The Infusion of AI in Circular Economy Model: Do Social Entrepreneurship and Psychological Distance Close the Loop

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ABSTRACT

The aim of this study is to examine IT professionals' perceptions about the perceived role of AI in the circular economy of smart cities and the perceived AI-driven innovation and governance in smart cities, about social entrepreneurship in smart cities and about psychological distance. For covering this aim, both qualitative and quantitative research approaches had been deployed. In its context a structured questionnaire had been used. The questionnaire was distributed to a purposive sample of 74 Greek experts. More analytically, participants were working in AI, software engineering, data science, and smart city-related fields. The research data were analyzed using descriptive statistics. At this point, it is mentioned that the results of previous research are verified from the current dissertation. The quantitative results showed that IT experts are positive about the role of AI in the circular economy of smart cities. They are also positive about the AI-driven innovation and governance in smart cities. The highest mean score had been presented in the IT experts' agreement that AI in smart cities promotes social entrepreneurship. On the contrary, the IT experts were neutral about the citizens' psychological distance that concerns the smart cities. Then, in the context of the qualitative findings participants mentioned some risks, including privacy and cybersecurity. Surveillance risks were also included in their main concerns. Furthermore, citizen responses to the smart city initiatives that are based on AI, were described as cautiously positive. At the same time, they were also characterized as conditional, as well. According to the participants' point of view, they are dependent on trust and tangible benefits. Moreover, respondents emphasized concrete applications in mobility, energy, waste management, and accessibility, as well. They also expressed skepticism to AI's superficial or symbolic uses. Finally, social entrepreneurship was associated with serving the vulnerable groups of the society. These groups include unemployed youth, elderly people, individuals with disabilities, and low-income populations.

Keywords: Artificial Intelligence, Circular Economy, Psychological Distance, Social Entrepreneurship.

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CHAPTER 1. INTRODUCTION

1.1 Aim and objectives

The aim of this study is to examine how professionals' perceptions of the infusion of AI in circular economy of Greek smart cities. In order to achieve this aim, this dissertation pursues the following objectives:

- The examination of the IT experts' perceptions about the perceived role of AI in the circular economy of smart cities.
- The examination of the IT experts' perceptions about the perceived AI-driven innovation and governance in smart cities.
- The examination of the IT experts' perceptions about psychological distance in smart cities.
- The examination of the IT experts' perceptions about social entrepreneurship in smart cities.

1.2 Research questions

Guided by the above-mentioned aim and objectives, and by the design of the questionnaire, the current research is going to answer the following central research question:

Which is the IT experts' perceptions about the infusion of AI in circular economy of Greek smart cities?

The above overarching question is further operationalized into the following specific research questions:

1. Which is the IT experts' perceptions about the perceived role of AI in the circular economy of smart cities? (Q1)

2. Which is the IT experts' perceptions about the perceived AI-driven innovation and governance in smart cities? (Q2)
3. Which is the IT experts' perceptions about psychological distance in smart cities? (Q3)
4. Which is the IT experts' perceptions about social entrepreneurship in smart cities? (Q4)

1.3 Significance and contribution to existing knowledge

The transition towards sustainable urban development has intensified global interest in smart cities. The reason is that it has integrated socio-technical systems, which are capable of addressing environmental and socioeconomic challenges (Angelidou et al., 2018).

In this context, the circular economy has become a major paradigm in theory and practice. Its aim is to replace linear models of production and consumption with systems, that are based on specific elements. These elements include resource efficiency, waste reduction, reuse, and regeneration (Dincă et al., 2022).

At this point, it is mentioned that smart cities are, nowadays, viewed as critical enablers of circular economy practices. This happens due to the fact that they are able to integrate digital technologies. They can also integrate data-driven governance and citizen-centered innovation, as well (Anttiroiko, 2023).

Among the emerging technologies, Artificial Intelligence plays a protagonist role, as it advances circular economy objectives in the urban environments. More analytically, the applications that are AI-driven, like for instance machine learning, predictive analytics, Internet of Things (IoT), and automated decision-support systems, might enable smarter resource management. Also, these AI-driven applications might enable waste optimization, energy efficiency, and innovative circular models that might be adapted by modern business entities (Dindarian, 2022; Fraga-Lamas et al., 2021).

Beyond operational efficiency, AI also contributes to urban innovation. It helps the increase of governance quality, and collaborative ecosystems across public, private, and social sectors, too (Santibanez Gonzalez et al., 2023).

However, technological advancement, alone, does not guarantee sustainable outcomes. This is why the importance of social and behavioral dimensions in smart city transitions is increased. In particular, Q4 might be considered as a bridge that exists between technological innovation and societal value creation. Its role is to translate the AI-enabled solutions into inclusive initiatives, which are locally integrated (Nuseir et al., 2020).

Even more, social enterprises often play a crucial role in citizen participation and participation. Their role is to address community needs. Therefore, they are able to align technological innovation with social and environmental goals (Bokhari & Myeong, 2022).

At the same time, citizens' perceptions and psychological engagement with smart city initiatives influence their effectiveness. At this point, it is mentioned that Psychological Distance refers to how close or distant individuals perceive technological and environmental issues from their daily lives (Caputo et al., 2023). Psychological distance affects citizen participation and their behavioral change as well due to the fact that it might affect their trust. More analytically, when AI-driven circular initiatives are perceived as abstract and distant, then the engagement and social impact may be limited. This result comes despite any technological sophistication (Cortés-Cediel et al., 2021; Zeng et al., 2025).

At this point, it is mentioned that despite the growing scholarly interest in AI, circular economy, and smart cities, limited empirical research has examined how these dimensions interact through SE. Especially, the influence of Q3 in the Greek context has not been studied yet. Therefore, this research aims to cover this existing gap. It aims to do so by focusing on Greek smart cities and exploring how perceptions of AI-driven circular economy and innovation shape Q4 outcomes through Q3.

As for the implications of this dissertation, it is expected to contribute to ongoing academic and policy discussions according smart cities. This might be achieved by emphasising on the importance of the examination of technological, social, and perceptual dimensions at the same time. This dissertation integrates artificial intelligence, circular economy practices, SE, and Q3 in a single analytical framework. By doing so, the research is able to offer information that are going to be useful for policymakers and urban planners, in order for them to design more inclusive and socially grounded smart city strategies.

1.4 Description of the structure

The current dissertation is structured as follows:

Chapter 1 presents the introduction. It outlines the background of the research, the aims and objectives, the research questions and finally, the significance of this study.

Chapter 2 includes the literature review. More analytically, this chapter focuses on circular economy principles and the role that is played by AI in smart cities. Then, emphasis is placed on Q4 and Q3.

Chapter 3 describes the research methodology. This description includes research design, research sample and the sampling method that had been followed and the description of the questionnaire and the overall research data collection. Finally, ethical considerations are also mentioned.

Chapter 4 presents and analyzes the empirical findings. Finally, Chapter 5 discusses the conclusions. This chapter, also, includes the limitations of this study. Finally, it presents suggestions for future research.

CHAPTER 2. LITERATURE REVIEW

2.1 Concepts and principles of the circular economy

The circular economy represents a shift from the traditional linear "*take-make-dispose*" economic model to more regenerative systems. These systems prioritize resource efficiency and waste minimization, together with value retention. These priorities are set across production and consumption cycles (Bucher et al., 2021).

At its core, the circular economy aims to decouple economic growth from resource depletion. This aim is achieved by extending product lifecycles. Also, circular economy promotes reuse and recycling. Furthermore, it redesigns systems to eliminate waste at the source (Bolger & Doyon, 2019; Abu-Bakar & Charnley, 2025).

In the urban contexts, there is an increasing concentration of population, infrastructure, material flows, and environmental pressures. This is why circular economy is even more important and necessary (Subrahmanyam, 2025; Wolniak & Stecuła, 2024).

More analytically, cities function as complex socio-technical systems. In these contexts, the principles of circular economy are operationalized through integrated strategies. These strategies include waste management, energy systems, mobility, construction, and water use as well (Singagerda et al., 2025).

Local governments play a central role in enabling the above-mentioned circular transitions. Their role concerns establishing regulatory frameworks and fostering cross-sector collaboration. Their role is equally important in supporting innovation ecosystems (Bolger & Doyon, 2019).

Therefore, circular cities move beyond isolated recycling initiatives toward coordinated urban strategies. These strategies include circularity into planning, governance, and service delivery (Redko, 2024).

One of the main principles of the circular economy is system-wide optimization rather than isolated efficiency gains. Therefore, cities are understood as complex socio-technical systems, where interventions in one sector shape outcomes in others (Hernandez et al., 2025).

Such a systemic perspective aligns with smart city frameworks, which emphasize data integration and interoperability alongside adaptive governance. At this point, it has to be mentioned that convergence of the circular economy and smart city models makes cities able to monitor resource use in real time. It also enables them to identify inefficiencies and design responsive interventions. Besides, this convergence enhance and improve sustainability outcomes (Singagerda et al., 2025).

Even more, circular innovation encompasses new business models and organizational practices, which support reuse, sharing, remanufacturing, and extended producer responsibility (Çetin & Kirchherr, 2025). These innovations are not only technological; they are also institutional and social. They require new forms of collaboration between public authorities and private actors. The cities' capacity to promote such innovation ecosystems, undoubtedly, determines the effectiveness of circular transitions (Panori et al., 2021).

Furthermore, the creation and management of knowledge further underpin circular economy implementation. More analytically, effective circular strategies depend on the ability to generate and apply knowledge across organizational boundaries. Besides, this enables continuous learning and adaptation (Abdalla et al., 2020).

In addition, circular practices contribute to reduced environmental impact. It might succeed by lowering emissions and conserving natural resources. It also succeeds by mitigating urban environmental risks (Cui et al., 2025; Yang et al., 2024).

In particular, circular approaches to waste, energy, and water management increase the cities' capacity to respond to environmental challenges. These include climate change and resource scarcity. These benefits extend beyond ecological performance. They further influence social well-being and quality of life in urban settings (Chatterjee et al., 2021).

Finally, the circular economy emphasizes inclusivity and social value creation. There is no doubt that circular transitions are more effective when they engage citizens and local communities. This aligns sustainability goals with everyday practices and social needs (Macke et al., 2019). It is about a social dimension that highlights the importance of participatory governance and trust in circular initiatives. As a result, the circular economy is viewed as a framework that integrates technological innovation, and social engagement in the smart cities (Ortega-Fernández et al., 2020).

2.2 The role of artificial intelligence (AI) in the circular economy

At first, it is mentioned that the AI-driven technologies allow cities to monitor resource flows and reduce inefficiencies across urban systems. They also allow them to predict the existing patterns on the levels of the demand (Alahi et al., 2023; Wolniak & Stecuła, 2024). These capabilities are relevant in circular economy contexts. In these contexts, real-time information and system-wide coordination are prerequisites for achieving resource recovery and lifecycle optimization.

In the urban environments' context, AI helps increase the circular economy performance. Some characteristic and indicative examples of AI applications are intelligent waste sorting and predictive maintenance (Chen & Zhang, 2022). Smart energy distribution is another example and all of these together contribute directly to resource loss minimization (Singagerda et al., 2025; Ojadi et al., 2025).

Moreover, AI-supported modeling and simulation tools allow city authorities to test alternative circular strategies before their final implementation. This ability reduces uncertainty. It also improves policy effectiveness (Alsabt et al., 2024).

Except for operational efficiency, AI facilitates innovation in circular business models and in the context of urban services. This is succeeded by the combination of AI with digital platforms and cloud computing infrastructures. Therefore, smart cities are able to support new forms of value creation. Characteristic examples of such forms are product-as-a-service models and shared mobility systems, too (Pandey, 2024; Li et al., 2024).

Also, AI-driven analytics offer organizations the ability to identify the resources that are underutilized. They also enable them to anticipate users' behavior and to design services that are in line with the circular principles. It is about an innovation dimension that is empowered by the integration of AI in a broader smart city ecosystem. In these ecosystems data interoperability and platform-based governance promote, on the one hand, experimentation, and, on the other hand, co-creation (Hwang, 2020; Lytras et al., 2019; Panori et al., 2021).

AI also plays a significant role in improving governance quality. It also improves institutional coordination in the circular smart cities. More analytically, intelligent decision-support systems increase transparency and accountability. They also help the evidence-based policymaking, by enabling public authorities to align the sustainability goals with specific and measurable results (Bokhari & Myeong, 2022; Tomor et al., 2019).

Furthermore, cross-sector collaboration is strengthened by information sharing that is conducted through the help of AI technology. Therefore, the procedure of information sharing might be easier and more effective between municipalities, private companies, and research institutions. This ends up facilitating the coordinated responses to the challenges that concern sustainability (Mikhaylov et al., 2018).

At an organizational level, the AI's effectiveness in circular economy applications depends on the knowledge management and the existing organizational culture towards innovation. It is a fact that smart cities that invest in AI capabilities must also develop suitable organizational structures and practices. Besides, investments in AI capabilities are not able to succeed if there is an absence of an organizational culture that supports learning and experimentation (Abdalla et al., 2020).

Without these complementary capabilities, there are risks on the AI adoption, like for example transparency and data governance. It is not a coincidence the fact that Ortega-Fernández et al. (2020), Katal (2024) and Ejjami (2024) mentioned that cities that have mature digital infrastructures and a governance that is characterized as innovation-oriented, show higher performance in AI-driven sustainability initiatives.

At this point, it has to be mentioned that some concerns still exist. These are related to transparency and data governance. They are also about inclusivity and accountability.

These are the issues that influence public trust. They also influence the long-term viability of the AI models that are integrated in the smart cities, as well (Bashynska, 2025; Roberts et al., 2024).

Finally, emerging perspectives have to also be considered. A characteristic example is the quantum AI urbanism. This highlights the evolving nature of AI's role in cities. More analytically, it shows the need of a shift to more adaptive and interconnected urban systems, as it was pointed out by Yigitcanlar et al. (2025).

2.3 Social entrepreneurship and its connection to sustainable innovation

SE in the context of the smart city is a mission-driven entrepreneurial activity. It is about an activity that mobilizes innovation to address social and environmental problems, while at the same time economic viability remains stable. In the circular economy transitions, the social enterprises act as translators between technological capabilities and community needs. This aims at the conversion of the AI-enabled solutions into public value that is finally tangible (Bolger & Doyon, 2019; Meduri et al., 2024; Tomor et al., 2019).

In that context, openness and collaborative governance further strengthen this role. They do so by reducing barriers to innovation. They also enable entrepreneurial ecosystems to combine municipal capacity with social initiative (Ferraris et al., 2020).

AI systems and the overall digital platforms are able to stimulate the emergence and scaling of socially oriented ventures. They might achieve this goal by expanding access to data. They might also achieve it by lowering coordination costs and enabling targeted sustainability services, as well. At this point, Panori et al. (2021) and Mikhaylov et al. (2018) mentioned that the platform-based co-creation and the data-intelligence systems are able to support new entrepreneurial arrangements. This mainly happens when cities institutionalize collaboration across their different stakeholders.

Relatedly, the collaboration frameworks between incubators and cities show the way through which the start-ups, together with the social ventures, might be empowered. This empowerment comes when urban institutions provide their resources and their experimentation space and they help the strategic alignment with the existing sustainability goals (Berniak-Woźny et al., 2025).

Examining the same issue from a social innovation perspective, it is understood that AI is also linked to "*smart decision-making*". This model in decision-making might enhance urban capacity towards problem-solving. It might enable entrepreneurial actors to design interventions with societal benefits that are measurable (Bokhari & Myeong, 2022).

The circular economy dimension further amplifies the relevance of SE. This happens because circular strategies require new business models. These models prioritize reuse, sharing, repair, and community-based delivery of the existing services. At this point, Hernandez et al. (2025), concerning circular innovation, emphasize the growing interdependence that exists between technological innovation and societal actors in delivering sustainable outcomes (Hernandez et al., 2025). Then, Redko (2024) mentioned that AI is able to empower Q4 through the improvement of sustainability intelligence. It might also do so by enabling socially oriented circular initiatives, which are more impact-focused.

Yet, ethical and legitimacy considerations are still decisive. As Roberts et al. (2024) and Bashynska (2025) mentioned, the AI practices that are responsible, transparent and inclusive influence whether, on the one hand, the citizens, and, on the other hand, the communities perceive the AI circular initiatives as trustworthy and socially beneficial. This means that the responsible AI practices might shape the environment in which social enterprises operate.

2.4 Psychological distance and consumer engagement in circular practices

Psychological Distance is the perceived remoteness of an issue from an individual's direct experience. It encompasses spatial, temporal, social, and cognitive dimensions. In the smart cities' context and in the context of the circular economy initiatives, psychological distance influences how citizens evaluate and engage with the policies and technologies that are considered as sustainability-oriented (Yang et al., 2022; Zeng et al., 2025).

More analytically, when circular economy practices or the AI smart city solutions are perceived as abstract and future-oriented, or if they are detached from the citizens' everyday life, then the citizens' engagement tends to be limited to them. This negative result comes regardless of the technological sophistication that is involved (Macke et al., 2019; Chatterjee et al., 2021).

Furthermore, Cui et al. (2025), Manoharan et al. (2023) and Yang et al. (2024), who focused on the smart cities, mentioned that citizens' engagement is not only determined by the performance of the infrastructure, it is determined by the perceived relevance and the personal impact. Similarly, Bosco et al. (2024) and Cortés-Cediel et al., (2021) showed that smart city projects that achieve tangible environmental and social outcomes are more possible to reduce the existing psychological distance of the citizens. These projects are also more possible to create a sense of community and a climate of shared responsibility.

Additionally, AI systems can either exacerbate or mitigate psychological distance. The outcome depends on how they are implemented and how effectively they are communicated. Therefore, on one hand, when the AI systems are complex, they may create perceptions of opacity and abstraction. This may increase the distance and skepticism (Bashynska, 2025; Roberts et al., 2024; Tomor, 2019).

On the other hand, the efficient personalization that is offered by the AI systems, alongside with the real-time feedback and the use of participatory digital platforms are able to make sustainability goals more visible (Bosco et al., 2024; Caputo et al., 2023). These positive and inclusive implementations might make the sustainable goals more emotionally salient, and thereby, this leads to increasing levels of the citizens' engagement (Bucher et al., 2021; Panori et al., 2021; Parlapalli et al., 2025).

Finally, it is mentioned that transparent decision-making and the existence of openness to citizen input tend to reduce perceived distance. They also increase trust in smart city initiatives (Ferraris et al., 2020; Tomor et al., 2019). Additionally, knowledge-sharing mechanisms in the smart cities support cognitive proximity. They do so by enabling citizens to better understand the purpose of the AI circular systems (Abdalla et al., 2020; Nuseir et al., 2020).

CHAPTER 3. RESEARCH METHODOLOGY

3.1 Research type

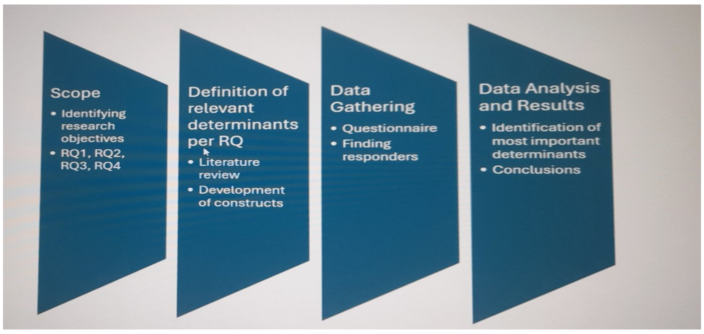
The current primary research adopts a quantitative and qualitative research design. This research aims to empirically examine the Greek IT experts' perceptions, that are related to the role of AI in the circular economy and innovation of smart cities.

Therefore, a quantitative approach was considered appropriate. The reason is that this research seeks to measure perceptions and relationships among the predefined constructs. It also aims to assess the strength and direction of these relationships (Hair et al. (2017). As for the qualitative part of the current research, it was deemed necessary to include some open-ended questions at the end of the questionnaire, in order to record the participants' opinions without being limited by predetermined answer choices, which were given through closed questions.

Also, it is mentioned that this research is cross-sectional. This happens due to the fact that the research data were collected at a single point in time (Maier et al., 2023). They captured the respondents' current perceptions and experiences about the AI-driven smart city initiatives in Greece.

The current research followed the four stages that are shown in Figure 1:

Figure *1*. Methodology stages



3.2 Research sample and sampling methods

The research sample consists of 74 IT experts, who are based in Greece. The participants have professional backgrounds that are related to artificial intelligence, software engineering, data science and smart city technologies.

At this point, it is clarified that the choice of IT experts was deliberate. This research population is directly involved in the design, implementation and evaluation of AI-based systems and of the projects that are integrated in the smart cities.

A purposive sampling method was employed. This sampling allowed the participants' targeted selection (Campbell et al., 2020). Therefore, participants met specific criteria that were relevant to the research objectives. It is about a non-probability sampling approach that was considered as suitable for this research, because of its exploratory and perception-based nature and because of the specialized profile of the targeted research population, too.

3.3 Research tool

The research data were collected by a structured and self-administered questionnaire, that was written in English. This questionnaire was designed specifically for the purposes of this study and it is presented in Appendix I. More analytically, the questionnaire was organized into six sections, corresponding directly to the research variables.

Section A collected demographic and professional information. This information include gender, age group, years of professional experience in IT or AI-related fields, area of expertise, employment sector, type of organization, current job role, and prior involvement in circular economy or smart city projects. These variables were included to contextualize the research sample.

Then, section B measured perceptions of the role of AI in the circular economy of smart cities. This section functioned as the first antecedent variable. The items in this section assessed respondents' views on the AI-enabled resource efficiency, waste reduction, circular business model innovation, cross-sector collaboration, co-creation, data-driven decision-making, transparency, and the design of innovative circular strategies. These statements were adapted from established studies on circular economy and AI in urban contexts as it is presented in Appendix I.

Section C included the perceptions of AI-driven innovation and governance in smart cities. It serves as the second antecedent variable. Specifically, these items examined AI's contribution to quality of life, operational efficiency, citizen participation, responsible AI awareness, socio-economic impact, innovation performance, interdepartmental collaboration, innovation policies, digital infrastructure, and knowledge sharing (Appendix I).

Section D measured psychological distance in smart cities (Q3). More specifically, the statements that are included in this section evaluated perceived remoteness of smart city and AI-driven sustainability initiatives from everyday life. They also evaluated the abstract nature of AI-based initiatives and the extent to which tangible results and personalized feedback reduce psychological distance and increase the connection with the sustainability goals.

Continuing, section E focused on social entrepreneurship in smart cities (Q4). The items that it includes, assessed the role of social entrepreneurship in the AI-based sustainable innovation's promotion and in linking technological advancement with social and environmental goals, increasing citizen engagement, accelerating sustainable innovation through collaboration, and strengthening community resilience and inclusion, as well.

Finally, it is pointed out that the closed-ended items in Sections B-E were measured using a five-point Likert scale ranging from 1 ("Strongly disagree") to 5 ("Strongly agree"). Finally, Section F is the last section of the questionnaire, and it included open-ended questions. These questions aimed to collect qualitative information regarding the implementation costs, the perceived risks, the clients' response and the influence of AI on social entrepreneurship in the context of the Greek smart cities.

3.4 Collection and analysis of the research data

The questionnaire had been distributed online, using Google Forms platform. The online distribution ensured the ease of access of the participants and therefore, the efficient data collection. The research sample was approached, through e-mails. The collection of the research lasted between 9/11/2025-26/12/2025. The questionnaire had been sent to 200 recipients and was completed by 74. This results in a response rate of 37%.

At this point, it is mentioned that participation was voluntary. Also, the respondents completed the questionnaire anonymously. The collected data were exported only for statistical analysis. In the statistical analysis, descriptive statistics were used in order to summarize demographic characteristics and the overall response patterns.

3.5 Research ethics

Ethical considerations were strictly observed throughout the process that had been followed in the context of this research process. More analytically, participants were informed about the purpose of the study. They were also informed about the voluntary nature of their participation.

Furthermore, before the completion of the questionnaire, participants were informed about their right to withdraw at any time, without having any consequences. Additionally, no personal identifying information was collected. Besides, this ensured, on the one hand, their anonymity, and, on the other hand, the necessary confidentiality.

CHAPTER 4. RESEARCH RESULTS

4.1 Demographics and other information

Table 1 presents the demographic characteristics and professional background of the respondents, who participated in the study (N= 74). More analytically, the research sample is composed of male participants, who account for 66,2% of the respondents. On the other hand, females represent a percentage of 33,8%.

As about the age, the current research sample is well distributed across different age groups. More analytically, the largest proportion of respondents is between 40-49 years old (31,1%). They are followed by participants, who are aged between 30-39 (24,3%) and 20-29 (23,0%). Then, respondents that are aged 50 years old and above represent 20,3% of the sample.

Regarding professional experience in IT or AI-related fields, a substantial proportion of participants (43,2%) report having 0-5 years of experience. At the same time, a percentage of 23,0% of the respondents declared that they have more than 16 years of experience. Fin ally, 20,3% mentioned that they have 6-10 years and 13,5% that they have 11-15 years of experience.

With respect to area of expertise, software engineering constitutes the largest group (43,2%). It is then followed by artificial intelligence and data science (both at 13,5%). A smaller proportion of respondents specialize in smart city technologies (6,8%). Then, a percentage of 23,0% of the participants report expertise in other related domains.

Then, in terms of employment sector, the majority of respondents are employed in the private sector (66,2%). Whereas a percentage of 28,4% work in the public sector. Afterward, a very small part of the current research sample is affiliated with academic or research institutions (1,4%). Finally, a percentage of 4,1% fall under other categories.

As for the types of organizations, respondents declared that they are primarily employed in services (37,8%) and IT/ITES industries (36,5%). These are followed by government departments (9,5%), manufacturing (1,4%) and other sectors (14,9%), as well.

Concerning the participants' current job roles, technical or IT specialists constitute the largest group (32,4%). This is followed by respondents that are categorized under other roles (29,7%). Managerial or decision-making roles account for 16,2% of the sample. Then, consultants and administrative staff each represent a percentage of 10,8%.

Finally, with regard to prior involvement in circular economy or smart city projects, a percentage of 37,8% of the respondents reported having direct experience. At the same time, 62,2% indicated no such involvement.

Table 1. Demographics and other information

		N
Gender	Male	49
	Female	25
Age group	20-29 years old	17
	30-39 years old	18
	40-49 years old	23
	50+ years old	15
	Other	1
Years of professional experience in IT or AI-related fields	0-5 years	32
	6-10 years	15
	11-15 years	10
	16+ years	17

Area of expertise	Artificial Intelligence	10
	Software Engineering	32
	Data Science	10
	Smart City Technologies	5
	Other	17
Current employment sector	Public Sector	21
	Private Sector	49
	Academic or Research Institution	1
	Other	3
Type of organization or industry	Manufacturing	1
	IT/ITES	27
	Government Department	7
	Services	28
	Other	11
Current job role	Managerial/Decision making	12
	Technical/IT specialist	24
	Administrative staff	8
	Consultant	8
	Other	22
Have you ever worked on projects related to circular economy or smart city initiatives?	No	46
	Yes	28

4.2 Quantitative research results

Table 1 presents the answers of the IT experts about the perceived role of AI in the circular economy of smart cities:

Table *1*. Perceived Role of AI in the Circular Economy of Smart Cities (Q1)

		N
AI is essential for improving the efficiency of resource management in circular economy systems of smart cities	Strongly Disagree	2
	Disagree	3
	Neutral	12
	Agree	36
	Strongly Agree	21
AI technologies (e.g., machine learning, IoT) can significantly reduce waste and environmental impact in smart cities	Strongly Disagree	5
	Disagree	9
	Neutral	14
	Agree	34
	Strongly Agree	12
The integration of AI supports innovation in designing circular business models (e.g., reuse, recycling, product life extension) in smart cities	Strongly Disagree	4
	Disagree	16
	Neutral	20
	Agree	25
	Strongly Agree	9
	Strongly Disagree	5

The success of AI in circular economy applications depends heavily on cross-sector collaboration (industry, government, academia) in smart cities	Disagree	7
	Neutral	27
	Agree	25
	Strongly Agree	10
AI supports innovation and co-creation in smart city circular economy projects	Strongly Disagree	1
	Disagree	9
	Neutral	13
	Agree	38
	Strongly Agree	13
AI facilitates data-driven decision-making for waste and energy optimization in the urban systems of smart cities	Strongly Disagree	3
	Disagree	9
	Neutral	13
	Agree	33
	Strongly Agree	16
AI-enabled monitoring tools improve transparency and citizen trust in circular urban initiatives in smart cities	Strongly Disagree	4
	Disagree	4
	Neutral	17
	Agree	33
	Strongly Agree	16
AI helps city authorities design innovative circular strategies (e.g., smart waste, energy sharing)	Strongly Disagree	1
	Disagree	5
	Neutral	10

	Agree	41
	Strongly Agree	17

Diagram 1 shows that 48,65% of the participants believes that AI is essential for improving the efficiency of resource management in circular economy systems of smart cities.

Diagram *1*. AI is essential for improving the efficiency of resource management in circular economy systems of smart cities

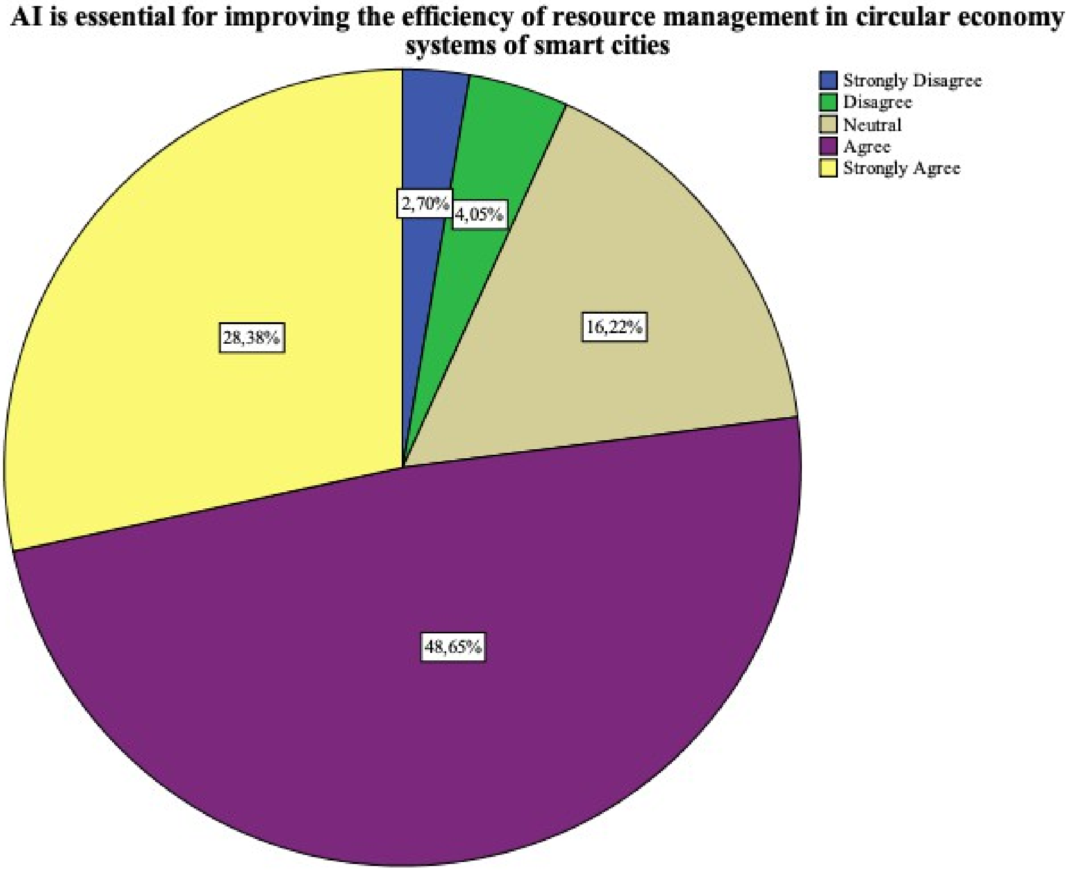


Diagram 2 shows that 45,95% of the participants believe that AI technologies (e.g., machine learning, IoT) can significantly reduce waste and environmental impact in smart cities.

Diagram *2*. AI technologies (e.g., machine learning, IoT) can significantly reduce waste and environmental impact in smart cities

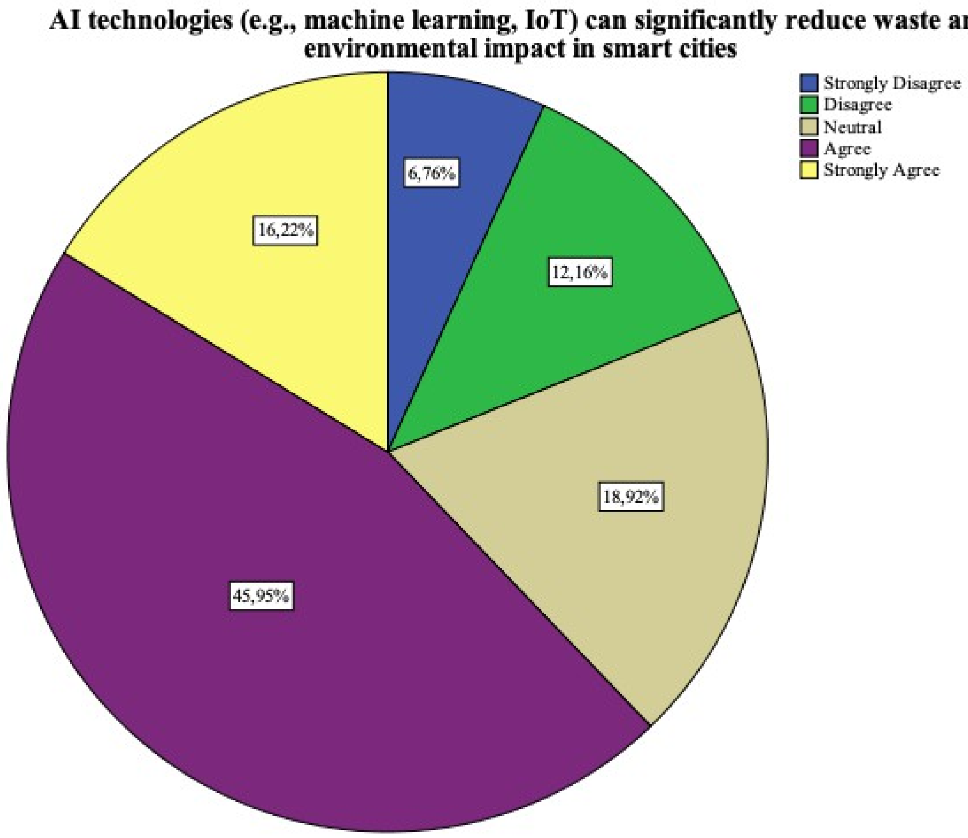


Diagram 3 shows that the highest percentage of the 33,78% of the participants believe that the integration of AI supports innovation in designing circular business models (e.g., reuse, recycling, product life extension) in smart cities.

Diagram *3*. The integration of AI supports innovation in designing circular business models (e.g., reuse, recycling, product life extension) in smart cities

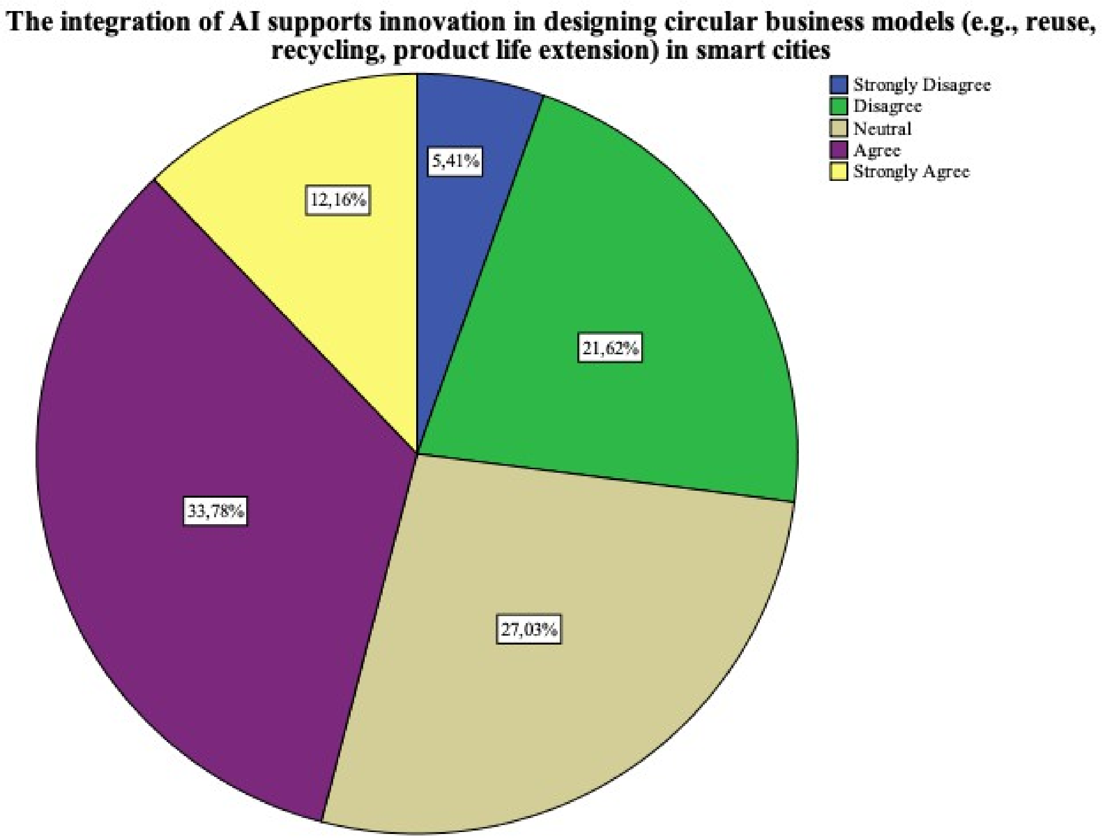


Diagram 4 shows that most of the participants (33,78%) believe that the success of AI in circular economy applications depends heavily on cross-sector collaboration (industry, government, academia) in smart cities.

Diagram *4*. The success of AI in circular economy applications depends heavily on cross-sector collaboration (industry, government, academia) in smart cities

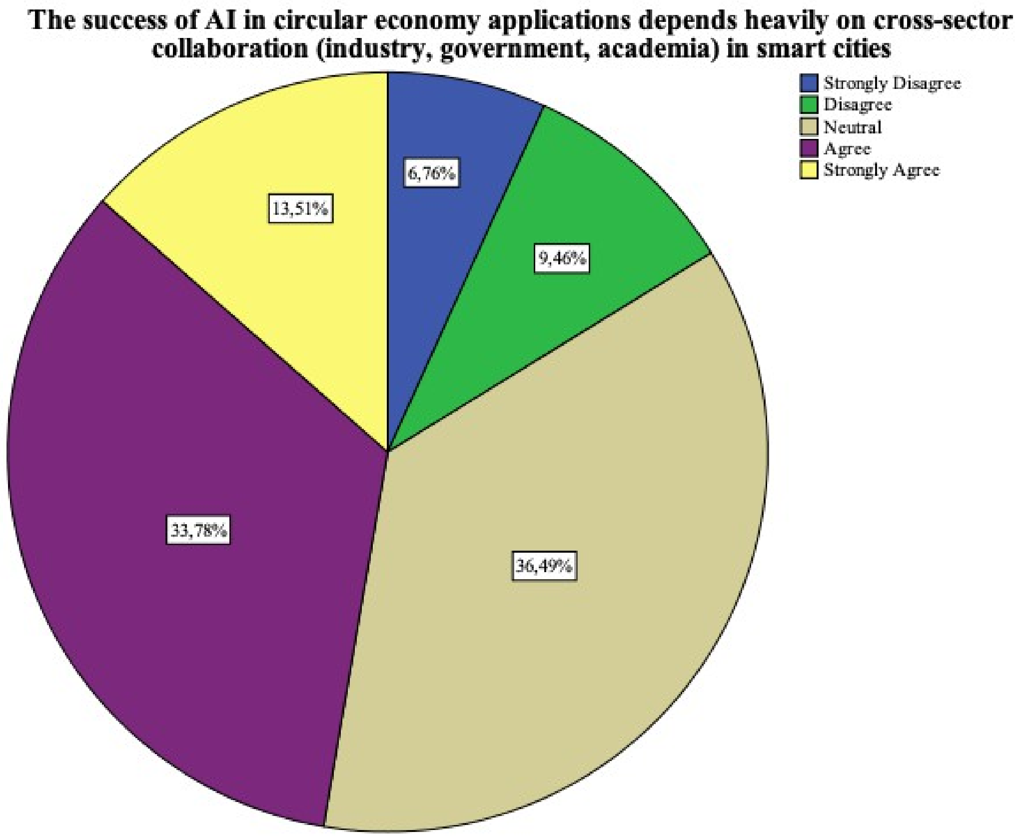


Diagram 5 shows that 51,35% of the participants believe that AI supports innovation and co-creation in smart city circular economy projects.

Diagram 5. AI supports innovation and co-creation in smart city circular economy projects

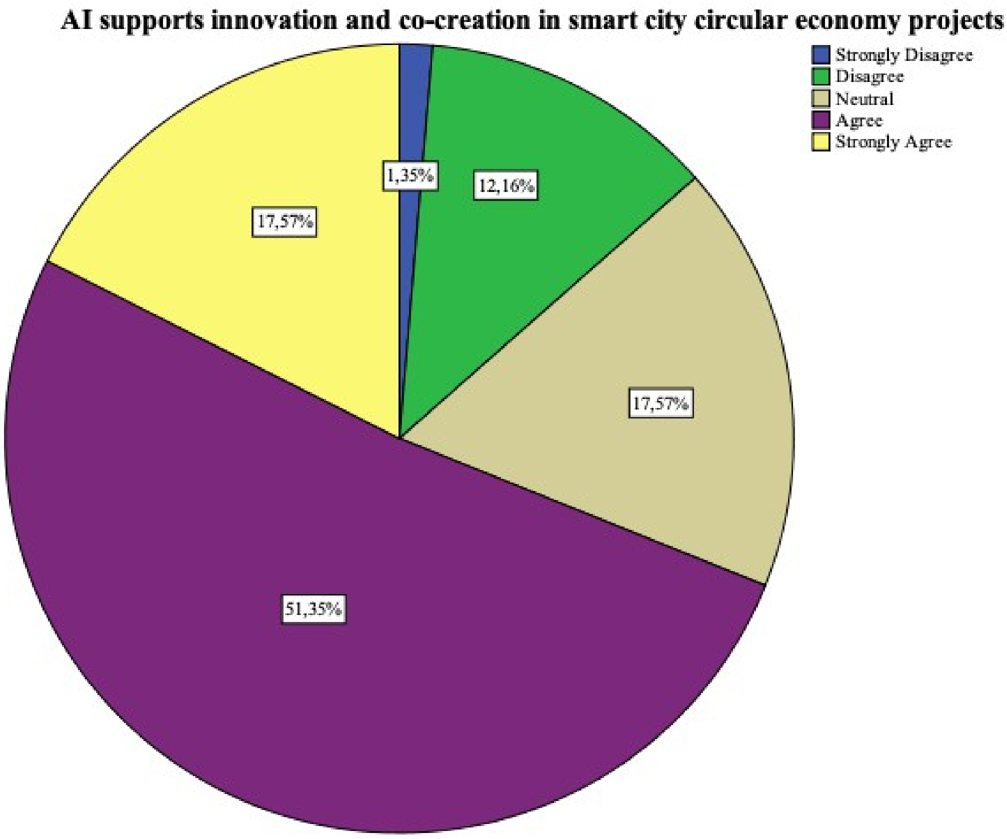


Diagram 6 shows that 44,59% of the participants believe that AI facilitates data-driven decision-making for waste and energy optimization in the urban systems of smart cities.

Diagram *6*. AI facilitates data-driven decision-making for waste and energy optimization in the urban systems of smart cities

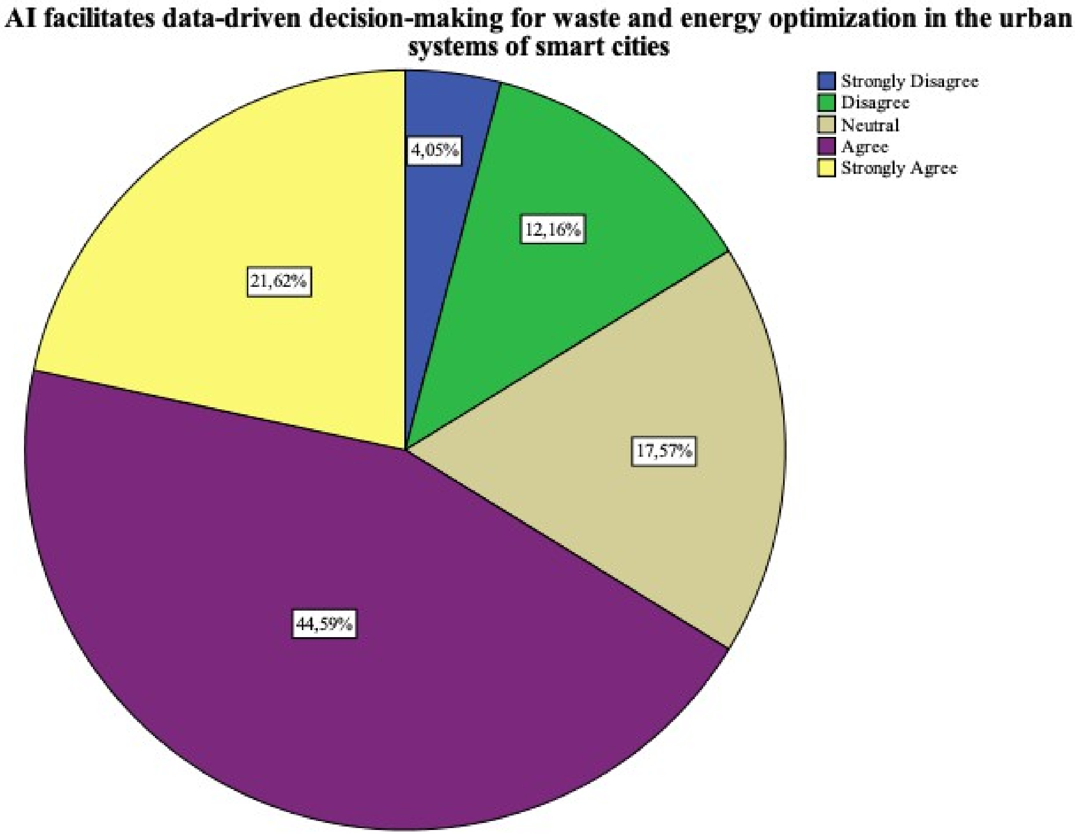


Diagram 7 shows that 44,59% of the participants believe that AI-enabled monitoring tools improve transparency and citizen trust in circular urban initiatives in smart cities.

Diagram 7. AI-enabled monitoring tools improve transparency and citizen trust in circular urban initiatives in smart cities

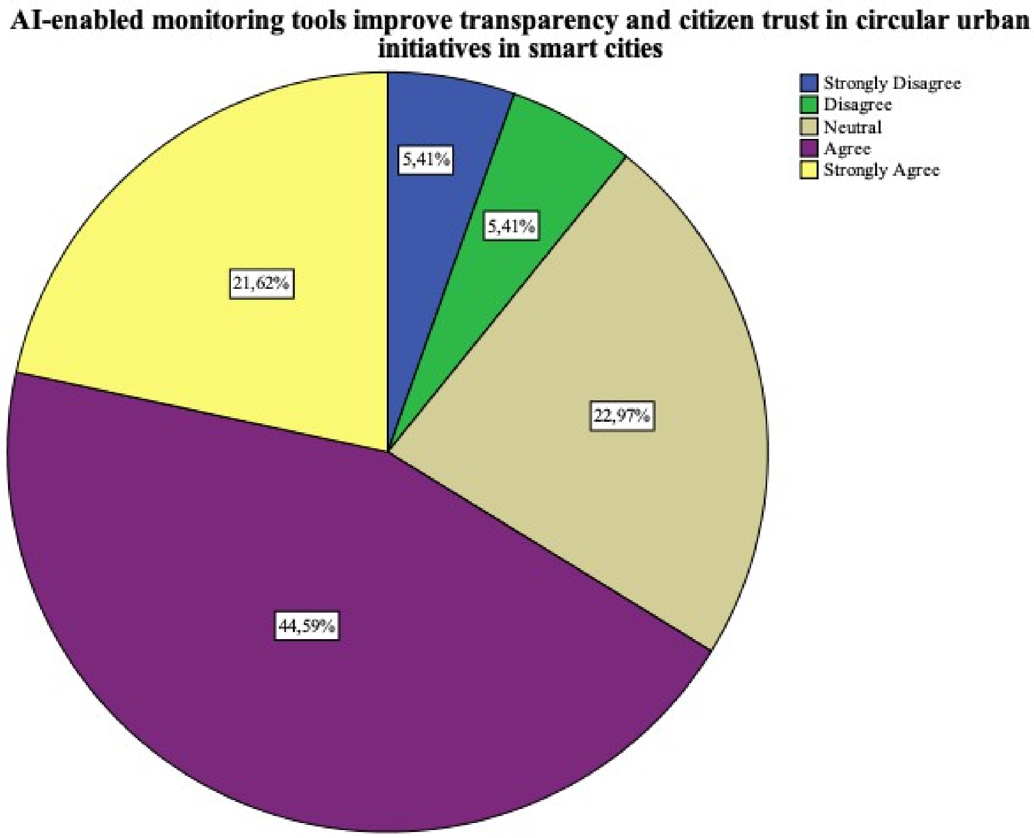


Diagram 8 shows that 55,41% of the participants believe that AI helps city authorities design innovative circular strategies (e.g., smart waste, energy sharing).

Diagram *8*. AI helps city authorities design innovative circular strategies (e.g., smart waste, energy sharing)

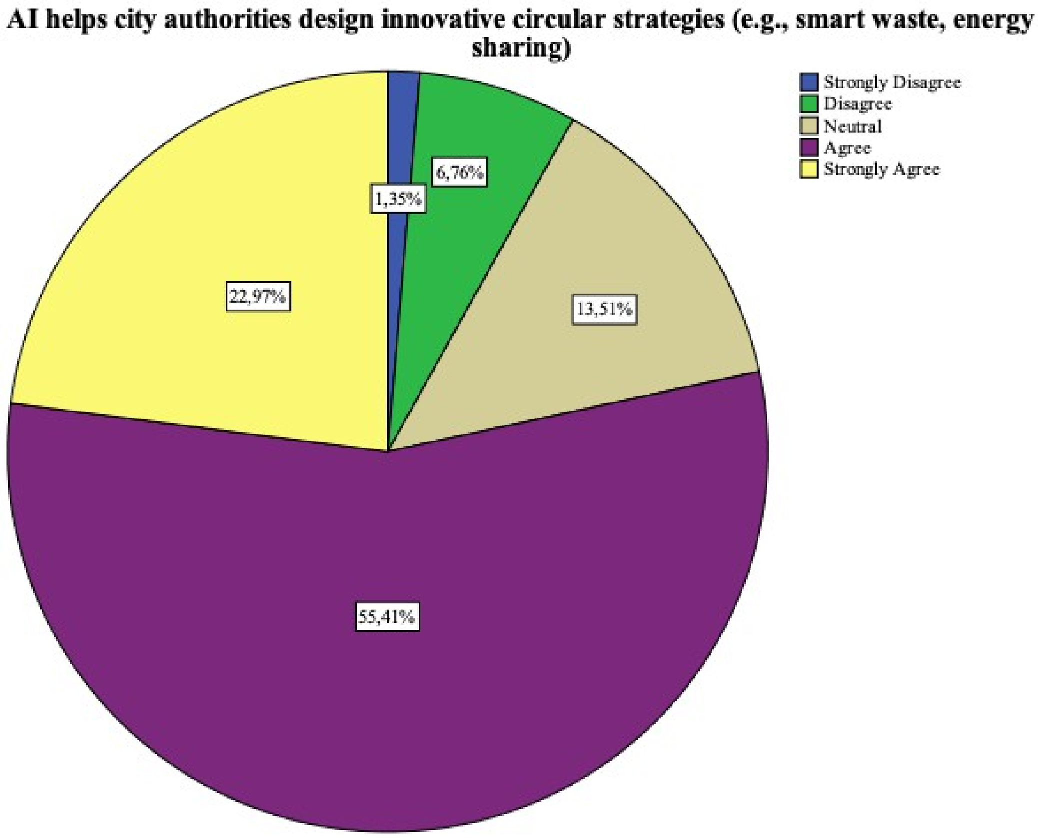


Table 2 presents the answers of the IT experts about the perceived AI-driven innovation and governance in smart cities:

Table *2*. Perceived AI-Driven Innovation and Governance in Smart Cities (Q2)

	N

AI contributes to improving the quality of life in smart cities through better governance and service delivery	Strongly Disagree	1
	Disagree	3
	Neutral	8
	Agree	41
	Strongly Agree	21
AI applications (e.g., predictive analytics, automation) enhance operational efficiency and cost-effectiveness in smart city infrastructure	Strongly Disagree	2
	Disagree	3
	Neutral	8
	Agree	38
	Strongly Agree	23
The use of AI in smart cities encourages citizen participation and supports social inclusion	Strongly Disagree	2
	Disagree	16
	Neutral	11
	Agree	32
	Strongly Agree	13
There is adequate awareness and training among smart city stakeholders to ensure responsible use of AI technologies	Strongly Disagree	9
	Disagree	17
	Neutral	19
	Agree	18
	Strongly Agree	11
The integration of AI in smart city projects has achieved a positive socio-economic impact so far	Strongly Disagree	6
	Disagree	10

	Neutral	22
	Agree	25
	Strongly Agree	11
Smart cities that invest in AI R&D show higher innovation performance	Strongly Disagree	1
	Disagree	8
	Neutral	14
	Agree	38
	Strongly Agree	13
AI solutions encourage interdepartmental collaboration in municipalities	Strongly Disagree	5
	Disagree	10
	Neutral	11
	Agree	35
	Strongly Agree	13
Innovation policies in smart cities enhance citizen engagement in AI-based initiatives	Strongly Disagree	3
	Disagree	8
	Neutral	13
	Agree	39
	Strongly Agree	11
The level of digital infrastructure determines the success of AI-driven innovation of smart cities	Strongly Disagree	2
	Disagree	3
	Neutral	12
	Agree	40

	Strongly Agree	17
AI contributes to the smart cities' innovation culture and knowledge sharing	Strongly Disagree	2
	Disagree	4
	Neutral	10
	Agree	45
	Strongly Agree	13

Diagram 9 shows that 55,41% of the respondents believe that AI contributes to improving the quality of life in smart cities through better governance and service delivery.

Diagram *9*. AI contributes to improving the quality of life in smart cities through better governance and service delivery

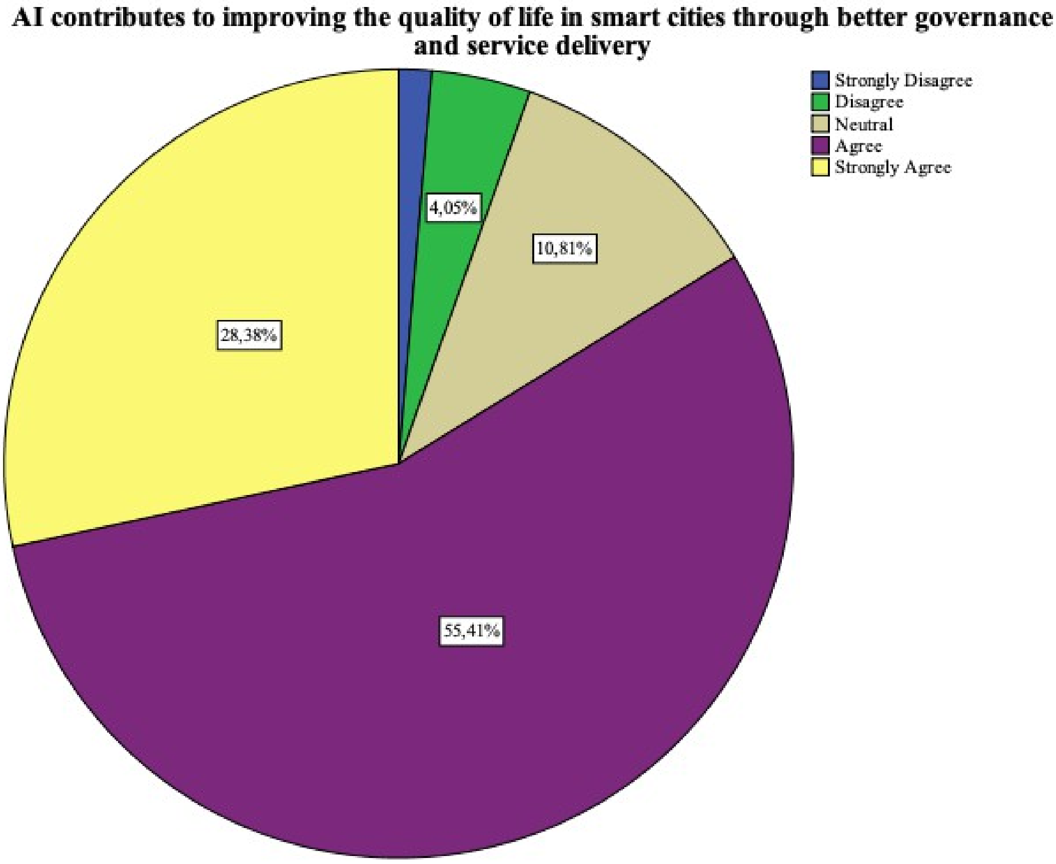


Diagram 10 shows that 51,35% of the participants believe that AI applications (e.g., predictive analytics, automation) enhance operational efficiency and cost-effectiveness in smart city infrastructure.

Diagram *10*. AI applications (e.g., predictive analytics, automation) enhance operational efficiency and cost-effectiveness in smart city infrastructure

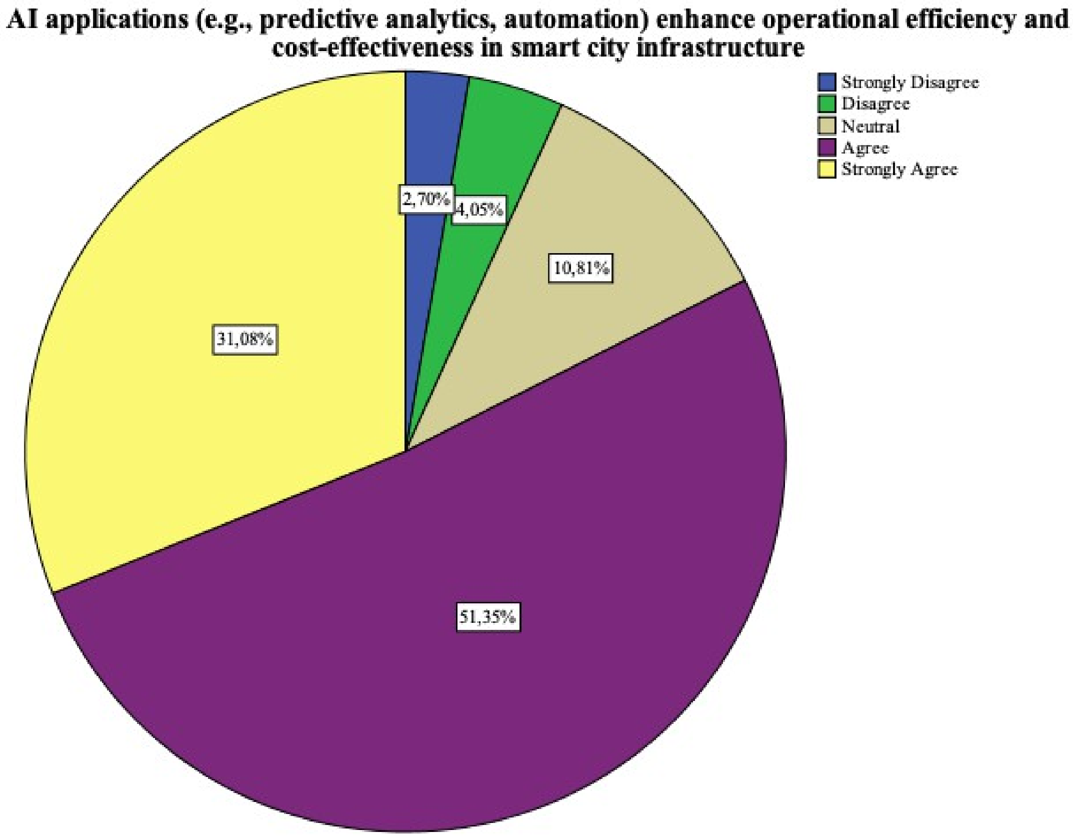


Diagram 11 shows that 43,24% of the participants believe that the use of AI in smart cities encourages citizen participation and supports social inclusion.

Diagram *11*. AI contributes to improving the quality of life in smart cities through better governance and service delivery

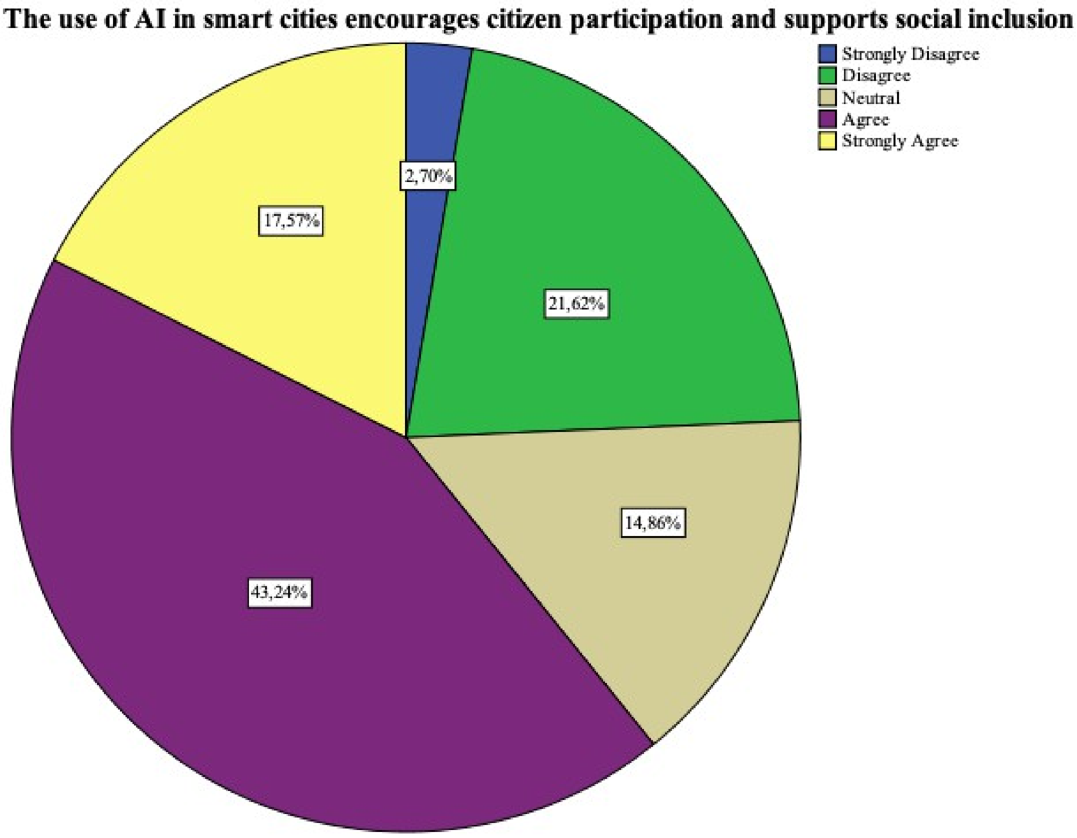


Diagram 12 shows that 24,32% of the participants believe that rhere is adequate awareness and training among smart city stakeholders to ensure responsible use of AI technologies, while 25,68% are neutral.

Diagram *12*. There is adequate awareness and training among smart city stakeholders to ensure responsible use of AI technologies

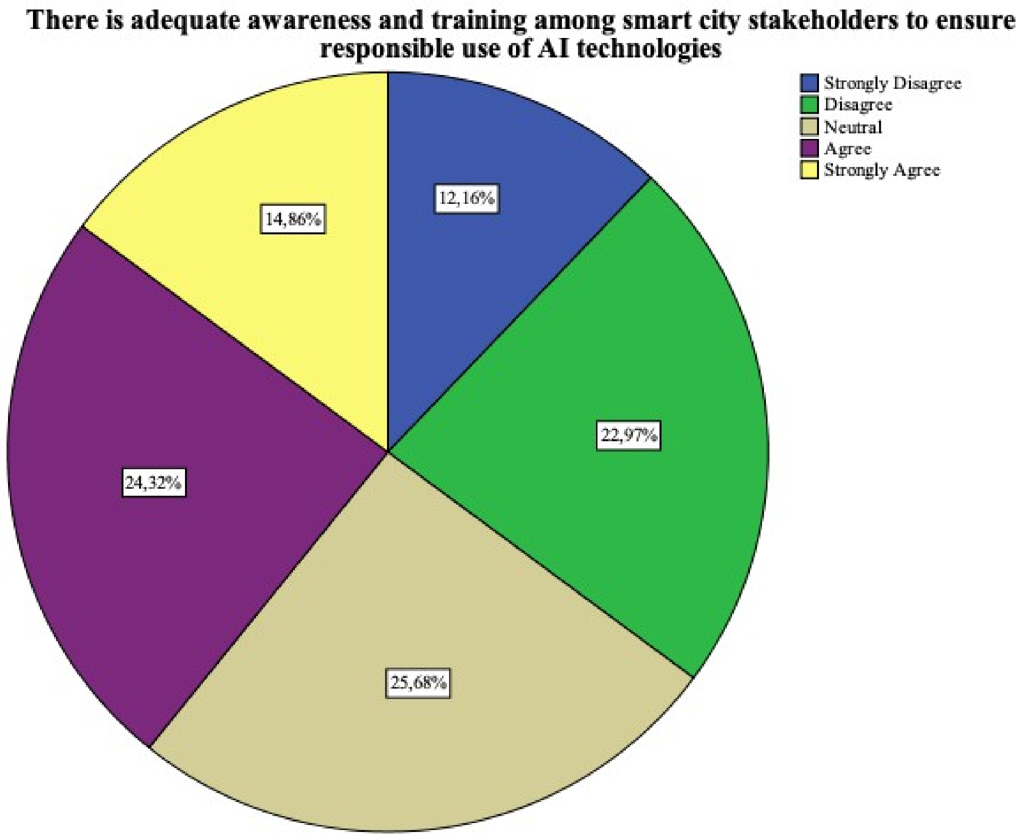


Diagram 13 shows that the highest percentage of 33,78% of the participants believe that the integration of AI in smart city projects has achieved a positive socio-economic impact so far.

Diagram *13*. The integration of AI in smart city projects has achieved a positive socio-economic impact so far

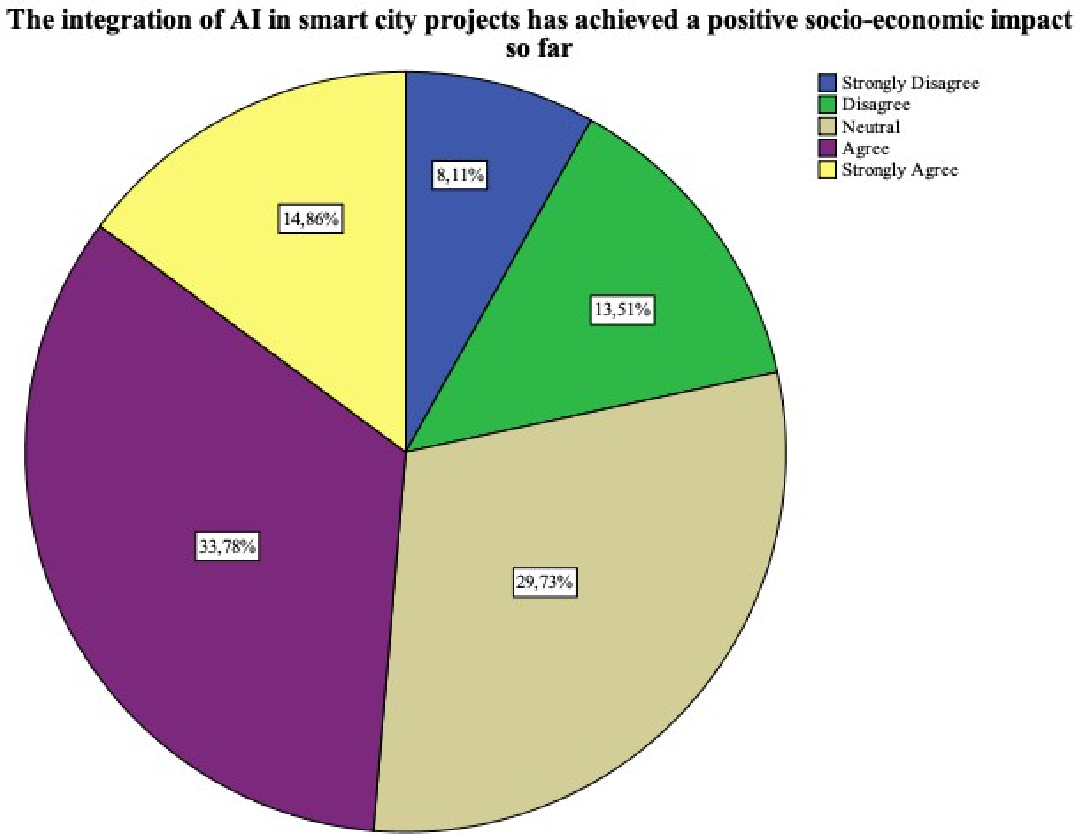


Diagram 14 shows that most of the respondents (51,35%) believe thatsSmart cities that invest in AI R&D show higher innovation performance.

Diagram *14*. Smart cities that invest in AI R&D show higher innovation performance

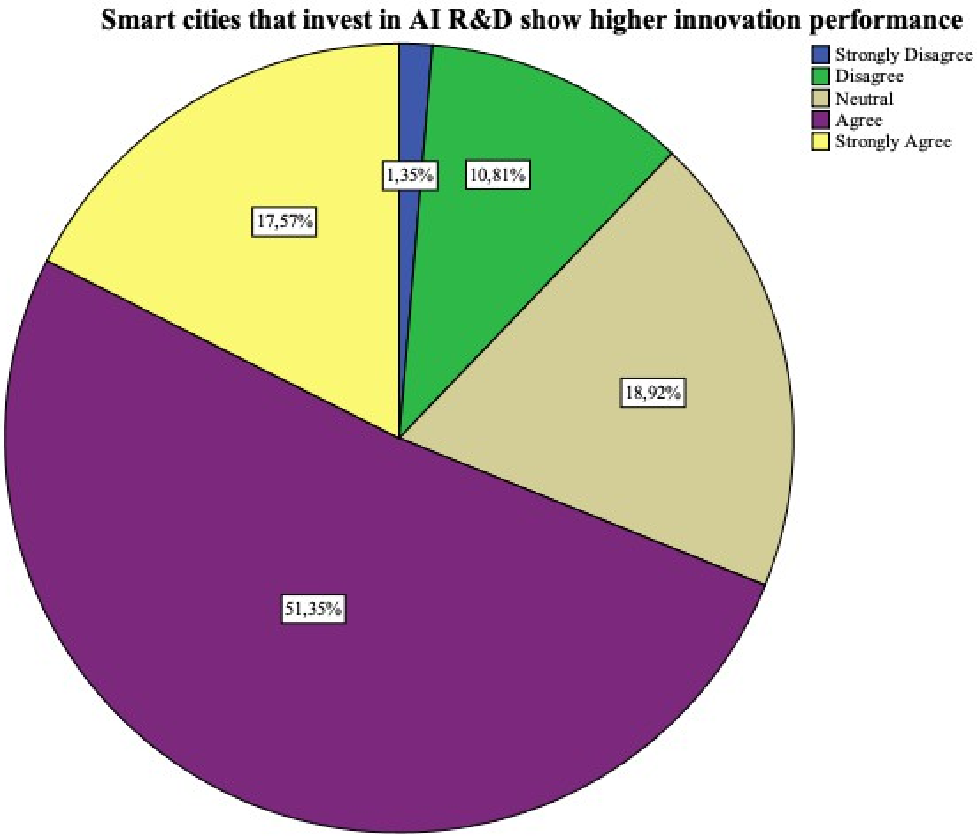


Diagram 15 shows that 47,30% of the participants believe that AI solutions encourage interdepartmental collaboration in municipalities.

Diagram *15*. AI solutions encourage interdepartmental collaboration in municipalities

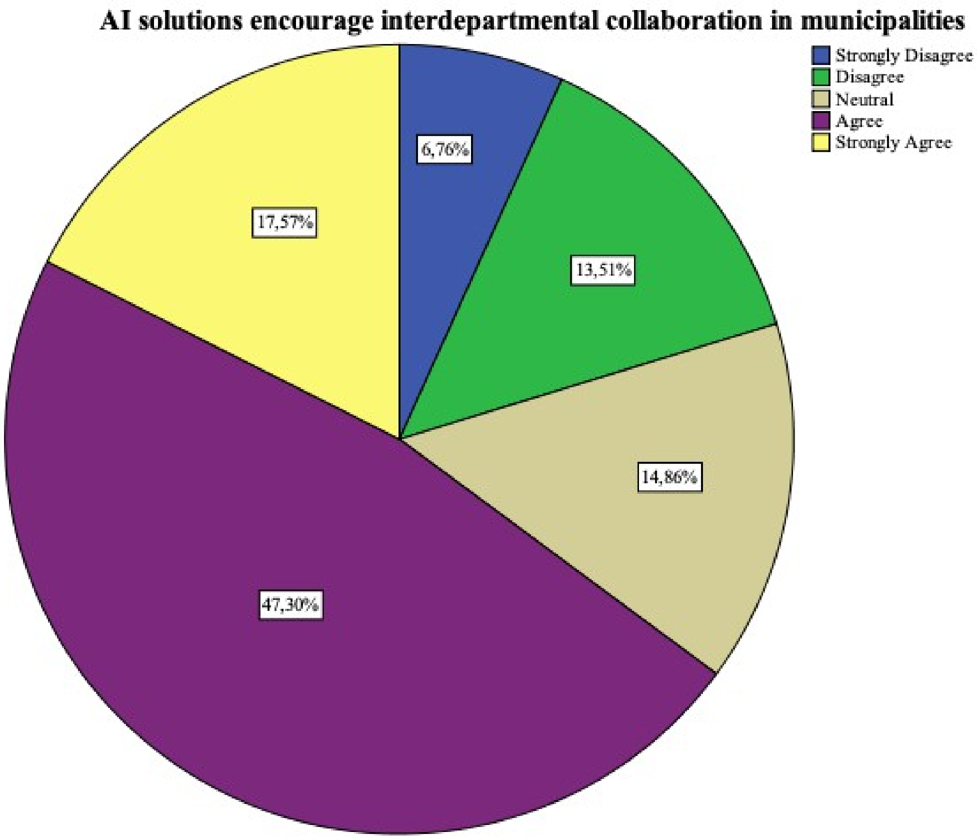


Diagram 16 shows that 52,70% of the respondents believe that innovation policies in smart cities enhance citizen engagement in AI-based initiatives.

Diagram *16*. Innovation policies in smart cities enhance citizen engagement in AI-based initiatives

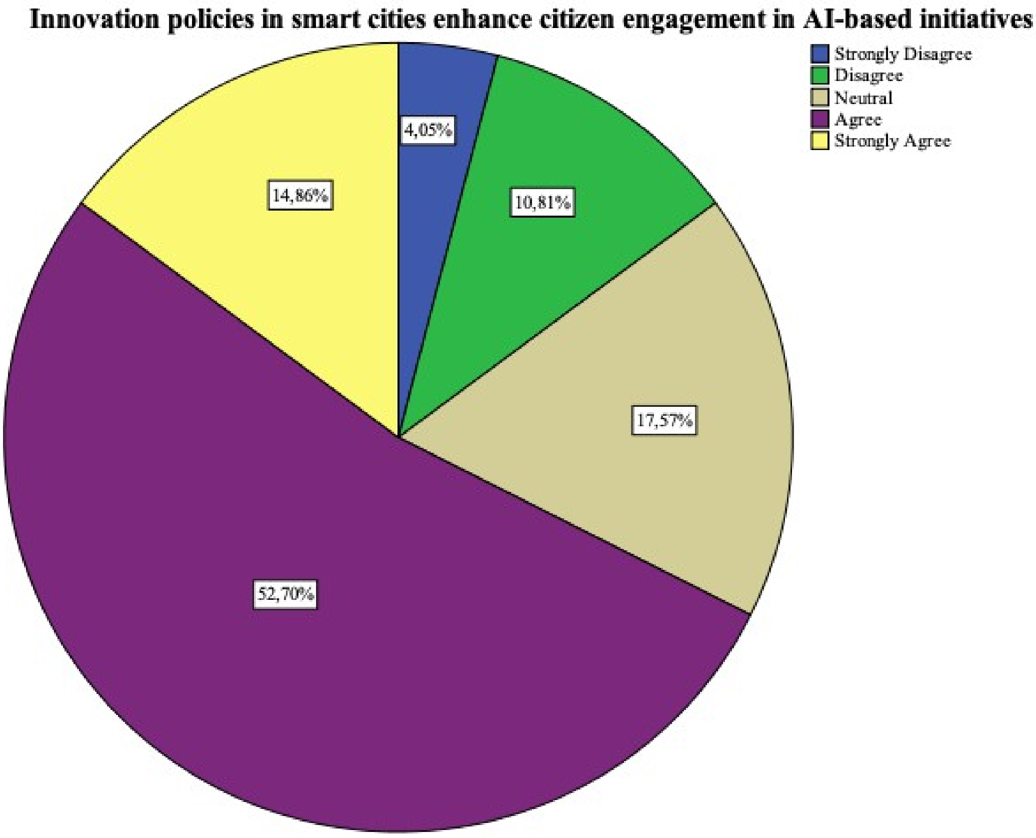


Diagram 17 shows that most of the respondents (54,05%) believe that the level of digital infrastructure determines the success of AI-driven innovation of smart cities.

Diagram *17*. The level of digital infrastructure determines the success of AI-driven innovation of smart cities

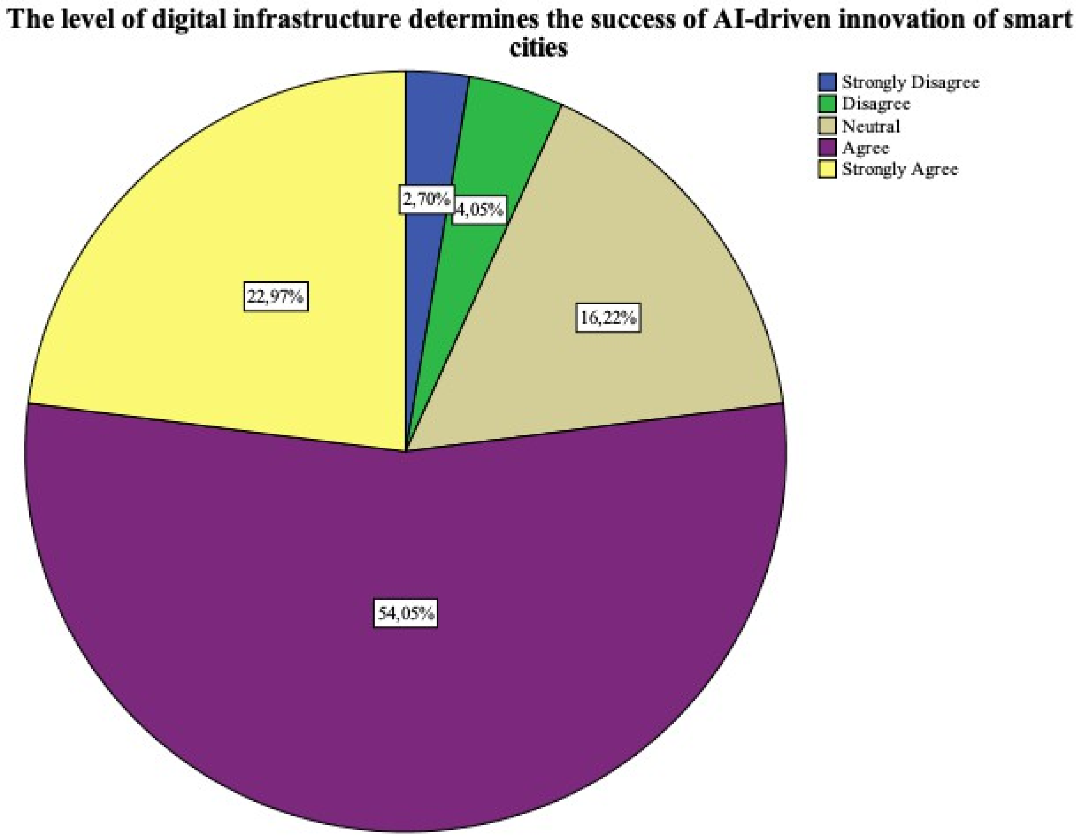


Diagram 18 shows that 60,81% of the participants believe that AI contributes to the smart cities' innovation culture and knowledge sharing.

Diagram ***18*****. AI contributes to the smart cities' innovation culture and knowledge sharing**

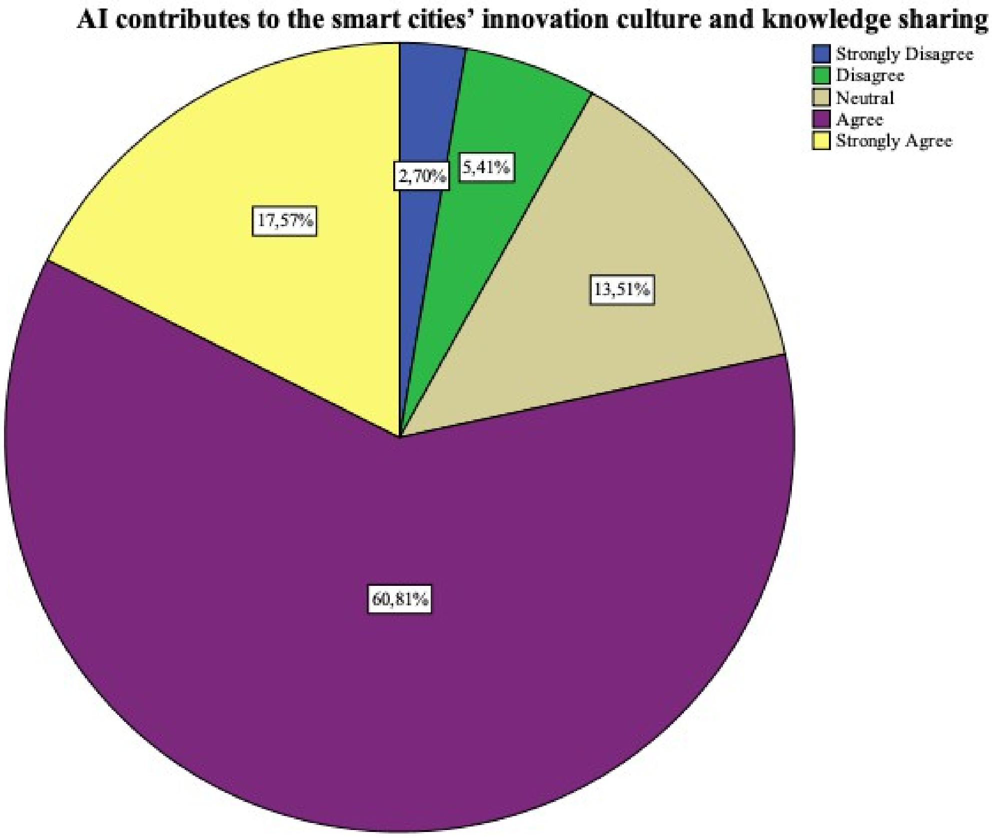


Table 3 presents the answers of the IT experts about the social entrepreneurship in smart cities:

Table ***3*****. Psychological Distance (Q3)**

		N
	Strongly Disagree	3

Social entrepreneurship plays a crucial role in promoting AI-based sustainable innovations in smart cities	Disagree	3
	Neutral	9
	Agree	45
	Strongly Agree	14
Initiatives led by social enterprises can effectively connect technological innovation with social and environmental goals in smart cities	Strongly Disagree	2
	Disagree	2
	Neutral	11
	Agree	45
	Strongly Agree	14
Citizens are more likely to engage in circular or smart city programs when they perceive tangible social benefits	Strongly Disagree	1
	Disagree	5
	Neutral	12
	Agree	29
	Strongly Agree	27
AI-driven smart city programs stimulate the emergence of social startups	Strongly Disagree	3
	Disagree	3
	Neutral	17
	Agree	38
	Strongly Agree	13
Collaborations between public authorities and social entrepreneurs accelerate sustainable innovation in smart cities	Strongly Disagree	1
	Disagree	4
	Neutral	9

	Agree	36
	Strongly Agree	24
Social entrepreneurship in smart cities enhances community resilience and inclusion	Strongly Disagree	1
	Disagree	4
	Neutral	10
	Agree	41
	Strongly Agree	18

Diagram 9 shows that 60,81% of the participants believe that social entrepreneurship plays a crucial role in promoting AI-based sustainable innovations in smart cities.

Diagram *19*. Social entrepreneurship plays a crucial role in promoting AI-based sustainable innovations in smart cities

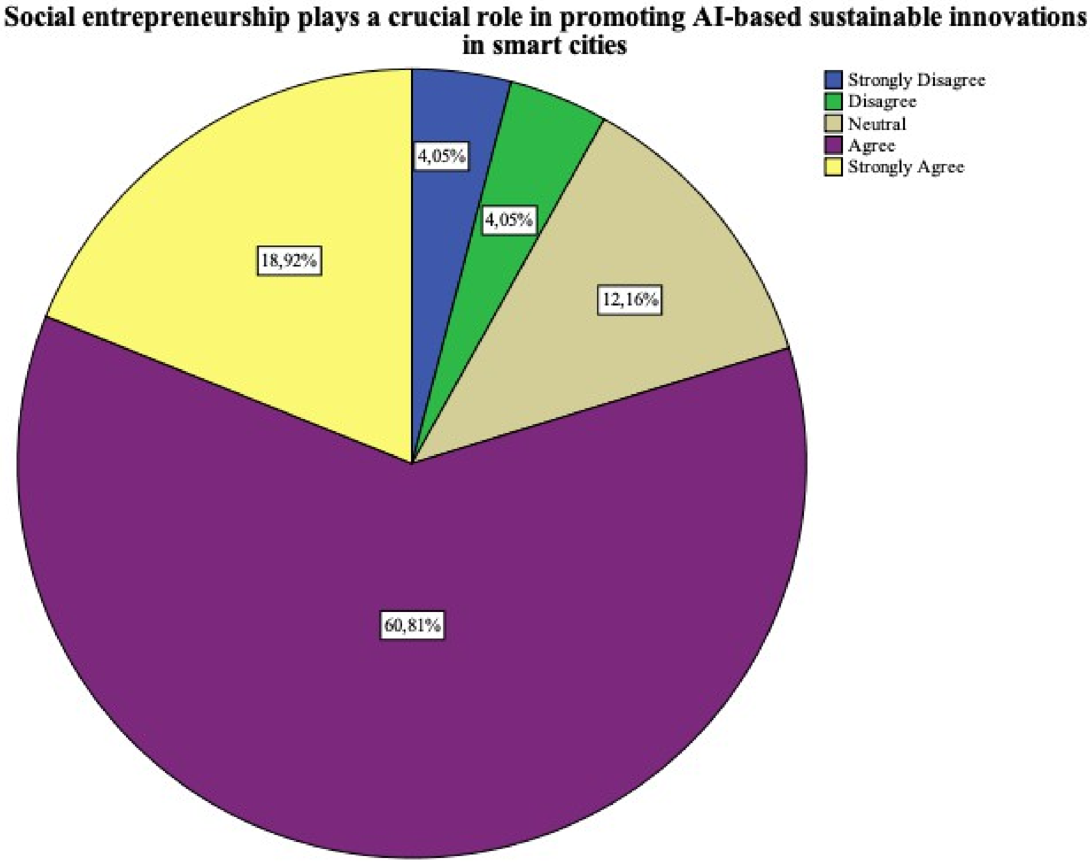


Diagram 20 shows that 60,81% of the respondents believe that initiatives led by social enterprises can effectively connect technological innovation with social and environmental goals in smart cities.

Diagram *20*. Initiatives led by social enterprises can effectively connect technological innovation with social and environmental goals in smart cities

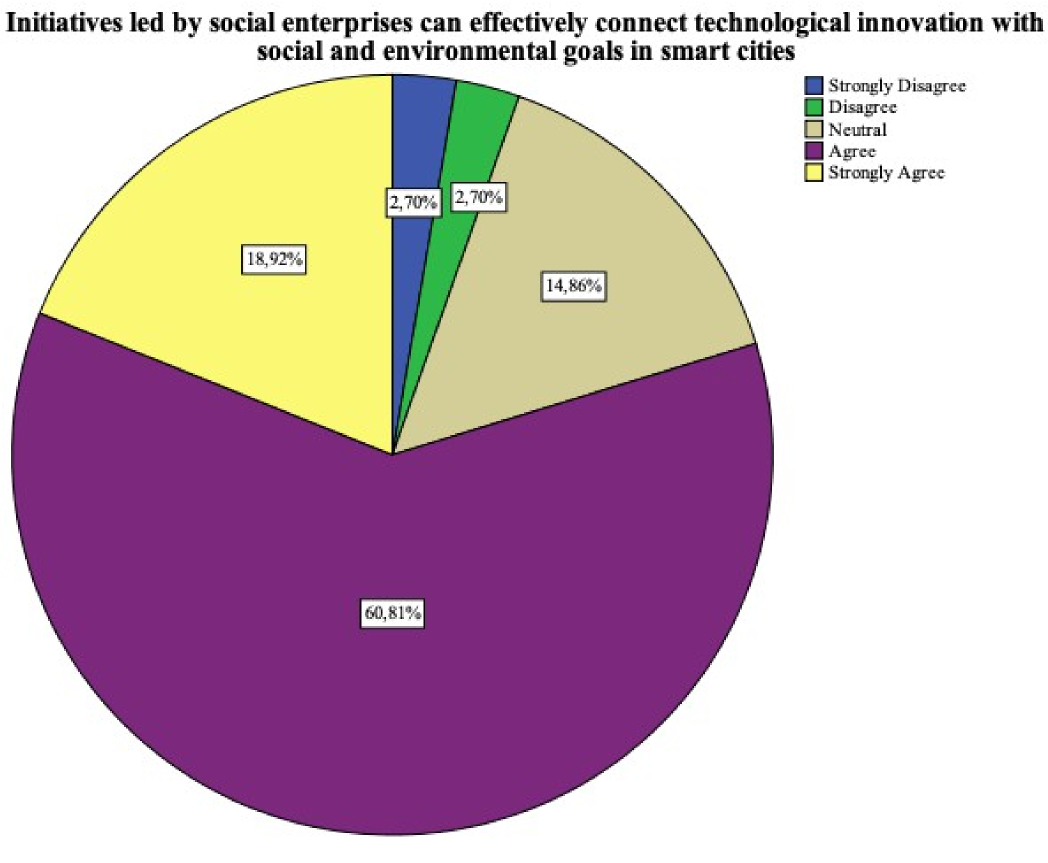


Diagram 21 shows that most of the participants (39,19%) believe that citizens are more likely to engage in circular or smart city programs when they perceive tangible social benefits. 36,49% of the participants strongly agree with this statement.

Diagram *21*. Citizens are more likely to engage in circular or smart city programs when they perceive tangible social benefits

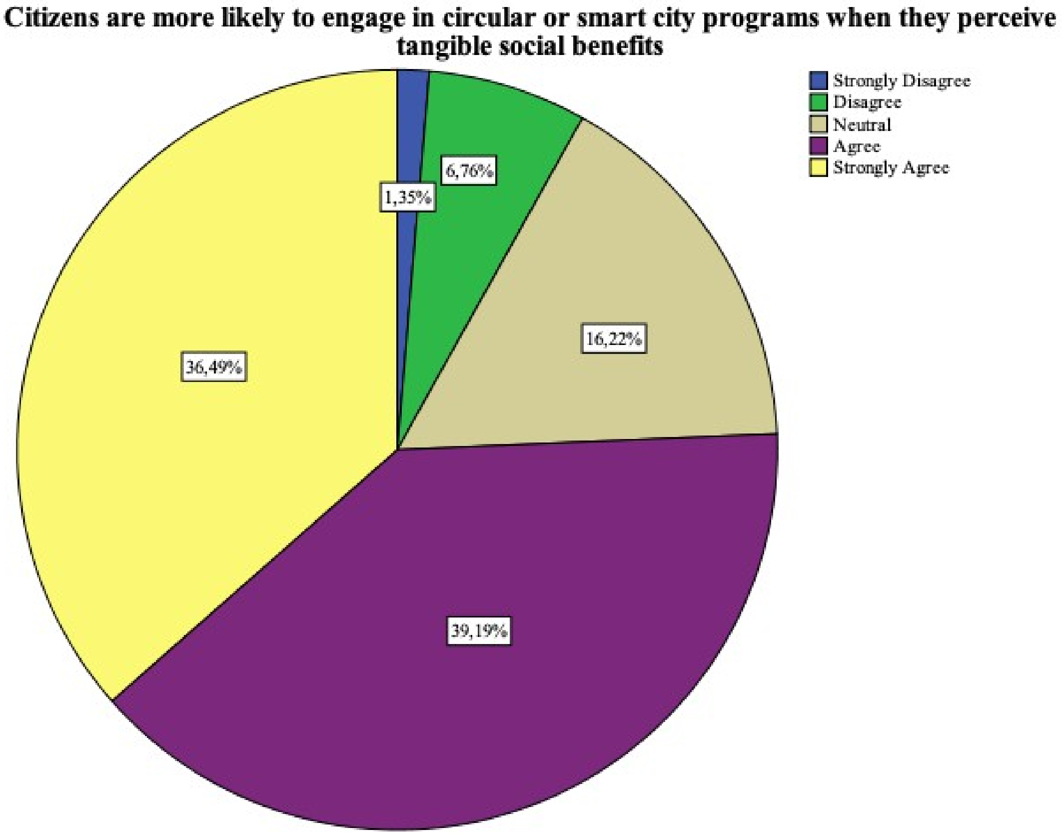


Diagram 22 shows that 51,35% of the participants believe that AI-driven smart city programs stimulate the emergence of social startups.

Diagram *22*. AI-driven smart city programs stimulate the emergence of social startups

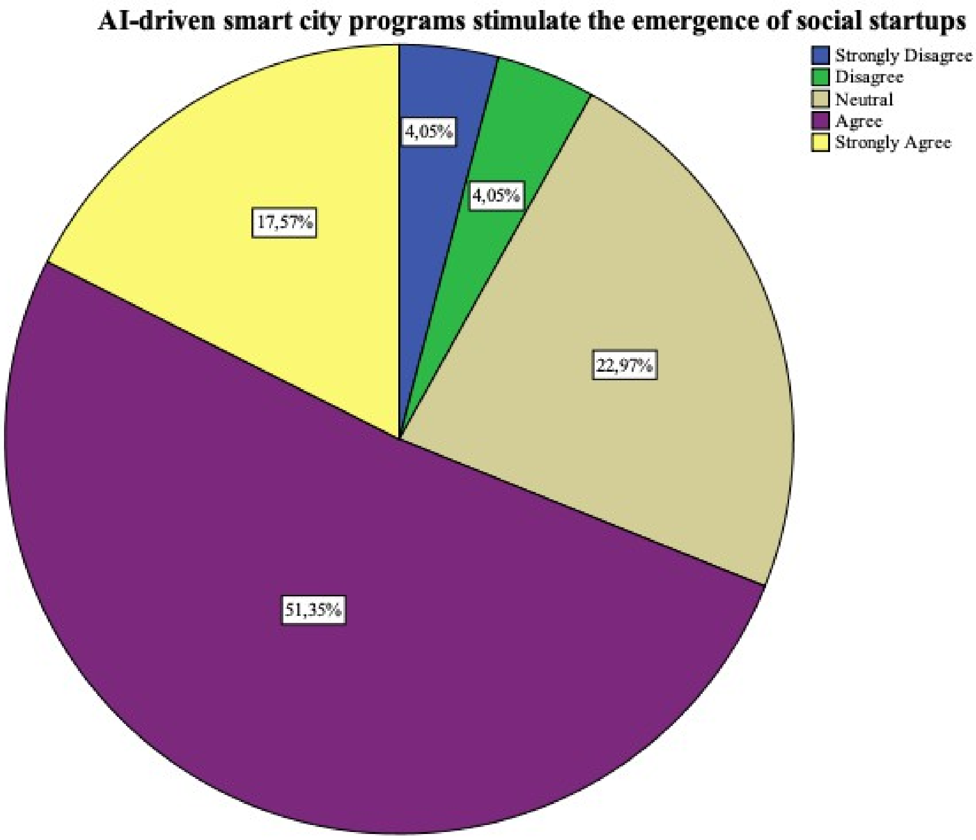


Diagram 23 shows that 48,65% of the respondents believe that collaborations between public authorities and social entrepreneurs accelerate sustainable innovation in smart cities.

Diagram *23*. Collaborations between public authorities and social entrepreneurs accelerate sustainable innovation in smart cities

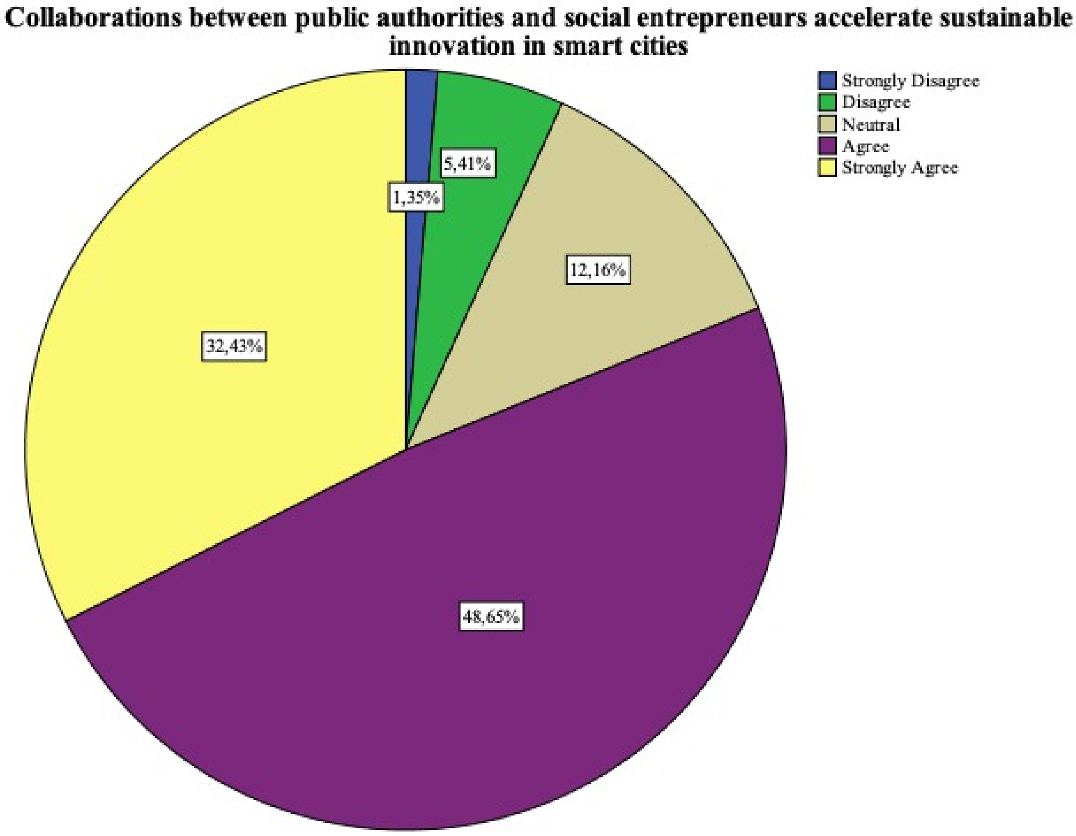


Diagram 24 shows that 55,41% of the respondents believe that social entrepreneurship in smart cities enhances community resilience and inclusion.

Diagram *24*. Social entrepreneurship in smart cities enhances community resilience and inclusion

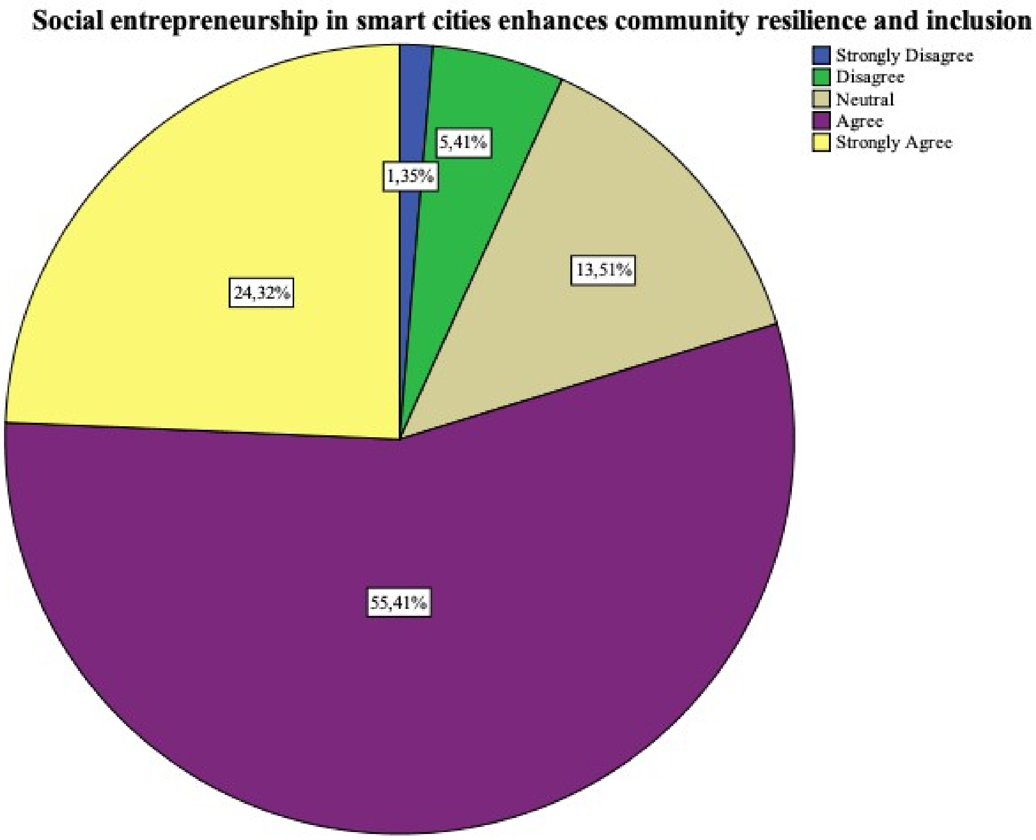


Table 4 presents the answers of the IT experts about the psychological distance in smart cities:

Table *4*. Psychological Distance (Q4)

		N
Psychological distance (feeling that environmental or technological issues are	Disagree	5
	Neutral	11

“distant” from one’s daily life) limits citizen participation in smart city initiatives	Agree	45
	Strongly Agree	13
I feel that smart city projects do not directly affect my everyday life	Strongly Disagree	11
	Disagree	25
	Neutral	18
	Agree	18
	Strongly Agree	2
AI-based sustainability initiatives often feel too abstract to relate to personally	Strongly Disagree	9
	Disagree	18
	Neutral	21
	Agree	20
	Strongly Agree	6
Receiving personalized feedback (e.g., via apps or sensors) would make me feel more connected to the city’s sustainability goals	Strongly Disagree	4
	Disagree	8
	Neutral	17
	Agree	35
	Strongly Agree	10
Psychological distance decreases when citizens observe tangible results from smart city programs	Strongly Disagree	2
	Disagree	6
	Neutral	12
	Agree	32
	Strongly Agree	22

Diagram 25 shows that 60,81% of the respondents believe that psychological distance (feeling that environmental or technological issues are “distant” from one’s daily life) limits citizen participation in smart city initiatives.

Diagram *25*. Psychological distance (feeling that environmental or technological issues are “distant” from one’s daily life) limits citizen participation in smart city initiatives

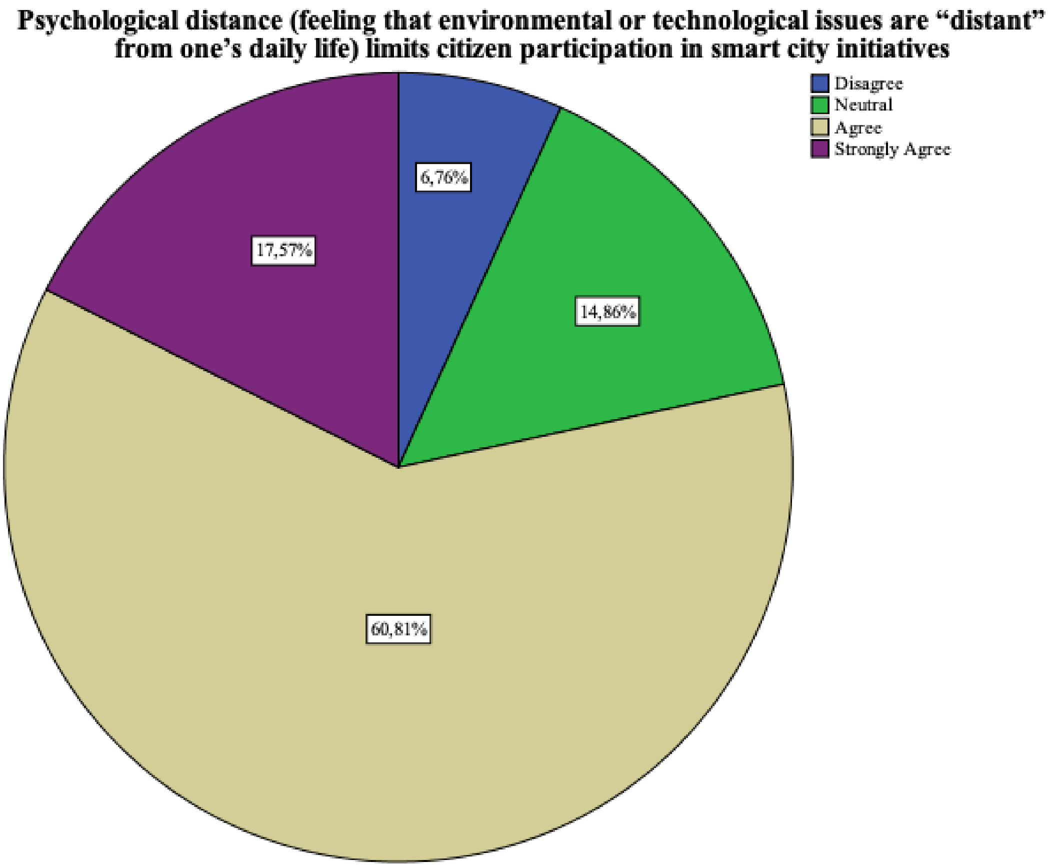


Diagram 26 shows that 33,78% of the respondents do not feel that smart city projects do not directly affect my everyday life, while 24,32% of the participants are neutral and the same percentage (24,32%) feel that smart city projects do not directly affect my everyday life.

Diagram *26*. I feel that smart city projects do not directly affect my everyday life

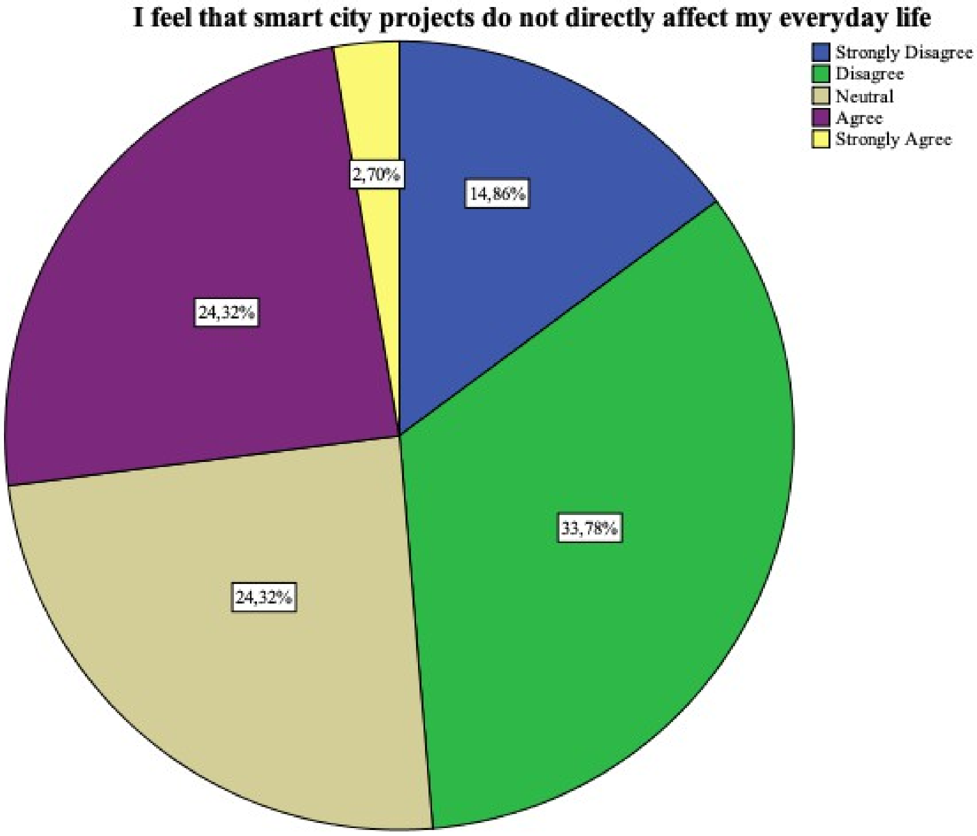


Diagram 27 shows that 28,38% of the participants are neutral about the fact that AI-based sustainability initiatives often feel too abstract to relate to personally. 27,03% of the respondents agree with this statement, while 24,32% disagree with that.

Diagram *27*. AI-based sustainability initiatives often feel too abstract to relate to personally

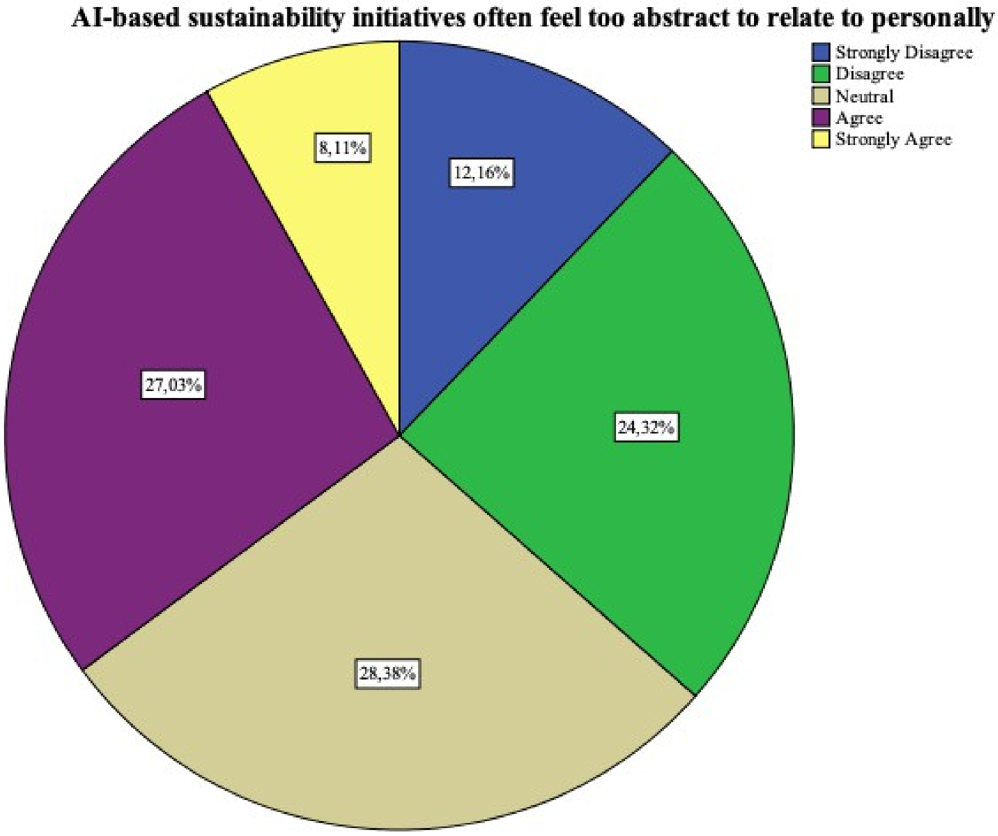


Diagram 28 shows that 47,30% of the respondents believe that receiving personalized feedback (e.g., via apps or sensors) would make me feel more connected to the city's sustainability goals.

Diagram *28*. **Receiving personalized feedback (e.g., via apps or sensors) would make me feel more connected to the city's sustainability goals**

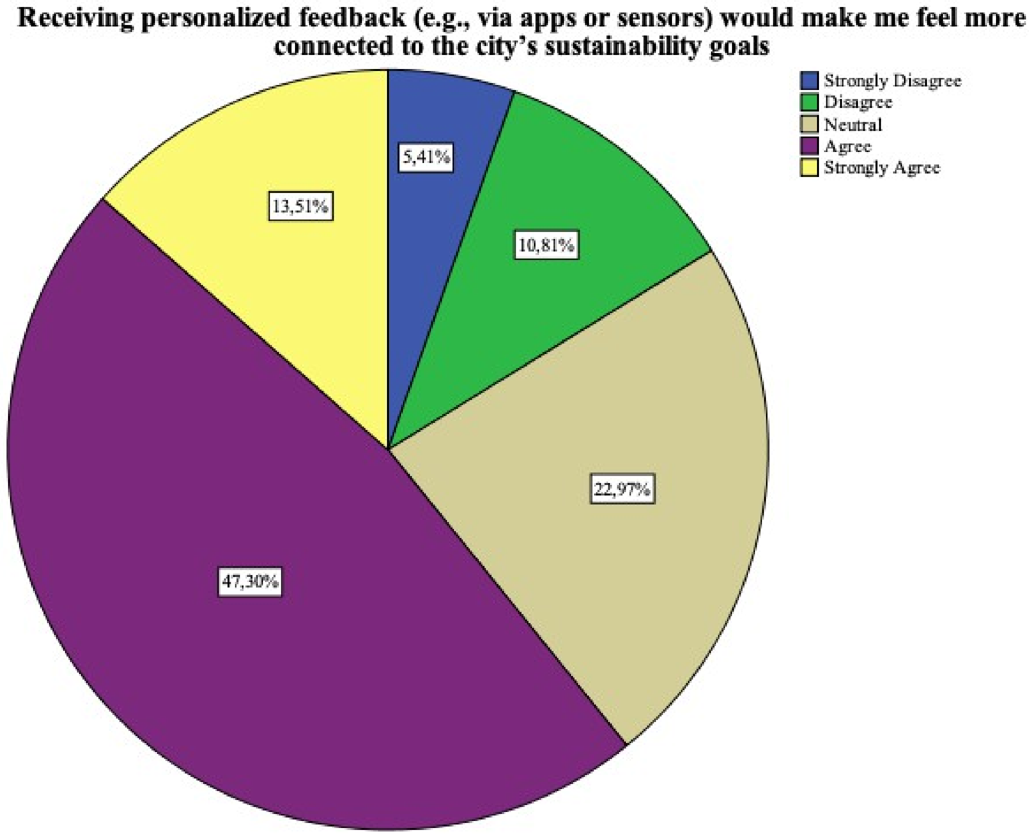


Diagram 29 shows that 43,24% of the participants believe that psychological distance decreases when citizens observe tangible results from smart city programs.

Diagram *29*. Psychological distance decreases when citizens observe tangible results from smart city programs

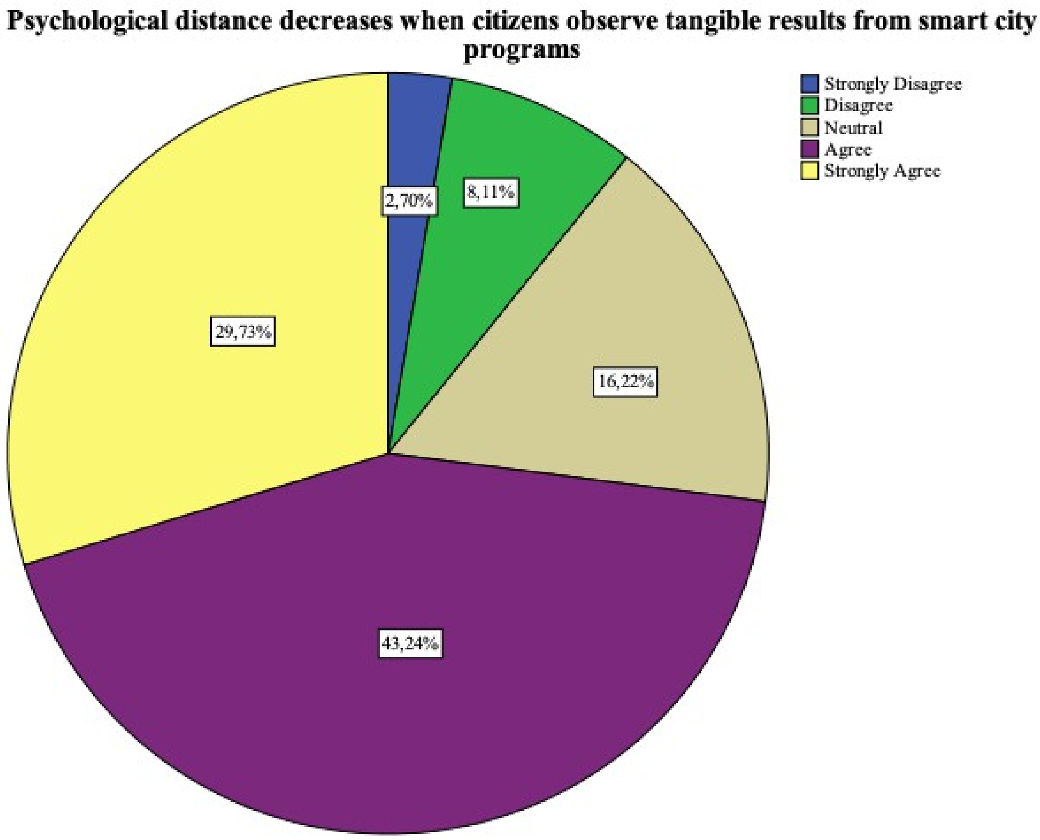


Table 5 presents the descriptive statistics, including means and standard deviations, of the main variables, that are included in the current statistical analysis. Regarding the antecedent variables, Q1 shows a mean value of 3,64, having a standard deviation of 0,82. This result means that respondents moderately agree that artificial intelligence plays an important role in supporting circular economy practices in the smart city's contexts.

Similarly, the variable Q2 shows a mean score of 3,67 and a standard deviation of 0,84. It is about a slightly higher mean value. This mean value suggests that respondents perceive AI-driven innovation and governance mechanisms as an important component of the development of the smart cities.

Then, the mediating variable Q3 shows a mean value of 3,38. This variable presents a lower standard deviation of 0,60. More analytically, compared to the antecedent variables, this variable shows both a slightly lower mean and reduced variability.

Finally, the consequent variable of Q4 presents the highest mean value, that is 3,93. It also has a standard deviation of 0,73. This result shows a generally strong positive orientation toward social entrepreneurship, among the participants.

Table 2. Variables descriptive statistics

Variable	Mean	Std. Deviation
Q1 (Perceived role of AI in the circular economy of smart cities)	3,6436	0,82389
Q2 (Perceived AI-driven innovation and governance in smart cities)	3,6689	0,84285
Q3 (Psychological distance)	3,3838	0,60387
Q4 (Social entrepreneurship)	3,9257	0,72995

4.3 Qualitative research results

The following table presents the summary of the participants' responses on the five open-ended questions:

Table 8. Summary of responses by open-ended question

Question	Main Themes	Indicative Responses
Q1. Annual costs of AI technologies in Greek smart cities	• High uncertainty and lack of knowledge • Perceived low cost for some applications • Perceived high cost for the large-scaled projects • The cost depends on the	"Depends on the application"; "Low cost when successful"; "Millions of euros"; "€50,000 to over €1 million per year"; "High initial cost but long-term benefits"

	application and the scale	
Q2. Risks of AI technologies in Greek smart cities	• Privacy and data protection • Cybersecurity threats • Loss of freedom and surveillance • Governance failures and misuse • Inequality and exclusion • System failure and lack of infrastructure	"Loss of privacy"; "Cybersecurity vulnerabilities"; "Mass surveillance"; "Algorithmic bias"; "Lack of transparency"; "Blackouts and system collapse"; "Public mistrust"
Q3. Client / citizen response to AI in smart cities	• Cautiously positive attitudes • Skepticism and uncertainty • Conditional acceptance, that is based on trust and benefits • Low awareness and limited exposure	"Generally positive but skeptical"; "Depends on tangible benefits"; "Low interest due to lack of infrastructure"; "Excited but uninformed"; "Cautious acceptance"
Q4. Influence of AI on SE	• Emerging and uneven influence • Enablement through data and efficiency • Applications in mobility, energy and waste, accessibility • Concerns about superficial or symbolic use of the AI	"AI enables data-driven social solutions"; "Smart mobility and waste management"; "Chatbots in municipalities"; "Still emerging in Greece"; "AI used as a label rather than substance"
Q5. Target population of social entrepreneurs	• Vulnerable and underserved groups • Youth and unemployed • Elderly and people with disabilities • Urban populations and municipalities • Broad and undefined target groups	"Unemployed youth and NEETs"; "Elderly and disabled"; "Low-income households"; "Urban residents"; "Municipalities"; "Everyone/community-oriented"

As it is critically observed in the context of Table 8, the respondents' answers show a high degree of uncertainty. They also present high levels of fragmentation and ambivalence, concerning the implementation of AI technologies in the Greek smart cities.

As for the perceived annual costs of the AI initiatives, the most dominant theme is uncertainty. Also, the dominant theme is the lack of concrete knowledge. Also, in relation to risks, the participants' responses converge strongly around concerns that are related to privacy and data protection. These concerns are also related to cybersecurity and surveillance, as well.

Then, the participants; responses to AI technologies in Greek smart cities are described as cautiously positive. But at the same time they are conditional, too. More analytically, on the one hand, many respondents declared curiosity, excitement, and appreciation for efficiency gains. On the other hand, these attitudes were accompanied by skepticism and uncertainty. This means a limited trust.

Also, AI's influence on social entrepreneurship is shown as emerging. At the same time, it seems to be uneven. In more analysis, respondents identified concrete applications in mobility, energy management and waste optimization. They also mentioned applications in accessibility for people with disabilities and digital public services, too. At the same time, they expressed concerns. These concerns were about superficial or symbolic uses of AI. This supports the quantitative finding that social entrepreneurship is driven mainly by the perceived concrete role of AI and that it is not driven by abstract innovation narratives.

Finally, social entrepreneurs are perceived to cater to vulnerable and underserved population groups. They indicatively include unemployed youth, elderly people, individuals with disabilities and migrants or low-income households.

CHAPTER 5. CONCLUSIONS, LIMITATIONS AND SUGGESTIONS

5.1 Conclusions

The aim of this dissertation was to investigate how professionals and stakeholders perceive the AI's contribution to the circular economy and smart city innovation.

More specifically, the research findings of this study showed that psychological distance (Q3) that concerns AI integration in smart cities is neutral. Also, the results shows that the perceived role of AI in the circular economy of smart cities (Q1) and the perceived AI-driven innovation and governance in smart cities (Q2) are equally high, according to the point of view of the IT experts. Finally, social entrepreneurship in smart cities (Q4) presented the highest mean score.

The above-mentioned research results partially agree with prior studies, like the ones of Caputo et al. (2023), Cortés-Cediel et al. (2021) and Zeng et al. (2025). These studies mention the role of psychological distance in shaping citizens' engagement with the initiatives to sustainability. More analytically, these studies supported that perceived proximity increases participation and trust in the projects of smart cities.

A possible explanation for the fact that there was a partial and not a fully agreement is the national and institutional context of Greece. It is a context, that differs substantially from the contexts that are examined in many previous studies. It is a fact, that Greece represents a country with moderate digital maturity. Also, Greece has relatively limited large-scale implementation of AI-driven smart city initiatives, at least in comparison to Northern and Western European countries. Therefore, the AI-enabled sustainability initiatives may still be perceived as fragmented or experimental.

Moreover, neutrality that concerns psychological distance may be attributed to the profile of the research sample. More analytically, the research sample consists of IT experts and professionals and not from citizens. IT experts are more likely to approach AI technologies from a technical perspective. They are more possible to focus on feasibility and practical applications.

Consequently, the psychological distance may be less salient for this research sample. The reason is that their engagement with AI-driven initiatives is shaped more by their professional knowledge, something that could noy happen for example in the case of the citizens.

Even more, the above-mentioned findings of this research about social entrepreneurship are consistent with the existing empirical evidence of Dindarian (2022), Fraga-Lamas et al. (2021) and Panori et al. (2021). It is about a result that supports the argument that social entrepreneurship in smart cities is driven by tangible and role-based perceptions of AI.

Therefore, social entrepreneurship in smart cities is not driven by affective or cognitive distancing mechanisms. This argument agrees with Bolger & Doyon (2019) and Bokhari & Myeong (2022). It supports the fact that social enterprises act as practical translators of technological capabilities in social and environmental value. This particularly happens when AI is perceived as integrated in the circular economy strategies and in governance frameworks.

Also, the positive perceptions of AI-driven innovation and governance is a finding that resonates with concerns, which had been raised by Bashynska (2025) and Roberts et al. (2024) about the opacity and legitimacy of governance systems that are AI-based. On the one hand, AI-driven governance may improve efficiency and coordination.

5.2 Limitations of the research

This dissertation has some limitations that should be acknowledged and they are the following ones:

- The size of the research sample (N= 74) limits the generalizability of the findings.

- The research relies on self-reported perceptions of the participants. These may be influenced by subjective bias or social desirability.
- This research includes a cross-sectional research design. This does not allow a causal inference. It does not allow the examination of changes in perceptions over time, as well.
- This research focused on professionals and stakeholders. This emphasis might limit the applicability of the research findings to the general citizen populations.

5.3 Suggestions for future research

Taking into account the findings and limitations of this dissertation, the following directions for future research are proposed:

- Future studies could employ larger and more diverse research samples. They might include participants across different countries or different smart city contexts.
- Longitudinal research designs are proposed to examine how AI's perceptions, Q3, and Q4 evolve, over time.
- Further research is proposed to distinguish between different dimensions of Q3. These might include temporal, social, spatial and cognitive dimensions. These studies might be able to assess whether specific dimensions lead to differentiated effects.
- A qualitative approach, including structured or semi-structured interviews, is proposed. This research might complement the quantitative findings of the current research.

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APPENDIX I. QUESTIONNAIRE

<u>QUESTIONNAIRE</u>

The Infusion of AI in Circular Economy of Greek Smart Cities: Do Q4 and Q3 Close the Loop

Dear participants,

The following questionnaire is part of a master's research study entitled "The Infusion of AI in Circular Economy of Greek Smart Cities: Do Q4 and Q3 Close the Loop".

The purpose of this study is to explore how Artificial Intelligence technologies contribute to circular economy practices and innovation in smart cities and how these perceptions influence Q4 and citizen engagement, under the moderating effect of Q3.

For better understanding, the following key terms are defined:

Circular Economy refers to a sustainable economic system, that minimizes waste and maximizes resource efficiency through reuse, recycling and the extension of the products' life.

SE describes entrepreneurial activities, whose aim is to solve social or environmental problems, while at the same time maintains economic viability.

Q3 represents how "close" or "distant" individuals feel to environmental or technological issues, while shorter distance leads to higher citizen's participation in smart-city initiatives.

The above three concepts are interrelated, since the AI technologies' adoption in smart cities increases circular-economy practices and might stimulate SE, which happens especially when citizens feel psychologically closer to these technological and environmental goals.

Your participation in this research is voluntary and anonymous. The collected research data are going to be used only for the purposes of the current academic research. There are no right or wrong answers, therefore, you are kindly requested to respond according to your personal views and experience.

Thank you for taking the time to contribute to this research.

Estimated completion time: Approximately 8 minutes.

<u>Section A. Demographic and Professional Information</u>

1. Gender:

a. Male

b. Female

2. Age group:

a. 20-29

b. 30-39

c. 40-49

d. 50+

e. Other

3. Years of professional experience in IT or AI-related fields:

a. 0-5

b. 6-10

c. 11-15

d. 16+

e. Other

4. Area of expertise:

a. Artificial Intelligence

b. Software Engineering

c. Data Science

d. Smart City Technologies

e. Other

5. Current employment sector:

a. Public Sector

b. Private Sector

c. NGO

d. Academic or Research Institution

e. Other

6. Type of organization or industry:

a. Manufacturing

b. IT/ITES

c. Government Department

d. Services

e. Other

7. Current job role:

a. Managerial/Decision making

b. Technical/IT specialist

c. Administrative staff

d. Consultant

e. Other

8. Have you ever worked on projects related to circular economy or smart city initiatives?

a. No

b. Yes

<u>Section B. Perceived Role of AI in the Circular Economy of Smart Cities (Q1)</u>

Please evaluate each statement of the following table on a scale from 1= Strongly disagree to 5=Strongly agree.

	1	2	3	4	5	Sources (*They will not be included in the questionnaire sent to the research sample)
AI is essential for improving the efficiency of resource management in circular economy systems of smart cities						(Abu-Bakar & Charnley, 2025, p.8; Çetin & Kirchherr, 2025, p.1704; Hernandez et al., 2025, p.14)

AI technologies (e.g., machine learning, IoT) can significantly reduce waste and environmental impact in smart cities						(Abu-Bakar & Charnley, 2025, p.9; Hernandez et al., 2025, p.1)
The integration of AI supports innovation in designing circular business models (e.g., reuse, recycling, product life extension) in smart cities						(Hernandez et al., 2025, p.12)
The success of AI in circular economy applications depends heavily on cross-sector collaboration (industry, government, academia) in smart cities						(Hernandez et al., 2025, p.14; Lytras et al., 2019, p.12; Redko, 2024, p. 33)
AI supports innovation and co-creation in smart city circular economy projects						(Hwang, 2020, p.1; Panori et al., 2021, p. 1)
AI facilitates data-driven decision-making for waste and energy optimization in the urban systems of smart cities						(Ojadi et al., 2025, p. 4284)
AI-enabled monitoring tools improve transparency and citizen trust in circular urban initiatives in smart cities						(Parlapalli et al., 2025, p. 232; Wolniak & Stecuła, 2024, p.1346)
AI helps city authorities design innovative circular strategies (e.g., smart waste, energy sharing)						(Bolger & Doyon, 2019, p. 2184; Singagerda et al., 2025, p.e02642)

Section C. Perceived AI-Driven Innovation and Governance in Smart Cities (Q2)

Please evaluate each statement of the following table on a scale from 1= Strongly disagree to 5=Strongly agree.

	1	2	3	4	5	Sources (*They will not be included in the questionnaire sent to the research sample)
AI contributes to improving the quality of life in smart cities through better governance and service delivery						(Chatterjee et al., 2021, p.127)
AI applications (e.g., predictive analytics, automation) enhance operational efficiency and cost-effectiveness in smart city infrastructure						(Bashynska, 2025, p.9; Pandey, 2024, p. 213)
The use of AI in smart cities encourages citizen participation and supports social inclusion						(Bashynska, 2025, p.10; Chen & Zhang, 2022, p.135)
There is adequate awareness and training among smart city stakeholders to ensure responsible use of AI technologies						(Bashynska, 2025, p.8, p.10; Manoharan et al., 2023, p. 1; Wolniak & Stecuła, 2024, p.1)
The integration of AI in smart city projects has achieved a positive socio-economic impact so far						(Alahi et al., 2023, p. 5206; Alsabt et al., 2024, p. 3389; Bashynska, 2025, p.8, p.13-14)

Smart cities that invest in AI R&D show higher innovation performance						(Bokhari & Myeong, 2022, p. 620; Li et al., 2024, p.1; Ortega-Fernández et al., 2020, p. 1)
AI solutions encourage interdepartmental collaboration in municipalities						(Mikhaylov et al., 2018, p.1; Yigitcanlar et al., 2025, p.1576)
Innovation policies in smart cities enhance citizen engagement in AI-based initiatives						(Bosco et al., 2024, p. 1; Wolniak & Stecuła, 2024, p.1346)
The level of digital infrastructure determines the success of AI-driven innovation of smart cities						(Ejjami, 2024, p.37; Katal, 2024, p.150)
AI contributes to the smart cities' innovation culture and knowledge sharing						(Abdlla et al., 2020, p. 47)

Section D. Psychological Distance (Q3)

Please evaluate each statement of the following table on a scale from 1= Strongly disagree to 5=Strongly agree.

	1	2	3	4	5	Sources (*They will not be included in the questionnaire sent to the research sample)
psychological distance (feeling that environmental or technological issues are "distant" from one's daily life) limits citizen participation in smart city initiatives						(Yang et al., 2024, p. 9-10)
I feel that smart city projects do not directly affect my everyday life						(Macke et al., 2019, p. 717)
AI-based sustainability initiatives often feel too abstract to relate to personally						(Bosco et al., 2024, p.1)
Receiving personalized feedback (e.g., via apps or sensors) would make me feel more connected to the city's sustainability goals						(Bucher et al., 2021, p. 43)
psychological distance decreases when citizens observe tangible results from smart city programs						(Cui et al., 2025, p. 665)

Section E. Social Entrepreneurship (Q4)

Please evaluate each statement of the following table on a scale from 1= Strongly disagree to 5=Strongly agree.

	1	2	3	4	5	Sources (*They will not be included in the questionnaire sent

						to the research sample)
SE plays a crucial role in promoting AI-based sustainable innovations in smart cities						(Redko, 2024, p. 33; Roberts et al., 2024, p.1453)
Initiatives led by social enterprises can effectively connect technological innovation with social and environmental goals in smart cities						(Roberts et al., 2024, p.1453)
Citizens are more likely to engage in circular or smart city programs when they perceive tangible social benefits						(Lytras et al., 2019, p.13; Roberts et al., 2024, p.1458)
AI-driven smart city programs stimulate the emergence of social startups						(Berniak-Woźny et al., 2025, p.219; Subrahmanyam, 2025, p.465)
Collaborations between public authorities and social entrepreneurs accelerate sustainable innovation in smart cities						(Ferraris et al., 2020, p. 1259; Tomor et al., 2019, p.508)
SE in smart cities enhances community resilience and inclusion						(Meduri et al., 2024, p. 52)

Section F. Open Questions

1. What are the costs entailed per year in implementing AI technologies in specific initiatives in smart cities in Greece?

2. What are the risks of AI technologies in smart cities in Greece?

3. How is client response with regard to AI technologies in smart cities in Greece?

4. How is Q4 influenced by the AI technologies in smart cities in Greece? Give examples.

5. Which segment of the Greek population do the social entrepreneurs cater to? Give examples.

END OF THE QUESTIONNAIRE

THANK YOU