلك، فإن افتقار المواطنين إلى الوعي والمعرفة

بتقنيات الاتصال يؤثر على الأداء الفعال لحوكمة المدينة الذكية. وإدراكًا لأهمية إدماج المجتمع في نجاح مبادرات المدينة الذكية، يقيم هذا البحث جاهزية المجتمع لسكان مدينتين جديدتين في مصر: الشيخ زايد وبدر. حيث استخدمت الدراسة استبيانات تم توزيعها على سكان المدينتين، وتم تمييز الاجابات على أساس الفئات العمرية ومتوسط الدخل ومستويات التعليم والمهنة ومستوى الإسكان، من خلال تقييم المتغيرات المتعلقة باستعداد المجتمع للمدن الذكية والوعي المجتمعي، والفائدة المتوقعة، وسهولة الاستخدام، والأمن والخصوصية، والنية السلوكية، ويهدف البحث إلى اكتساب رؤى حاسمة حول مستوى جاهزية المجتمع لمثل هذه التحولات. وتشير النتائج إلى مستويات متفاوتة من جاهزية المجتمع في المدينتين، مما يؤدي إلى توصيات استراتيجية مصممة خصيصًا لتأهيل التحول المجتمعي. بالإضافة إلى ذلك، يؤكد البحث على أن المدن الذكية يجب أن تحقق الإدماج الاجتماعي لجميع المواطنين، بغض النظر عن خصائصهم الديموغرافية والاجتماعية والاقتصادية.

الكلمات المفتاحية: المدينة الذكية - جاهزية المجتمع - المدينة الجديدة - الفجوة الرقمية - الوعي الاجتماعي.

1. Introduction

The significance of understanding the community's readiness for change becomes evident with the implementation of major initiatives, interventions, and projects that impact community life. Recently, there has been a growing research interest in examining the readiness of communities in various contexts, such as special economic zones (Azizurrohman et al., 2023), tourism (Wijaya et al., 2020; Prayitno et al., 2022; Sayuti, 2023), and other contexts. One of these contexts is smart cities (Staletić et al., 2020), as they are considered a significant change that requires the community's preparation and readiness. By evaluating community readiness, governments can ensure a successful implementation of smart city projects that meet the needs and expectations of their citizens (Antoni et al., 2020)., The smart cities concept is about creating cities that utilize information and communication technologies (ICT) to enhance the quality of urban services, reduce costs, and engage more effectively with citizens (Hamed et al., 2016b). Moreover, smart city initiatives are considered essential for modern urban development as they offer numerous benefits in terms of economic growth, improved quality of life, and sustainable development (Anthopoulos, 2017). This was practically proven as recent research has established that the usage of smart city services has a positive impact on citizens' quality of life (Lee, 2023; Yeh, 2017). However, in order for smart cities to be truly sustainable, they should aim to improve the quality of life for all citizens, ensuring inclusive digital infrastructure and education to ensure equitable access to smart city benefits (Monfaredzadeh & Krueger, 2015), this is because the digital divide can exacerbate social inequalities (UN-Habitat, 2021).

1.1. Citizen-Centric Approach towards Smart Cities

Investigating smart cities is a continuing concern within urban planning, yet, the complexity of smart city initiatives and the critical factors that influence their success requires in-depth investigations into each of these factors. One of the six main dimensions of smart cities is smart people/ citizens (Hamed et al., 2016a), and aiming for more inclusive, adaptable, and context-specific approaches to developing smart cities that truly benefit the whole community is one of its main challenges (Mutambik et al., 2023). Cities that have successfully implemented smart city initiatives tend to adopt a citizen-centric approach, prioritizing the needs and preferences of their citizens and ensuring transparency in the use of data and technologies (Lee, 2023; Mutambik et al., 2023; Wirsbinna et al., 2023). Also, this is what was concluded in Staletic (2020) study that user-centric approaches towards smart city services should align with citizen expectations (Staletić et al., 2020). Equally important, is the consideration of citizens' satisfaction levels to increase the adoption and use of smart city services.

Understanding the factors that influence community acceptance or rejection of smart city technologies, including age, education, and occupation, is crucial for the successful implementation of these initiatives (Alderete, 2021; Wirsbinna et al., 2023). Various models have been developed to assess the interaction between citizens and technology, with the Technology Acceptance Model (TAM) being one of the most widely used. TAM offers a framework for evaluating and enhancing citizen engagement with smart city services, ultimately improving urban quality of life and addressing urban challenges (Lee, 2023). By employing TAM, researchers can analyze levels of citizen satisfaction with smart city services and identify the key factors that influence user acceptance of these technologies. Another noted model is the Unified Theory of Acceptance and Use of Technology (UTAUT), which explains and predicts user acceptance and behavior toward technology, and directly determines technology use behavior and behavioral intention. These constructs are moderated by variables such as age, gender, experience, and voluntariness of use, making UTAUT a comprehensive framework integrating variables from eight established models (Xue et al., 2024). Additionally, a comprehensive model combining elements from three frameworks has been developed to evaluate smart city readiness from a citizen's perspective. This model considers factors such as competent human resources, ICT policies, and community participation, providing a robust framework for measuring the success of smart cities (Setijadi et al., 2019). Furthermore, the General Usability and Acceptance Model for Technology Use (GUAM) incorporates user expectations, institutional support, social influence, and perceived system expectations, leading to significant improvements in behavioral intention and technology use (Obienu & Amadin, 2021). Thus, for governments to ensure the successful implementation of smart city initiatives, continuous evaluation of community readiness is essential to identify and address gaps (Antoni et al., 2020). Moreover, raising community awareness and fostering a positive perception of smart cities through various awareness tools are critical for the sustainability of these initiatives (Chong et al., 2022).

1.2. Measuring Community Readiness for Smart Cities

In line with the Egyptian government’s plan for digital transformation, the Ministry of Housing, Utilities and Urban Communities (MoHUUC) has a strategy for new smart cities through establishing a group of new smart sustainable cities -fourth-generation cities-, in addition to its plan for transforming previous generations of new cities into smart and sustainable cities through technological interventions that suit the context and needs of each city (Alborsaa, 2024) (MoHUUC, 2024). However, as discussed earlier, a major challenge with this kind of transformation is community readiness. This issue has led the research to explore whether the community of these new cities in Egypt is ready for such a transformation.

The importance and originality of this study lie in its focus on community readiness for smart cities. Since the 1980s, research on community acceptance of technology has led to the development of numerous models applied across various countries and domains (Lai, 2017). Recent studies, such as those conducted in the UAE, suggest that while technological and platform attributes are important, social factors and citizens' readiness play a more significant role in the adoption and utilization of smart city services (El Barachi et al., 2022). Similarly, research in Taiwan, concluded that high service quality, robust privacy protection, and the building of trust among citizens are the most crucial variables for the successful adoption of smart cities (Yeh, 2017). In the City of Denton, USA, Habib et al (2020) found that addressing privacy concerns and

building trust is essential for the successful implementation and adoption of smart city technologies (Habib et al., 2020). Likewise, studies in Jordan have shown that security, privacy, and information are the key factors influencing citizens' adoption of smart city technologies (Nusir et al., 2023). In South Korea, research on Seoul's community readiness for smart services revealed that awareness levels, acceptance factors, and the intention to use smart city services are crucial determinants of success (Lee, 2023). Building on this extensive background, the present research conducted an in-depth analysis of these frameworks to identify the most influential variables for assessing community readiness for smart cities. The variable selection process involved categorizing the identified variables into three distinct groups, as outlined in Table 1, based on their frequency of occurrence in the literature and their relevance to assessing community readiness for smart city adoption. Two of these groups were included in the assessment framework due to their direct influence on community acceptance: the primary variables, which directly reflect community readiness, and the sub-variables, which are closely integrated with the primary variables. The third group includes the excluded variables, which were rarely mentioned in previous studies, indicating their limited importance in assessing community readiness. Consequently, six variables were selected to form the foundation of the community readiness assessment framework, which are elaborated in the next sections.

1.2.1. Communities Awareness

In the context of smart cities, community awareness indicates the residents' knowledge and understanding of the smart city initiatives in their city. For a smart city to be effective, its residents must be aware of its existence and functionalities. Some researchers concluded that the implementation of smart city services using digital infrastructure was not effective, as it still needs to enhance awareness and usage among residents (Chong et al., 2022).

1.2.2. Perceived Usefulness

This variable refers to the degree to which individuals believe that a particular technology will enhance their work performance and overall quality of life. Perceived usefulness covers the expected benefits of smart city initiatives, such as improved quality of life, reduced operational costs for city services, resolution of urban environmental issues, and enhanced safety (Lee, 2023). Studies have demonstrated that when people perceive that smart city technologies can bring tangible benefits, such as increased convenience, and efficiency, they are more likely to adopt these technologies (Nusir et al., 2023).

1.2.3. Perceived Ease of Use

Perceived Ease of Use refers to the degree to which individuals believe that using a particular information system is free of effort and not difficult. This concept is a critical determinant in the successful adoption and implementation of smart city initiatives (Lee, 2023). It is emphasized that even highly educated users have concerns about the ease and efficiency of using smart city services, suggesting that perceived complexity can hinder their interaction (M. Lytras & Visvizi, 2018).

1.2.4. Security and Privacy (Trust in Technology)

This variable discusses the confidence that residents have in the security and privacy of smart city technologies, which significantly influences their willingness to adopt and use these services. Trust in technology is closely tied to perceived security and perceived privacy, where residents need assurance that their data is safe and used appropriately. Studies have shown that concerns about security breaches, data leakage, and external threats can prevent residents from using smart city services (Habib et al., 2020; Lee, 2023). As highlighted by Yeh (2017), residents are more likely to embrace smart city services if they perceive them as secure, private, and beneficial (Yeh, 2017).

1.2.5. Behavioural intention

Behavioural intention measures how committed a person is to engage in a particular activity. According to Habib et al (2020), behavioural intention is a crucial determinant of whether individuals will accept and utilize new technologies (Habib et al., 2020). This concept includes both neutral acceptance, where an individual acknowledges a technology without judgment, and acceptance above neutral, where an individual values and trusts the technology (Wirsbinna et al., 2023). Thus, behavioural intentions are fundamental in predicting the successful implementation and user engagement with smart cities.

1.2.6. Community Participation

Smart city requires residents' involvement in the planning, implementation, and utilization of its technologies and services. Therefore, active community participation brings valuable insights and feedback, making smart city solutions more citizen-centric and effective (M. D. Lytras et al., 2021). Engaged residents are more likely to adopt and support smart city initiatives, feeling a sense of ownership and investment in their city's transformation (Wirsbinna et al., 2023). The success of smart cities is closely linked to the level of resident participation and their positive attitudes towards these technological advancements as they enable residents to contribute to decision-making processes (Alderete, 2021).

Table 1 shows the ccategories of smart city readiness assessment variables and the number of repetitions they appear in theoretical studies.

Table 1. Variables of community readiness assessment and their frequency of repetition

Categories	Variables (and their equivalents)	No. of repetitions
Main variables that reflect the assessment of the community readiness	Trust in Technology/ Perceived Security /Perceived Privacy/Perceived Risk/Insecurity/Security and Privacy/ Mistrust	9
	Local Communities Awareness / Local Communities Perception /Positive Attitude /Smart Cities Prioritization/ Awareness	6
	Perceived Ease of Use / User Characteristics /Self-Efficacy	5
	Perceived Usefulness /Effort Expectancy / Quality	5
	Community Participation / Empowerment / Social Influence	4
	Behavioral intention/ Attitude Toward Using / Intention to Accept	4
Sub-variables to be included within main variables	Trust in Government / E-government	3
	Internet Usage Behavior / Use of the Internet / ICT Infrastructure & Internet Connectivity	3
	Price Value	2

Variables to be excluded	Optimism	1
	Human Resources	1
	Empowerment	1
	Actual System Use	1
	Trialability	1
	Sustainability of Smart Cities	1
	Observability	1
	Legal Considerations	1
	Compatibility	1
	Innovativeness	1
	Discomfort	1

Source: The authors based on (Alderete, 2021; Antoni et al., 2020; Chong et al., 2022; El Barachi et al., 2022; Habib et al., 2020; Hamdan & Aldhaen, 2024; Lee, 2023; M. D. Lytras et al., 2021; Nusir et al., 2023; Wirsbinna et al., 2023)

2. Methods

2.1. City Selection

The MoHUUC plan for the fourth generation of new cities has been prepared from the outset to be smart cities. Correspondingly, a strategy is being prepared to formulate the characteristics of new smart cities in Egypt through developing a plan to transform the first, second and third generations of new cities into smart cities, alongside the development of the fourth-generation cities (MoHUUC, 2024). This research was inspired by the assumption that as these cities of the Correspondingly first, second and third generations transform smart cities, the community's readiness to engage with smart technologies will become a critical factor in their success. While the research concept applies broadly to all urban areas integrating technology into daily life, the focus on new cities was chosen due to their advanced stage of planning and proximity to smart transformation. Specifically, El-Sheikh Zayed and Badr cities were selected as case studies because they are central to the smart city strategy, as pilot case studies, currently being implemented (MoHUUC, 2024), making them ideal candidates for assessing community readiness for smart city adoption.

As Egypt embarks on its Integrated Urban Land Management initiative, the government selected El-Sheikh Zayed City to be an applied model for this initiative (Reda, 2023). Likewise, as part of Egypt’s national urban policy, which introduced the concept of smart cities that respond to the needs of citizens, Badr City has joined the K-City Network to finance its transformation into a smart city (Al-Ahram, 2024). Accordingly, this research has used a purposeful sampling approach to select cases that are most likely to yield appropriate and representative results; El-Sheikh Zayed and Badr cities. Additionally, there are secondary reasons that enhance this selection such as; having diverse demographics, socio-economic composition, and differences in the level of access to technology. Both El-Sheikh Zayed City and Badr City are new Egyptian cities of the second generation of new cities. El-Sheikh Zayed City is located in the Giza Governorate. It was established in 1995 with an area of about 9,500 acres. The population of El-Sheikh Zayed City in 2023 is about 450,000 people. It is an integrated city with all services, facilities and large green areas with an area of 40% of its total area. While Badr City is located in Cairo Governorate. It was established in 1982 with a total area of around 18.5 thousand acres. The city's population is about 350,000 people, in 2023. Badr City includes many services and is connected to several regional networks (New Urban Communities Authority, n.d.).

2.2. Data Collection

This study utilized a mixed-methods approach to assess community readiness for the implementation of smart cities in El-Sheikh Zayed and Badr cities. Both qualitative and quantitative methods were employed. First, the qualitative methods, through analyzing existing literature and previous studies related to the topic of community readiness to smart cities to contextualize the main variables that were discussed to rely on in creating the community readiness assessment framework. Second, the quantitative methods, where secondary data from different sources summaries the social and economic characteristics of both cities. The research referred to the Atlas of Egyptian Cities (World Bank Group, 2023), the Egyptian National Urban Observatory, and the Central Agency for Public Mobilization and Statistics, which were used in formulating the questionnaire questions. Second, the structured questionnaires, which was distributed among residents of both cities to gather quantitative data on various themes related to community readiness. The questionnaire was divided into seven themes (Table 2).

Table 2. The questionnaire sections

Variables	Aim	Questions Overview
Basic Information	Identify the basic characteristics of the community in terms of the different categories and link them to the variables.	Gender, age, educational level, occupation, average income level, and ownership of smart devices
Community Awareness	Measures the level of awareness and understanding of smart city concepts among community members.	The extent of the community's knowledge of the transformation of new cities into smart cities in Egypt, the extent of their knowledge of the existence of smart services and their usage, and the extent of their knowledge of the existence of initiatives to transform the city into a smart city.
Perceived Usefulness /Benefits,	Assesses the perceived benefits and usefulness of smart city technologies and initiatives.	Benefits perceived when citizens used modern technology applications related to the smart city, such as increasing productivity at work - improving the quality of life - saving time and effort - improving transportation services - …)
Perceived Ease of Use (User Capabilities)	Evaluate the community's perceived ease of using smart city technologies and their capabilities in adapting to these technologies	Mentioning the type of smart applications that are being dealt with - mentioning the extent of availability of the city's physical and technological infrastructure, and the degree of its efficiency, ...)
Security and Privacy (Trust in Technology),	Measures the level of trust in the security and privacy of smart city technologies.	This comes by asking a set of questions such as (the possibility of disclosing the user's personal data/work data to facilitate the provision of appropriate smart services / mentioning the specific type of transactions that are reliable in conducting them during modern smart applications....)
Behavioral Intention Regarding the Use of Technology Applications	Assesses the community's intention to use smart city technologies and applications.	The rate of internet usage/ the daily activities dependent on internet use/ the degree of readiness/desire to use smart applications in different activities like using e-government services, online shopping, smart transportation applications...
Community Participation	Evaluates the level of community participation and engagement in smart city initiatives.	Interest in participating in transforming their city into a smart city, the importance of community participation and support in decision-making, suggestions that make smart city services easier to use and more acceptable by the community

Source: The authors based on the literature review

Regarding the questionnaire, the initial phase involved conducting a pilot survey, which was evaluated by five experts in the field of smart cities to ensure clarity and ease of the questions for the participants. Following this validation, the electronic questionnaire was distributed among the citizens of both cities, where the objectives of the questionnaire were clearly stated at the beginning of the questionnaire, and specific and clear questions were asked. An appropriate scale was also used to measure participants' responses, a five-point Likert scale (1 to 5) was used. Moreover, the sample size was determined in accordance with Krejcie and Morgan's (1970) sampling guidelines, this study employed a random sampling method with a 90% confidence level and an approximate margin of error of 5% (Krejcie & Morgan, 1970). Based on the 2023 population census, El-Sheikh Zayed required a minimum sample size of 273 individuals, yet the study successfully collected 411 responses, more than the required sample size. Similarly, Badr City, necessitated a minimum sample size of 173 individuals, while 89 responses were obtained.

2.3. Data Analysis

The data analysis for this study aimed to provide actionable insights into the community readiness for smart city transformation in El-Sheikh Zayed and Badr cities. A comprehensive analysis was conducted using the SPSS software, structured across five key steps: reliability analysis, weighting, hierarchical cluster analysis, correlation, and factor analysis. Firstly, a reliability analysis was performed to assess the measurement scales and the items that compose these scales (Field, 2009). The Cronbach's Alpha model was employed to evaluate the internal consistency of the items within each variable, thereby validating the reliability of the questionnaire. The analysis, which encompassed all twenty-three items across six variables, yielded a Cronbach's Alpha of 0.708, indicating a satisfactory level of internal consistency and confirming the reliability of the measurement tool. Secondly, the study applied weighting to the data based on age to ensure that all demographic classes within smart cities were appropriately represented. In addition, descriptive statistics and cross-tabulations were then utilized to summarize and validate the findings of the questionnaire. The third step involved hierarchical cluster analysis, which was employed to classify the questionnaire variables and identify the most significant and efficient variables influencing the results (Field, 2009). This analysis led to the selection of thirteen out of the twenty-three variables as being highly influential. In the fourth step, correlation analysis was conducted to explore the relationships between community readiness variables and various population characteristics, including income, gender, age, educational level, occupation, and housing status. The correlations were measured using either the Phi and Cramer's V coefficients for nominal and ordinal variables, or the Gamma coefficient for ordinal variables. Statistical significance was set at $p < 0.05$. The correlations were categorized into strong, moderate, weak, and insignificant, providing insights into the influence of demographic and socio-economic factors on community readiness. Finally, the fifth step calculated community readiness scores for each variable across both cities, as well as the overall readiness for each city. Factor analysis was utilized in this step to reduce the data and identify a smaller number of factors that explained most of the variance observed in the dataset (Field, 2009). The geometric mean was then used to calculate the overall readiness scores for each variable and the cities as a whole. This method allowed the determination of five groups, shown in Table 3, that represent varying levels of readiness, which are: unprepared, not ready, fairly ready, ready, and very ready.

Table 3. Community Readiness Categories

Readiness score	**< 5**	**5 - 15**	**15 - 25**	**25 - 35**	**> 35**
Readiness categories	Unprepared	Not Ready	Fairly Ready	Ready	Very Ready

3. Results

As outlined in the data analysis section, this study examined six key variables to assess community readiness for smart city transformation in Egypt. The results section is organized into three parts. The first part provides an overview of the respondents' profiles from both El-Sheikh Zayed and Badr cities, highlighting the demographic and socio-economic characteristics of the two cities and the questionnaire respondents. The second part presents the correlation analysis between the six variables of community readiness and the six identified community characteristics, focusing on the significance of these relationships. Finally, the third part details the analysis of community readiness levels for each variable across both cities, offering a comprehensive understanding of the findings.

3.1. General Overview of Community Demographic and Socio-economic Characteristics

Based on CAPMAS (2019), indicators for the socio-economic characteristics of the residents of El-Sheikh Zayed and Badr cities indicate a high illiteracy rate in Badr City reaching 29.13% compared to 3.12% in El-Sheikh Zayed City, while the percentage of university graduates in Badr City is 24.9% compared to 89.46% in El-Sheikh Zayed City, which is expected to be reflected in the community readiness results monitored through the questionnaire form in both cities. In terms of the percentage of computer and internet usage by the residents of the two cities, it indicates that the two cities are close despite their relative decrease in Badr City, where these percentages in Badr City are 5.89% and 6.09%, respectively, while the same percentages in El-Sheikh Zayed City are 6.24% and 6.30%, which may be confirmed through the questionnaire (CAPMAS, 2019).

According to the analysis of the respondents in the survey, it is presented in Table 4 that the number of female respondents is higher than male respondents whereas based on age 36-45 is the greater age group of respondents. Also, it is clear that all respondents are educated, starting from intermediate qualification to a doctorate, and the largest percentage of respondents are those with an income of less than 25 thousand pounds (75.2%), while most of the respondents are from the private sector (57.2%), and most of the sample is limited to residents of high-income and middle-income residential areas.

Table 4. The Respondents' Demographic and Socio-economic Characteristics

Basic Information	**Category**	**El-Shiekh Zayed**		**Badr**	
		Frequency	**Percentage**	**Frequency**	**Percentage**
Gender	Male	166	40.4%	39	43.8%
	Female	245	59.6%	50	56.2%
Age	Under or 25 years old	43	10.5%	7	7.9%
	26-35 years old	66	16.1%	18	20.2%
	36-45 years old	117	28.5%	42	47.2%
	46-55 years old	88	21.4%	0	0.0%

Basic Information	Category	El-Shiekh Zayed		Badr	
		Frequency	Percentage	Frequency	Percentage
	56-65 years old	85	20.7%	10	11.2%
	Over 65 years old	12	2.9%	12	13.5%
Educational Level	Unqualified	0	0.0%	0	0.0%
	Intermediate qualification	9	2.2%	11	12.4%
	University Student	23	5.6%	9	10.1%
	Bachelor's Degree	282	68.6%	55	61.8%
	Master's or Doctorate Degree	97	23.6%	14	15.7%
Monthly Income	Less than 10,000	144	40.4%	41	46.6%
	10,000 to 25,000	124	34.8%	32	36.4%
	25,000 to 50,000	54	15.2%	8	9.1%
	More than 50,000	34	9.6%	7	8.0%
Occupation	Governmental Sector	74	21.3%	14	18.4%
	Private Sector	199	57.2%	38	50.0%
	International Cooperate	7	2.0%	2	2.6%
	Not Working	52	14.9%	17	22.4%
	Student	16	4.6%	5	6.6%
Housing Level	High-income Housing	227	60.2%	23	46.9%
	Middle-income Housing	120	31.8%	21	42.9%
	Low-income Housing	30	8.0%	5	10.2%

Source: The authors based on the questionnaire analysis

3.2. Community Readiness Variables Relations with Demographic and Socio-economic Characteristics

Table 5 provides insights into the significance levels along with their interpretations, which explains the relationship between the six variables; community awareness, perceived usefulness, perceived ease of use, security and privacy, behavioural intention regarding the use of technology, and community participation, and the population characteristics, including income, gender, age, educational level, occupation, and level of housing.

Community readiness variables are influenced by various demographic and socio-economic characteristics, with income, educational level, age, and occupation playing the most significant roles. These factors collectively impact variables such as community awareness, perceived usefulness, perceived ease of use, and behavioral intention to use technology. Among these, income and educational level are particularly influential in shaping community awareness, while age and occupation strongly affect perceived usefulness and behavioral intentions. Gender has a weaker impact across most variables, particularly on community awareness and trust in technology, where it shows weak to no significant effect. While age was not always a strong determinant, shows a weak negative relationship with perceived ease of use and community

participation, indicating that older individuals are less inclined to engage with technology. Overall, socio-economic factors are more critical than demographic factors like gender in determining the community's readiness for smart city transformation.

Table 5. Relationships between community readiness variables and the demographic and socio-economic characteristics

		Community Awareness	**Perceived Usefulness**	**Perceived Ease of Use**	**Security and Privacy**	**Behavioral intention**	**Community Participation**
Gender	Value	0.049	0.171	0.320	0.034	0.158	0.159
	Significance level	0.271	0.005	0.000	0.446	0.006	0.013
	Significance relationship	Insignificance	Weak	Moderate	Insignificance	Weak	Weak
Age	Value	0.214	0.406	-0.228	0.143	0.513	-0.146
	Significance level	0.000	0.000	0.000	0.068	0.000	0.003
	Significance relationship	Weak	Moderate	Negative weak	Insignificance	Moderate	Negative weak
Income	Value	0.206	0.284	0.410	0.159	0.325	0.239
	Significance level	0.000	0.000	0.000	0.011	0.000	0.002
	Significance relationship	Weak	Weak	Moderate	Weak	Moderate	Weak
Educational Level	Value	0.206	0.283	0.410	0.159	0.325	0.239
	Significance level	0.000	0.000	0.000	0.000	0.000	0.000
	Significance relationship	Weak	Weak	Moderate	Weak	Moderate	Weak
Occupation	Value	0.256	0.387	0.385	0.314	0.325	0.294
	Significance level	0.000	0.000	0.000	0.000	0.000	0.002
	Significance relationship	Weak	Moderate	Moderate	Moderate	Moderate	Weak
Level of Housing	Value	0.139	0.328	0.205	0.125	0.361	0.338
	Significance level	0.000	0.000	0.052	0.05	0.000	0.000
	Significance relationship	Weak	Moderate	Insignificance	Insignificance	Moderate	Moderate

Source: The authors based on the SPSS analysis

3.3. Community Readiness Levels

The scoring of each of the six variables that shape the community readiness with the six demographic and socio-economic characteristics of the community is presented in Table 6. In this section, the results of the analysis of both cities across each of the six variables, the total readiness in each variable, and the total community readiness of the city are presented.

3.3.1. Community Awareness

Community awareness examines the community's knowledge, understanding of benefits, and acceptance of changes resulting from the smart cities initiatives. The analysis showed no significant gender differences in awareness between male and

female residents in El-Sheikh Zayed and Badr City, with both groups demonstrating limited knowledge of smart city initiatives and services. However, age played a notable role, with residents aged 36-45 and 56-65 in both cities showing higher awareness, while awareness about smart cities declined significantly among those over 65. Similarly, educational level strongly influenced community awareness, with bachelor's degree holders being the most prepared, followed by those with advanced degrees. While lower education levels corresponded with less readiness. Also, income levels impacted awareness differently across the two cities; in El-Sheikh Zayed, those earning less than 10,000 EGP were the most aware of smart cities, whereas higher income groups were less. Nevertheless, in Badr City, only the lowest income group showed some awareness, while higher earners were largely unprepared. Regarding the occupation, the classification revealed divergent readiness levels between the cities. In El-Sheikh Zayed, government and private sector employees exhibited high awareness, while in Badr, these groups, along with non-workers, were not aware of the smart cities transformation. Last, housing level further influenced community awareness, with high-income residents in El-Sheikh Zayed being more prepared, unlike middle and low-income residents. In Badr City, all housing categories showed similarly low awareness.

3.3.2. Perceived Usefulness

The perceived usefulness of smart technologies was evaluated by analyzing the anticipated benefits among different demographic groups in El-Sheikh Zayed and Badr cities. In El-Sheikh Zayed, both men and women showed high readiness for adopting smart technologies, while in Badr City, only women exhibited such readiness, indicating greater awareness among females. Regarding age, residents aged 36-55 in El-Sheikh Zayed were the most prepared, while those over 65 were less convinced of the benefits. In Badr City, only the 36-45 age group showed strong readiness, with other groups remaining unprepared. Educational levels played a significant role, with higher education correlating with greater readiness in both cities. In El-Sheikh Zayed, individuals with bachelor’s, master’s, and doctorate degrees were highly prepared, while those with intermediate qualifications or still in university were not. A similar trend was observed in Badr City, where bachelor’s degree holders were the readiest, followed by those with advanced degrees. Likewise, income and occupation also influenced readiness. In El-Sheikh Zayed, lower-income groups (under 25,000 EGP) were more prepared, while in Badr City, only the lowest-income group showed some readiness. Government workers in El-Sheikh Zayed and private sector employees in Badr City were the only occupational groups ready for smart transformation. However, across both cities, housing levels did not significantly affect readiness, as all categories were generally unprepared for the shift.

3.3.3. Perceived Ease of Use

The community’s ability to use smart technology, particularly the ease of using smart applications, is a critical factor in assessing readiness for smart city transformation. In El-Sheikh Zayed City, neither men nor women are adequately prepared for this transition, primarily due to difficulties in using technology. In Badr City, however, men are more ready than women. Age-wise, younger and middle-aged groups in both cities show some readiness, while older residents, particularly those over 56, are less prepared, reflecting the challenges they face with adopting new technologies. Education plays a crucial role in readiness, with bachelor’s degree holders in El-Sheikh

Zayed being the most prepared, followed by those with advanced degrees, while students remain unprepared. In Badr City, residents across all educational levels struggle with the ease of using smart technology. Income also influences readiness, with the 10,000-25,000 L.E. income group being the most prepared in both cities, while other income groups are not. Occupational differences reveal that in El-Sheikh Zayed, only private sector workers are ready for smart transformation, while in Badr City, most occupational groups are unprepared. Housing levels further highlight this disparity; in El-Sheikh Zayed, even high-income residents are not ready, while in Badr City, only the middle-income group shows some readiness.

3.3.4. Security and Privacy

Security and privacy are crucial factors in assessing community readiness for smart city initiatives, as they directly affect trust in technology and government. In both El-Sheikh Zayed and Badr cities, women show higher readiness for smart transformation than men, likely due to greater confidence in using smart applications. Age-wise, residents aged 36-55 are the most prepared, while younger (under 25) and older (over 65) groups exhibit low readiness, reflecting decreased trust in technology. Education level also plays a role. In El-Sheikh Zayed, bachelor's degree holders are the readiest, followed by those with advanced degrees, while less educated groups show low readiness. In Badr City, only bachelor's degree holders demonstrate moderate readiness. Income levels show a similar pattern, with lower-income groups in El-Sheikh Zayed being more prepared, while higher-income groups are less so. In Badr City, moderate-income earners are somewhat ready, but others are not. Occupational differences are evident as well. In El-Sheikh Zayed, private sector workers are the most prepared, followed by government employees, while other groups lag. In Badr City, only private sector workers show moderate readiness. Housing levels also influence readiness; higher-income residents in El-Sheikh Zayed are the most prepared, while lower-income groups are not. In Badr City, middle-income residents are moderately ready, but high- and low-income groups are unprepared.

3.3.5. Behavioural Intention

Behavioural intention is key to understanding how communities engage with smart technologies, shaping their readiness for smart city transformation. In El-Sheikh Zayed City, both men and women show low readiness, while in Badr City, both genders are more prepared, displaying similar behaviors in using technology. The 36-45 age group in both cities is the readiest, while younger groups in Badr City face challenges that limit their readiness. Educational level further influences readiness. In El-Sheikh Zayed, bachelor's degree holders are the most prepared, with advanced degree holders following, while those with lower qualifications are not ready. In Badr City, only bachelor's degree holders show moderate readiness. Income levels reveal that in both cities, the 10,000-25,000 L.E. group is the most prepared, reflecting their frequent use of smart applications. Occupationally, private sector workers in both cities are fairly ready for smart transformation, while government employees and other professions are not. Housing levels indicate that in El-Sheikh Zayed, all groups lack readiness, whereas in Badr City, only middle-income residents show some intention to engage with smart technologies.

3.3.6. Community Participation

Community participation is essential for the success of smart city initiatives, encouraging collaboration across sectors. In El-Sheikh Zayed City, both men and women are equally ready to engage in the transformation, while in Badr City, only women show a willingness to participate. Age influences participation readiness, with the 36-45 age group in El-Sheikh Zayed being the most prepared, followed by those aged 26-35 and 56-65. Younger and middle-aged groups in Badr City, however, are generally not ready to engage. Educational attainment plays a crucial role, with bachelor's degree holders in both cities being the most prepared for participation, while those with lower educational levels are not. Income levels further impact readiness; in El-Sheikh Zayed, the 10,000-25,000 L.E. group is the most willing to participate, whereas, in Badr City, this same group shows the highest readiness, with other income groups lagging behind. Occupational and housing classifications reveal limited readiness across both cities. In El-Sheikh Zayed, high-income residents are ready to participate, but medium and low-income groups are not. In Badr City, no housing category shows a significant willingness to engage in the smart city transformation process.

3.3.7. Community Readiness of El-Sheikh Zayed City and Badr City

The results highlight varying levels of readiness across the variables, presented in Table 6 and Figure 1, reflecting the different demographic, socioeconomic, and educational factors influencing each city's readiness for smart transformation. Community Awareness in El-Sheikh Zayed City is notably higher than in Badr City, with residents demonstrating a greater understanding of Egypt's initiatives to transform new cities into smart cities. This heightened awareness contributes significantly to El-Sheikh Zayed's overall readiness. However, Badr City exhibits lower levels of awareness. Perceived Usefulness of smart city technologies also varies between the two cities. El-Sheikh Zayed residents, particularly those with higher educational level and middle-income levels, recognize the benefits of smart technologies more clearly, contributing to their moderate readiness. In contrast, Badr City shows lower perceived usefulness across most demographic groups, hindering overall readiness. Perceived Ease of Use remains a significant barrier in both cities, though it is more noticeable in Badr City. The challenges in adopting and using smart technologies across various socio-economic groups in both cities highlight the need for user-friendly solutions and targeted support to improve ease of use and, consequently, readiness for transformation. The Security and Privacy concerns also influence readiness levels. While El-Sheikh Zayed residents show moderate confidence in the security of smart technologies, Badr City residents express lower confidence, which contributes to their overall lower readiness. Addressing these concerns is critical for both cities to foster trust and increase engagement with smart technologies. Behavioural Intention to adopt smart technologies is insufficient in both cities. Neither El-Sheikh Zayed nor Badr City demonstrates strong behavioral intention across demographic groups, indicating that, despite some readiness in other areas, the willingness to embrace and continuously use smart technologies remains limited. Community Participation readiness is uneven across demographics in both cities, with El-Sheikh Zayed showing somewhat better preparedness compared to Badr City. However, overall, neither city exhibits a strong readiness for active community participation in the smart transformation process, reflecting a need for strategies to enhance engagement and involvement.

Table 6. Community Readiness Scores according to Demographic and socio-economic characteristics per each variable

Population Ch.	Population Characteristic Classifications	Variables											
		Community Awareness		Perceived Usefulness		Perceived Ease of Use		Security and Privacy		Behavioral intention		Community Participation	
		Zayed	Badr	Zayed	Badr	Zayed	Badr	Zayed	Badr	Zayed	Badr	Zayed	Badr
Gender	Male	6.2	12.9	52.2	22.3	7	28.6	31	18.4	1.2	27.2	21.7	8.6
	Female	8.4	12.1	52.6	35.7	4.3	23.8	40.3	26.9	1.6	28.9	27.9	22.8
Age (years old)	Under or 25	15.6	7.8	17.9	10.8	15.2	7.5	13.3	6.7	12.1	6.5	15.4	1.6
	26-35	15.6	7.8	34.1	21.5	19.7	26.4	23.1	16.7	28	13.1	25.3	9.8
	36-45	36.3	35.2	53.7	37.7	32.2	28.3	40	30	41.9	34.3	40.6	14.7
	46-55	34.6		52		17.9		42.7		29.8		10.8	
	56-65	43.2	9.8	28.5		13.4		31.1		32.6		31.6	
	Over 65	5.2		4.9				5.3					9.8
Educational Level	Intermediate Qualification	3.3	10.5	3.9	1.8		5.9	4.3	0.9	3.2			
	University Student	5.1	5.2	8.5	9	7.3	3.9	4.3	2.8	3.6	9.2	5.4	1.4
	Bachelor's Degree	40.7	33.2		43.1	53.5	14.8	52.2	19.3	50.1	23.6	47.6	23.1
	Master's or Doctorate Degree	25.9	5.2	48.8	16.2	34.9	13.8	33.4	6.5	15.8	10.5	29.5	7.2
Income (L.E)	Less than 10,000	39	22.7	44	24.2	10.3	12.6	28.5	19.5	24.8	13.3	20.8	6.6
	10,000 to 25,000	24.2	11.4	54.4	10.6	33	23.5	29	26.6	18.1	12.4	33.5	26.4
	25,000 to 50,000	21.2		24.1	12.1	12.9	7.9	18.3	3.6	5.9	2.9	17.4	
	More than 50,000	5.9		15.1	10.6	11	6.3	7	5.3	5.9	1.9	7.4	3.3
Occupation	Governmental Sector	38.9	5.4	11.1	5.2	5.1	8.5	23.8	12.6	8.7	9.8	6.5	6
	Private Sector	54.5	11.4	32.5	30.9	21.5	13.1	35.2	16.9	20.6	24.4	12.2	9.1
	International Cooperate			0.5	2.6		1.5	0.9	2.8	1.2		1	
	Not Working	17.9		5.8		2.1		5.7		3.2	4.9	2	13.6
	Student	5.5	1.3	1.9	6.4	1.7	2.3	2.6	2.8	1	4.9	1.4	
Housing Level	High-income Housing	25.4	5.8	10.5	6.8	7.5	14.5	38.6	12.1	4	8.4	24.9	5.2
	Mid-income Housing	13	4	5.7	13.5	2.9	19.3	17.7	15.1	0.8	18.3	6.1	10.4
	Low-income Housing	6.2	0.9	1.7	2.7	0.6	4.8	2.9	3	0.5	4.2	3.3	
Total Readiness (per variable)		16.3	8.9	15.2	12.4	10.7	10.5	15.6	9	7.2	10.8	12.3	8

Source: The authors based on the SPSS analysis (The authors)

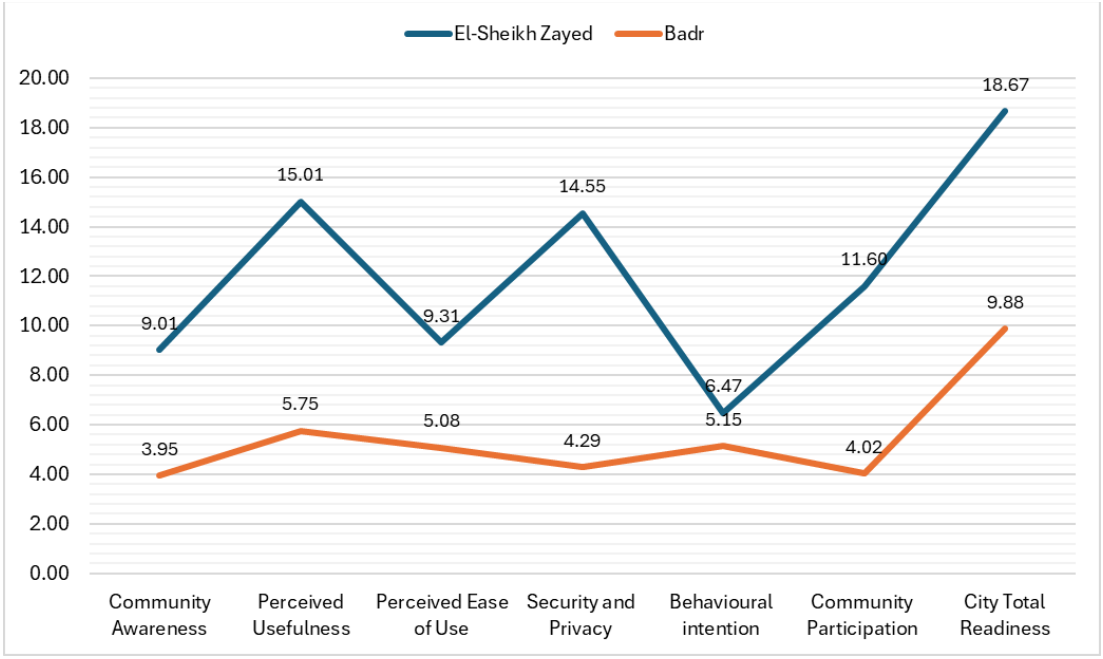

Figure. (1). Readiness scores for the key variables of community readiness and total city readiness (The authors)

Considering all variables, the study concludes that El-Sheikh Zayed City's community shows moderate readiness for smart transformation, with its population displaying some level of preparedness across several key factors. However, the city still requires targeted interventions to improve ease of use, increase community participation, and address security and privacy concerns. On the other hand, Badr City's community is not ready for smart transformation, with significant gaps in awareness, perceived usefulness, ease of use, and overall confidence in smart technologies. Addressing these deficiencies will be essential to achieving successful smart city initiatives in Badr City.

4. Discussion

The research findings reveal notable differences between the two cities in terms of community readiness, highlighting the need for tailored policies to address their unique challenges and enforce their strengths. First, El-Sheikh Zayed City demonstrates a higher overall readiness for smart transformation compared to Badr City, particularly among middle-income groups (10,000-25,000 L.E.) and bachelor's degree holders. These groups show a strong awareness of smart city initiatives, a clear understanding of the benefits, and confidence in the security and privacy of smart technologies. As well, educational levels in El-Sheikh Zayed play a crucial role in this readiness. However, it is surprising that higher-income groups (over 50,000 L.E.) in El-Sheikh Zayed show lower readiness. This variance might be due to less reliance on government services, where smart technologies are more prevalent, or due to a smaller sample size for this group in the study.

Given El-Sheikh Zayed's high level of readiness, policies should focus on accelerating the adoption of advanced smart technologies. A comprehensive smart city master plan that integrates IoT devices, AI-driven services, and advanced data analytics should be developed to enhance city management and service delivery (Albino et al., 2015). Promoting public-private partnerships can foster innovation and investment in smart city projects, leveraging the residents' high interest and capability to use smart

technologies (Kitchin, 2015). In addition, expanding digital government services, implementing smart transportation systems, and enhancing energy management through smart grids are essential steps to improving the quality of life in the city (M. Lytras & Visvizi, 2018). Addressing concerns about data privacy and security is also critical in the city strengthening data protection regulations and ensuring compliance with stringent privacy standards can build trust in smart technologies (El Barachi et al., 2022). Furthermore, establishing a transparent data governance framework that allows residents to control how their data is used can further enhance trust. Last, conducting regular community workshops and training programs should in order to increase awareness and capability in using smart city technologies, encouraging community participation and feedback (Yigitcanlar et al., 2022).

In contrast, Badr City faces significant challenges that hinder its community's readiness for smart transformation. The city has lower levels of community awareness, education, and greater concerns about privacy and security, which collectively contribute to its lower readiness. The middle-income group (10,000-25,000 L.E.) shows some willingness to engage with smart technologies, but overall, the city requires targeted interventions to raise awareness and build trust. For Badr City, a gradual approach to smart transformation is recommended. Piloting smart city projects in specific sectors such as waste management and public safety can demonstrate immediate benefits and build public support (Chourabi et al., 2012). These projects can serve as proof-of-concept initiatives that showcase the practical advantages of smart technologies, helping to overcome their disbelief and resistance. Focusing on essential services like smart healthcare and education can also address immediate community needs, providing tangible improvements that resound with residents (Angelidou, 2014). Furthermore, to improve awareness and engagement, community outreach programs should be implemented to inform residents about the goals and benefits of smart city initiatives, and establishing community advisory boards can involve residents in planning and implementing smart city projects, ensuring that initiatives align with local needs and priorities (Yigitcanlar et al., 2022). One key aspect especially for elderly people is enhancing digital literacy; basic digital skills programs can prepare residents with the necessary knowledge to engage with smart applications, while specialized training sessions for local businesses and entrepreneurs can help leverage smart technologies for economic growth (Albino et al., 2015). Additionally, addressing data privacy and security concerns is vital for both cities. Badr City, in particular, requires robust regulations to protect data privacy and ensure that all smart applications meet privacy and security standards (El Barachi et al., 2022). As well as, transparent communication about how data is managed and protected can help build trust among residents, encouraging them to embrace smart technologies.

5. Conclusions

This study assessed the readiness of El-Sheikh Zayed and Badr cities for transitioning into smart cities, focusing on key variables such as community awareness, perceived usefulness, ease of use, behavioral intention, security and privacy, and community participation. The findings reveal a significant difference in readiness levels between the two cities, with El-Sheikh Zayed exhibiting greater preparedness across various demographic groups, particularly among younger, middle-income, and higher-educated residents. This higher readiness in El-Sheikh Zayed is attributed to stronger community awareness, a clearer understanding of the benefits of smart technologies, and a more favorable attitude toward adopting these technologies. In contrast, Badr City

demonstrated lower overall readiness for smart transformation, largely due to factors such as lower educational levels, limited community awareness, and greater concerns regarding privacy and security. These findings highlight the need for targeted interventions in both cities. In Badr City, including large-scale awareness programs, digital literacy initiatives, and strategies to enhance community participation in the decision-making process. By addressing these gaps, Badr City can improve its readiness for smart city initiatives. For El-Sheikh Zayed, the focus should be on sustaining and enhancing its high levels of readiness through continuous training, active community engagement, and ensuring equitable access to smart technologies. Additionally, addressing security and privacy concerns will be essential in building trust and encouraging broader community involvement in the smart transformation process.

This study offers valuable insights and practical recommendations for enhancing community readiness for smart city transformation. However, it is important to note the limitations of this research, particularly the reliance on electronic questionnaires, which may have excluded segments of the population less familiar with technology. Future research should aim to include a more diverse sample through field surveys and interviews to provide a more comprehensive assessment of community readiness. Also, studying the current access of the community to technological benefits, and address the challenges of smart city transformation.

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