Examining the factors inhibiting Smart Cities implementation in Jordan

Abstract

The smart city has emerged as a revolutionary concept that connects all the different aspects of our life, and the world is witnessing a change of the cities to become smart. As most of the literature related to smart cities refers to the experience of such projects in the context of developed countries, the primary aim of this study was to examine the factors affecting the implementation of smart city projects in a developing one, namely Jordan, through covering the gaps that existed in previous research. The factors examined were divided into: governmental, economic, social, technological, legal, and environmental. The findings were based on semi-structured interviews undertaken with experts (seven participants from the private sector, five from the public sector, and three from academia) entrenched in smart city projects in Jordan. The findings of the study reveal that a lack of cooperation and coordination, unclear smart city vision, and poor private-public participation from the governmental group are found to be the top factors that hinder the transformation into a smart city. In the other groups, the need for more flexible legislation to obtain funding (economic factors), community involvement (social factors), poor data availability and scalability, integration and convergence issues across IT networks, and the lack of a database and a centralised analytics system (technological factors), the need for open data and access to such datasets, and lack of regulatory norms, policies, and directions (legal factors) and growing population problems (environmental factors) are the significant factors. This research project is useful to the government and policymakers in several ways. The paper ends with a number of recommendations and avenues for future research.

Keywords: Smart City, ICT, Urbanism, Barriers, Jordan

1. Introduction

Smart cities have become an important part of any government agenda, because these projects can help in building more sustainable urban environments for individuals. According to Sujata et al. (2016), the ability to monitor and manoeuvre through different critical infrastructure fields, such as railway and road tunnels, which can be digitally maintained and monitored for security, generally characterises a smart city. Smart cities require governance techniques that effectively combine the physical, IT, business, and social infrastructure of a city (Harrison et al., 2010), as well as investment in human and social capital alongside technological communication to help develop city governance (Caragliu et al., 2009). Smart and innovative cities aim to improve citizens' quality of life (De Las Heras et al., 2020). Hall et al. (2000) defined a smart city as one that maximises the benefits of its resources, plans preventive maintenance activities, controls security aspects, links and integrates all of its critical infrastructure (such as communications, water, power, and energy), and enhances the quality of the services it offers to its citizens. Additionally, Harrison et al. (2010) argued that a city is smart when all of its physical infrastructure, IT infrastructure, business infrastructure, and social infrastructure are connected and working together effectively. Currently, 56 percent of the global population resides in urban areas; however, by 2050, nearly 70 percent of people will live in cities (McKinsey Global Institute, 2023). Smart cities are necessary to ensure a better quality of life.

The primary literature on smart and sustainable cities is predominantly Western-focused. While there are shared concerns, each country has different challenges, priorities and implementation strategies. For instance, on one hand, studies on smart cities in the context of developed countries highlight the challenges faced despite the increasing availability of technology. Mosannenzadeh et al. (2017) note that barriers to smart project implementation can range from financial limitations to specific constraints influenced by local socioeconomic, environmental, and political conditions. Some argue that the failure of many smart city projects stems from top-down approaches that prioritise technology implementation primarily serving corporations (Neirotti et al., 2014). This failure is attributed to a lack of understanding of citizens' needs and preferences (Carrasco-Saez et al., 2017; Costales, E. 2022). On the other hand, developing countries often encounter governance challenges, such as inefficiency and corruption, which can hinder smart city initiatives (Vu, K., & Hartley, K. 2018). However, they also have opportunities for innovation and leapfrogging due to fewer infrastructure constraints, enabling them to adopt cutting-edge technologies and experiment with novel approaches. This agility allows them to bypass stages of traditional development and implement innovative solutions.

As a developing country, the Jordanian government updates its e-governmental system yearly, making it one of the leading e-governmental systems in the Middle East. Ciborra and Navarra (2005) stated that because of its ability to adopt new technological communication systems and information, Jordan is seen as the future Singapore or as the Bangalore of the Middle East. However, the massive population growth is affecting the urban structure of Jordan’s cities (Meaton and Alnsour, 2012). Although Jordan suffers from a lack of natural

resources, such as water and energy, it shows a good example of dealing with the refugee crisis over the past years. The refugee influx is one of the factors that leads to growth of the population (Alnsour, 2016). This growth affects the urban structure of the cities and causes problems such as informal settlements, water shortage, pressure on services, traffic congestion, pollution, and other environmental issues (Meaton & Alnsour, 2012). The growth of the population puts more pressure on achieving a better life for the citizens. As a result, the governments and the private organisation have suggested several smart projects and initiatives to deal with those problems. Several projects and initiatives have been proposed. Traffic Monitoring and Traffic Lights Programming, Bus Rapid Transit, Smart City Roadmap, the Air Quality Monitoring System, Renewable Energy, and the E-Government Program are a few of the projects that have been suggested to make Amman a Smart City. The Smart City Roadmap project was launched in cooperation with the U.S. Trade and Development Agency (USTDA). USTDA provided technical assistance to boost city operations, public services, and quality of life by implementing information and communication technologies. The partnership also included the Traffic Monitoring Platform Project, which dealt with traffic congestion in Amman (USTDA, 2018).

Another important milestone was the establishment of the Jordanian Smart Cities Association. In 2019, the Arab Renewable Energy Commission launched the Jordanian Smart Cities Association, which is the first of its kind in the Middle East to focus on sustainability and renewable energy. It aims to achieve energy efficiency and to utilise more renewable energy sources (Petra, 2019). Moreover, King Abdullah II took the first step towards smart cities with the e-government initiative in 2001, which the Ministry of Communication and Information Technology made a part of its 2006 agenda (Almarabeh and Adwan, 2013). In the Jordan Strategy Forum's (2019) report of 2018, Jordan was ranked 115 out of 193 UN Member States. According to the report, the e-Government Strategy 2014–2016 and Reach 2025 implemented additional e-services for several ministries and public institutions, such as the National Aid Fund services, tax payments, and services provided by the Income and Sales Department, as well as other government services provided by the e-government portal launched in 2016, and these were extensively updated in 2019.

Given the growing significance of smart cities in addressing urban challenges, this paper examines the challenges and barriers faced by smart city initiatives in Jordan. Being a developing country, the Jordanian government aims to enhance its e-governmental systems on an annual basis, positioning it as one of the foremost e-governmental systems in the Middle East. Although Jordan has an agenda for implementing smart city projects and promoting smart urbanisation in its capital (Jordan Times, 2022), there are factors that impede the progress of smart urbanisation in the city. Although there is some evidence from a citizen perspective (Nusir et al, 2023), previous studies have not explored the obstacles to implementing smart city projects in Jordan, nor have they focused on the barriers that contribute to the failure of such initiatives. Even though some studies have investigated the challenges associated with the implementation of smart cities in developing countries, there remain certain areas that require additional research. For instance, in Gupta and Hall's (2022) and Vu and Hartley (2018)'s studies the interviews were limited to governments and professionals, failing to encompass all

the groups which may be important, considering that different stakeholder groups have different priorities and interests. Consequently, the research recommended undertaking more comprehensive research involving additional groups, such as academics. Therefore, this study seeks to answer the following research questions: Firstly, which factors influence the implementation of smart city projects in a developing country like Jordan? Secondly, how do these factors differ from those of western/developed countries?

The following section discusses in detail a list of potential factors to explore, followed by an explanation of the research design and methodology. Finally, the paper concludes by presenting the main research findings and discussing potential future implications for academic research in this field.

2. Literature review

The smart city has emerged as a revolutionary concept that connects all of the different aspects of our life. Accordingly, smart cities have several definitions in the literature. Hall et al. (2000) defined a smart city as a city that takes the maximum benefit of its resources, plans its preventive maintenance activities, controls security aspects, links and integrates all of its critical infrastructure, i.e. roads, tunnels, communications, water, power and energy, and enhances the quality of the services to its citizens. Harrison et al. (2010) described a city as smart when all of the physical infrastructure, IT infrastructure, business infrastructure and the social infrastructure are connected and working together effectively. However, Caragliu et al. (2009) take into account investing in human and social capital, communication technology and wise management of resources, by applying mutual governance to leverage data to improve the quality of life. In the same vein, Dameri (2013) stated that the aim of creating smart cities is to achieve benefits for the citizens in terms of inclusion and participation and where those cities are environmentally sustainable and digitally developed.

Due to the increase in the pace of urbanisation and the pressure this has created on the services in big cities, being a smart city has become necessary and smart city projects have gained attention in the public, private and the academic sectors (Doheir et al., 2015). Recent reports show that around 50% of people reside in cities, and this is predicted to increase further to 70% by 2050 (cited in Doheir et al., 2015, McKinsey Global Institute, 2023). Given the increasing pressures to sustain urbanisation, officials and decision makers are attempting to turn cities into smart ones, with smartness offering the optimal solutions to face common obstacles. However, changing existing cities into smart ones faces several challenges. Prior literature has shown that there are several barriers that hinder the implementation of smart city projects, primarily reflecting the experience of such projects in Western countries. For instance, the Joss et al. (2019) study examines narratives and important junctures mainly associated with contemporary smart city discourses in 27 cities. These cities participate in shaping the global smart cities discourse network, with nine in Australasia, nine in Europe, eight in North America, and only one in the Middle East, but none from Africa or Latin America.

Developed countries generally exhibit better cooperation and coordination among various sectors, clearer visions for their smart city projects, and a competitive advantage in attracting

foreign investments and accessing financial resources (Kummitha & Crutze, 2019, Mishra, 2019). They also emphasise the importance of cyber security in smart project development. Developed countries prioritise environmental considerations and have well-developed green economy plans and ecological legislation (Ferrara, 2015). In contrast, developing countries face challenges in achieving coordination, defining a cohesive vision, attracting investments, and dealing with budget constraints (Vu & Hartley, 2018). Vu and Hartley (2018) also argued that change management capabilities and competence are critical challenges, alongside a shortage in capabilities for change management. Technological illiteracy among citizens and concerns about data sharing hinder the progress of smart urbanisation in developing countries (Peprah et al., 2019). In addition, developing countries lack advanced technological applications, infrastructure tools for big data analysis, and appropriate legislation specific to smart projects (Monzon, 2015). Many developing countries suffer from inadequate implementation methods, proper infrastructure, limited finance, inadequate economic growth, and political instability (Hamza, 2016). Poverty, cultural challenges, and the ongoing proliferation of slums and illegal migration from rural regions to urban centers have also been found to impede implementation. Yadav et al. (2019) identified several key problems, including energy and environmental issues, infrastructural limitations, strategic and policy concerns, informational and technology obstacles, social, and mobility constraints. In the context of India, Prasad and Alizadeh (2020) found that smart dimensions such as smart governance, smart citizens, and smart infrastructure are important but others were ignored, e.g. smart environment and smart economics. Gupta and Hall (2022) identified seven risks: resource management and partnership, institutional, scheduling, and execution, social, financial, political, and technology, while Razmjoo et al.'s (2021) list of factors included inadequate private-public participation, reliance on fossil fuels, environmental neglect, limited internet technology infrastructure, and dated technology in urban areas. More recently Smith et al. (2023) identified significant obstacles for Medellín, with high socio-economic inequality being a key barrier. This inequality prevents many citizens from actively participating in smart city processes due to limited access and resources for creating, innovating, and learning. Of course, the establishment of technology-enabled smart cities in developing countries is dependent on implementing wider simultaneous socioeconomic, human, legal, and regulatory changes (Tan and Taeihagh, 2020), which may often be of a wider nature to those in developed countries as their starting position may not be as advanced. Bhattacharya et al. (2020) stated that to achieve sustainable smart cities in developing countries, it is imperative to provide habitats with necessities such as reliable access to electricity and water, ensuring the safety and security of citizens, maintaining a clean and pollution-free environment, offering dependable transportation options, and providing improved and affordable medical facilities, which could be challenging. So, although the same factors may be important in both areas, when it comes to the implementation and success of smart city projects, when considering developed and developing countries, how these factors are manifested can be different.

As an aspiring country, Jordan is seeking to change its cities into smart ones and aims at using smart technologies to follow the pace of growth and advancement. Although Jordan suffers from a lack of natural resources, such as water and energy, it realised that the best solution to those challenges is by changing the cities to become smart. Decision makers believe

that such implementation will improve the quality of people's life as well as solving the problems that face the cities in general. When it comes to initiating smart projects, Amman, the capital city of Jordan, has been the target of several projects. According to the EGDI Index for E-Government in 2008-2010, Jordan was ranked 50th among countries, but it declined, and in 2021 it was ranked 117th. After 2021, its ranking began to increase, becoming 100th among countries. Also, according to IMD Smart City Index 2023, Amman ranked 135 out of 141 countries. This relatively indicates its progress towards smartness. It is worth mentioning that Amman was not listed in this index in 2021. It should be noted that Jordan achieved D level, which is considered one of the lowest HDI levels. The city level HDI data provides insights about the socio- economic environment (IMD Smart City Index, 2023). However, most projects have failed or did not achieve their goals because of several challenges that face the implementation of smart city projects in Jordan.

2.1 Theoretical framework

The smart city concept features six dimensions: smart governance, smart economy, smart people, smart mobility, smart environment and smart living. These dimensions are based on the urban life aspects (e-democracy, industry, education, logistics & infrastructure, efficiency & sustainability and security & quality) (Lombardi et al., 2012). Prior literature has investigated the factors that affect the implementation of smart projects. Some papers explored the barriers that affect the implementation in all dimensions (Rana et al., 2019; Joshi et al., 2016; François, 2019; Gracias et al., 2023), while other papers focused on one dimension and investigated the different factors that influence the implementation process (Letaifa, 2015; Tan, S & Taeihagh, 2020; Scuotto et al. 2016, Vodă & Radu, 2018). Accordingly, several systematic reviews divided the factors according to the dimension aspects and therefore they divided them into governmental, economic, social, technological, legal, and environmental. This division made it possible to form a holistic view that helps organise the factors more effectively, offering insights about the implementation process from different points of view. Different studies have examined the factors that contribute to shaping the smart cities. For instance, Rana et al. (2019) conducted a systematic literature review and their work listed 31 key barriers to smart city development. Joshi et al. (2016) outlined six key factors for the development of smart cities: Social, Governmental, Economic, Legal, Technology, and Environmental, while the smart city dimensions identified by Joss et al. (2019) based on evidence from 27 sources were: digital technology, infrastructure, government, economy, society, spatial planning/development, environment, sustainability, experimentation/innovation, and international. More recently, François (2019) stated that smart cities are at the intersection of social, environmental, economic, governmental, and technological factors. Li et al. (2022) suggest that smart city development should focus on creating new solutions for social, economic, governmental, and environmental factors to improve the sustainability and quality of life in cities. According to Gracias et al. (2023), smart city projects are assessed based on several criteria, including social, environmental, economic, and technological factors. This approach guarantees that smart city initiatives are both economically viable and environmentally and socially sustainable. So although lists of potential areas may differ from one study to another, there is overlap with regards to the dimensions that are typically considered.

Based on the above, this study is based on the key factors that are significant in different contexts regarding the smartness of the cities in both developed and developing countries. Following this division allows for a holistic view to explore the factors. The implementation of smart city projects takes a considerable amount of time, which affects the assessment process (Mishra et al., 2023). Therefore, this study seeks to provide a comprehensive analysis of the previous studies that examined smart cities and the factors that affect the adoption. The categorisation of the challenges and barriers takes into account these factors, which appear starting from the creation of smart cities projects, throughout the development process to the budgeting of those projects.

In the following section we consider the most important factors reported in the literature and we aim to use them as a starting position for our exploration in the context of Jordan.

2.1.1 Governmental Factors

Lack of Cooperation and Coordination is one of the most noted factors in previous studies. The definition of a smart city is connected to the ability to connect between different sectors of society from the governmental sector to the IT sector, and business sector (Caragliu et al., 2009; Harrison et al., 2010). The words coordination, communication and collaboration are used by many researchers in their analysis papers, models or suggestive governance mechanisms (Caragliu et al., 2009; Harrison et al., 2010; Rana et al., 2019; Toppeta, 2010; Webb, 2011). It can be argued that in developed countries, there is usually better cooperation and coordination among different sectors, such as the government, IT sector, and business sector. They also tend to have a clearer vision of their smart city projects. *An unclear Smart City Vision* can have a major impact on project implementation. A clear vision of the smart project in addition to the effective application of IT management ensures the implementation and development of the smart city project (Rana et al., 2019). Some challenges that tend to face smart city applications are: alignment of organisational goals and projects, multiple or conflicting goals, integration across government systems, and a lack of knowledge regarding interoperability (Chourabi et al., 2012). *Political Instability* can affect smart city project implementation as the lack of political leadership, coordination and political stability is a key factor in the smart urbanisation of cities (Letaifa, 2015), as well as cases of corruption and social and special polarisation (Monzon, 2015). *Poor private-public participation / knowledge transfer from the private sector* is another significant factor that leads to the success or failure of smart city implementation, as this factor can help boost the success rate and become an incubator of new ideas and projects (Chen et al., 2017; Koppenjan & Enserink, 2009; Kummitha & Crutzen, 2019; Lee et al., 2014; Rana et al., 2019). Allowing the increase of public-private corporations will lead to an increase in the small regional corporations to provide their services for the wellness of the citizens (Lee et al., 2014). Conversely, developing countries often face challenges in achieving coordination and defining a cohesive vision due to factors like political instability, and competing priorities.

2.1.2 Economic Factors

A lack of Competitiveness among companies in the region or local area to take on the challenge of smart city project implementation is a factor adding to the failure of such projects

(Monzon, 2015; Rana et al., 2019). It is one of the factors that needs to be supported by governments in the urban areas to develop and emerge in smart urbanisation (Monzon, 2015). *Global Economy Volatility and Foreign Investments* plays a role in giving foreign investors an evaluation of the investment risk (Liu et al., 2018). When volatility increases, and the global economy's uncertainty grows, the development of smart cities could be affected (Ferrara, 2015), which in turn affects the foreign investment rate. Developed countries have a competitive advantage in attracting foreign investments and possess better financial resources for smart city solutions. They often benefit, to some extent, from the steadiness provided by the global economy. In contrast, developing countries face various challenges due to factors such as limited competitiveness, difficulties in attracting foreign investments, and budget constraints. *Budget Constraints and Financing Issues* affect the ability of governments to establish smart city projects. The dependency on the state or the government on development funds creates more problems and prevents the government from having their own revenues, which are needed to start those projects (Kumar, 2017).

2.1.3 Social Factors

According to a report by the European Commission, a city cannot become Smart without the involvement of stakeholders, regardless of the influence of ICT on its data (Joss et al., 2019). Therefore, *Community Involvement* is a key factor that affects the implementation of smart city projects (Chatterjee & Kar, 2017; Gil-Garcia & Aldama-Nalda; 2013; Jamal & Sen, 2019; Liu et al., 2018;). To improve social life, citizens should be aware of smart healthcare, smart agriculture, smart education and smart services, etc. (Lytras & Visvizi, 2018). Moreover, to ensure a sustainable urban development, citizens' participation is necessary in the formulation of the urban policies (Margerum, 2002). Based on that, community involvement is characterised by empowering the citizens (Joia & Kuhl, 2019; Viale et al, 2017), digital inclusion (Gil-Garcia & Aldama-Nalda; 2013; Joia & Kuhl, 2019;), mutual governance (Macke et al., 2018) and behavioural change (Liu et al., 2018). *The Degree of Inequality* is a contradictory factor, as smart city initiatives may reinforce the inequalities and reproduce them in new ways (Daatta, 2015; Shelton et al., 2015). Several studies have shown that socially marginalised people who do not receive better education and those who are digitally skilful will not benefit from smart city projects since they do not know how to use those technologies (Mundoli, Unnikrishnan, & Nagendra, 2017; Söderström, Paasche, & Klauser, 2014). However, smart city applications are designed to combat the different forms of inequality such as the unavailability of public services in certain areas (Lee et al., 2014). *Technology Illiteracy* slows down the adoption of new technologies and the scaling up of technology adoption, as illiteracy in developing countries can be an obstacle that hampers the adoption (Peprah et al., 2019; Rana et al., 2019). Therefore, being technologically illiterate can affect the implementation process and therefore a number of citizens will be neglected and will not benefit from those projects (Shayan, 2020). *Skilled human* Capital is one of the drivers for the development of smart city projects (Joia & Kuhl, 2019). Increasing the technological capacity in terms of knowledge, expertise and motivation of the human resources is necessary to implement smart city projects (Chatterjee, Kar & Gupta, 2018; Chen et al., 2017). For instance, operational efficiency and dealing with the technical risks such as privacy and security issues

will be enhanced if the IT staff are technically competent (Chen et al., 2017). Accordingly, increasing skilled human capital is recognised as a major aspect for smart city future plans in several countries such as Turkey (Tekin Bilbil, 2017). Factors such as those listed above are important in both developed and developing countries. Still as far as inequalities, inclusion and the necessary skills to make the most of smart city services are concerned they are likely to manifest themselves in very different ways and give rise to different objectives. For example, developed countries may focus on the importance of increasing cyber security, and dealing with increasing the citizens' engagement in the development of smart project applications, while in developing countries, projects may struggle with technological illiteracy among citizens, a fear of sharing information and citizens being unaware or even unconvinced of the need for smart urbanisation.

2.1.4 Technological Factors

Privacy and Security Issues, such as cyber hacking, viruses, low privacy and high costs (Balta-Ozkan et al., 2013; Chourabi et al., 2012; Elmaghraby & Losavio, 2014) are one of the citizens' concerns since the integration of several networks and centralising the systems in the cities alongside with the development in big data analytics could reveal citizens' personal information and maximise the risks such as identity theft and cyber security attacks (Mboup & Oyelaran-Oyeyinka, 2019). Real-time data collected from the sensors through scanning, tracing, and locating could be dangerous (Wu et al., 2018). Accordingly, smart city networks raise the risks of cyberattacks (Colding and Barthel, 2017). *Integration and Convergence Issues Across IT Networks/ Lack of Database and Centralised Analytics System* is still a challenge that hinders the advancement of smart city projects (Chourabi et al., 2012; Kogan & Lee, 2014; Lee et al., 2014, Zanella, et al., 2014). System integration is a complex system that has undetected information related to healthcare, security agencies, smart transport, mobile communication, and energy efficient systems (Nyberg, 2018). Cyber networks should be integrated and supported to facilitate data exchange and analysis (Rana et al., 2019). *Poor Data Availability and Scalability* is found in the existing literature to be one of the challenges while implementing smart city projects. Data availability creates transparency, provides better decisions, assists in times of crisis and improves the delivery of public value (Janssen et al., 2017; Pereira et al. 2017). *Technology-Related Infrastructure Readiness / Poor IT Infrastructure and Improper Access to New Technology* readiness is an indispensable factor that affects the implementation of smart city initiatives (Idele & Mboup, 2019; Joshi et al., 2016; Reddy et al., 2016; Zan et al., 2015). To enhance the operational and administrative capability of smart city initiatives, a high- quality wireless infrastructure and service-oriented information systems are required (Azevedo Guedes et al., 2018; Idele and Mboup, 2019; Joia & Kuhl, 2019). A sensor web, communication networking technologies, data centres, cloud infrastructure, analytical systems, integrated management and command centres are the main components to build a smart city (Rao & Prasad, 2018). However, a lack of internet penetration, a lack of internet connection to share information and lacking the technical capacity to develop the needed technologies for smart city implementation are among the problems facing the implementation of smart city projects (Peprah et al., 2019; Praharaj et al., 2017; Wu et al., 2018).

Considering that technological and infrastructure maturity is higher in developed countries than developing ones, technological factors often play a different role when it comes to the implementation of smart city initiatives. For instance, while in developed countries the discussion may revolve around enhancing already existing data-collecting methods or increasing the security of information, in developing countries there are still issues with sharing personal information and digitisation. Similarly, there may be limited infrastructure available in developing countries when it comes to using big data analysis, reliable network connectivity to enhance real-time data sharing, the availability of sensors across the country, as well as different centralised analytics systems across different sectors to enable shared data and project implementation.

2.1.5 Legal Factors

Issues of Openness of Data are part of scientific progress, the societal engagement, and the overall development of smart cities (Mak & Lam, 2021). Datasets should be available in an open manner in order to be used properly, with the users obeying the legal provisions (Lindman & Rossi, 2013). However, the slow progress in the legislation related to open data has slowed down the progress of smart cities, especially in developing countries (Máchová & Lněnička, 2017. Addressing the Challenge of *Transparency and Liability* in smart city development is needed to ensure the progress of the city and its inhabitants. By interconnecting with their citizens in a dynamic way, smart governments are expected to be accountable. Hence, lacking transparency and liability between the government and the citizens creates a barrier in the face of the implementation of smart cities (Nam & Pardo, 2011). *A lack of Regulatory Norms, Policies and Directions* is connected to the constant renewal of the ways in which technology is connected to society and the government. There are doubts about whether the current legal regulations are suitable for modern technological devices and systems (Gasiola et al., 2019). The literature related to developed countries has discussed the need for legal updates on already existing laws related to data openness or certain application processes in the project implementation, whereas in developing countries, the issue with the existing legislation is that it does not facilitate the implementation of smart projects. The laws available in most cases do not tackle smart projects specifically. Rather they are related to project implementation in general.

2.1.6 Environmental Factors

Lacking an Ecological View in Behaviour is connected mainly with having an ecological plan that is compatible with smart city projects and is an important factor for their success. A smart city's spatial layout should be designed on the basis of the ecological environment around it (Chen, 2021). A sustainable environment that minimises the impact on the environment and natural resources is a key priority for developed countries. In Europe, the legislation ties the development of smart cities in with the establishment of a green economy in the area and the development of renewable energy resources (Ferrara, 2015). On the other hand, developing countries may not have mature go-green action plans and thus such plans do not form an integral part of smart projects. *Growing Population Problems* affect the current healthcare facilities, which cannot handle the number of people, especially in times of risks and

pandemics, which calls for smart solutions (Silva et al., 2018). Making a city smart through using technologies like big data, machine learning, and IoT can help solve this issue. They can be used in managing traffic and mobility, parking problems, as well as safety (Nambiar et al., 2018). *The Effect of Carbon Emissions* on smart cities was the main concern in a number of previous studies. By shifting to smart cities, there is an expectation of reducing the environmental threats like carbon emissions (Yoon, 2015). For example, when automobiles spend less time on the road because of a city's smartness they help in reducing the dangerous emissions (Yoon, 2015). *Lack of Sustainability Considerations* is frequently associated with the objective of smart cities (Toli & Murtagh, 2020; Yigitcanlar & Kamruzzaman, 2018). Some definitions of smart cities state that they aim to be more sustainable and that sustainability is one of their strategic goals (NRDC, 2012; Toli & Murtagh, 2020). However, environmental sustainability is only one of the three dimensions of sustainability alongside economic and social ones (Lehtonen, 2004). *Degradation of Resources,* which include water, food, and other energy resources, is one of the main barriers to the success of smart cities. However, this barrier is more challenging for smart cities in the South and East- Mediterranean regions than those in Europe (Monzon, 2015).

3. Methodology

3.1 Research design

The primary aim for this study is to examine the success and failure factors that affect the implementation of smart city projects in Jordan. The study used Jordan as a case study to identify influential factors given the increase in its population from urbanisation, crises in surrounding countries, and the refugee influx (Nordregio, 2019). A qualitative approach was adopted to understand the barriers to implementing smart city projects. Maxwell (2008) identifies specific objectives for which qualitative research is beneficial: comprehending the specific context in which participants operate and the impact this context has on their actions, producing new insights based on solid evidence, comprehending the processes through which actions occur, and developing causal explanations. Qualitative studies differ from standard quantitative studies in that they are based on a conceptual framework that includes concepts, subjects, beliefs, and theories that support the project (Tonon,2015). Therefore, employing qualitative approaches offers more effectiveness than quantitative methods in this type of study since it allows for more accurate interpretations of the results and facilitates the exploration of new issues. To accomplish this objective, it was necessary to identify the primary barriers to implementing smart city projects. Consequently, the methodology was separated into three phases: a) Identification and organisation – The process of investigating and selecting academic works that discuss the barriers to and performance of thematic analysis, to organise them within specific groups. b) Evaluation – Identifying experts and conducting the interviews. c) Interpretation – Analysing the final results obtained from the evaluation process.

3.2 Data collection and analysis

To identify the initial set of barriers a search was undertaken using the terms "smart city" and "barrier" or "challenge". Among the results, about 62 were considered to be of interest and were reviewed more thoroughly. The list featured papers that were concerned only with developed countries, other papers that were concerned with developing ones only and a few

that examined multiple countries. This made it possible to identify patterns inside and across the data to generate the final list of barriers. A thematic inductive analysis was undertaken in order to produce codes and topics and was linked to the list of barriers (Rice & Ezzy, 1999). The final selection consisted of 24 barriers, which were divided into 6 groups, including Governmental, Economic, Social, Technological, Legal, and Environmental.

A qualitative analysis was applied to address the research questions to provide deeper analysis of the factors. This approach leads into an exploratory quantitative approach. To this end, a preliminary empirical study using interviews was chosen to collect the data. Semi-structured interviews within a qualitative analysis opens the door to more flexibility and it makes the process of investigating the factors and the communication with all stakeholders easier (Leedy and Ormrod, 2005). To identify the vital factors affecting the implementation of smart city projects in Jordan, semi-structured interviews were adopted as the primary data collection method. The use of semi-structured interviews makes it possible for participants to discuss those factors and express their views about the challenges that their sectors may face while implementing smart city projects. A pilot study was conducted to test the preliminary draft of the interview script. The script and questions were revised before conducting the main interviews. The questions covered: participants' background; the major challenges facing the implementation of smart city projects in Jordan; and questions related to governmental, economic, social, technological, legal, and environmental factors. After that, online interviews using Zoom were conducted with key people from the public sector, private sector and academia. The interviews lasted approximately 45 minutes. The interviews were recorded with the permission of the participants and transcribed immediately after the interview sessions. Then, the transcripts were sent to the participants for their approval.

3.3 Sampling

The participants were sampled using purposeful sampling. Purposeful sampling is widely used in qualitative research for the identification and selection of information-rich cases related to the phenomenon of interest where participants are chosen on purpose (Palinkas et al., 2015). Selection criteria included the participant's area or work and role (private sector, public sector, or academia), sector experience, years of experience, and background (Gupta and Hall, 2020, 2022; Vu and Hartley, 2018). The cases were categorised into three main groups (Table 1). The groups were divided into public sector (PU1, PU2 . . . etc.), private sector (PR1, PR2 . . . etc.), and academia. The participants included officials from the Greater Amman Municipality (GAM), stakeholders, IT experts, and academics interested in smart city concepts and key people from private companies working on smart projects in Jordan. Each participant had more than five years of experience working on smart projects in their fields.

Table 1: List of participants

Number	Industry	Interviewer's Position
PU1	Public Sector	Director- ICT Department
PU2	Public Sector	Survey and Geometric Engineer
PU3	Public Sector	Head of Local Plans Division
PU4	Public Sector	Senior Manager - Smart City Solutions Expert
PU5	Public Sector	Artificial Intelligence Department
PR1	Private Sector	Urban Planner and Researcher

PR2	Private Sector	Business Development Director
PR3	Private Sector	Experienced ICT Professional, Presales and Tender Manager
PR4	Private Sector	Country Manager/ Jordan at BMB
PR5	Private Sector	Coordinator, Executive Office at King Hussein Business Park
PR6	Private Sector	Data & AI Director
PR7	Private Sector	General Manager and Partner at Consulting company
A1	Academic Sector	Professor of Urban Planning
A2	Academic Sector	Assistant Professor of Engineering
A3	Academic Sector	Professor of ICT

3.4 Analysis

In the last stage, the meetings were recorded and transcribed for data analysis and extraction. The language of the interviews was primarily Arabic. Miles and Huberman's (1994) procedure for managing and analysing the data was adopted. For Miles and Huberman (1994), data analysis is divided into "data reduction", "data display" and "conclusion drawing/verification".The same process was used in our analysis procedure. A qualitative analysis was adopted to find the common themes, and patterns. Also, a comparison across cases was adopted to extract richer insights from our data. Interviewing stakeholders provides a rich opportunity to gather firsthand perspectives and shed light on the challenges and opportunities within the Jordanian contact. First, data reduction includes the summary and simplification of the data. In our study, all obtained data was organised according to the following categories: participants' background; the major challenges facing implementation of smart city projects in Jordan; and questions related to governmental, economic, social, technological, legal, and environmental factors. Then the data was divided into three main groups according to the sector: public, private and academic. This helped identify commonalities and differences among the sectors. The last stage is "conclusion drawing/verification". In this stage, the transcribed data was summarised into main points and similar points were clustered together to form unified statements, which either agreed with or were inconsistent with previous findings in relation to the Jordanian context. Along the way, additional factors were identified and added to the initial proposed factors and further analysed through local references such as news or updated legislation. Moreover, based on the interviewees' comments on different topics, a number of practical implementations and recommendations were developed based on previous smart projects and failure or success samples put forward in the interviews.

4. Findings

Table 2 in the study presents a succinct summary of the interview findings, followed by a comprehensive section that analyses these findings in the context of Jordan as a developing country. The collected interview data has undergone meticulous examination to extract essential insights regarding smart city initiatives in Jordan, encompassing areas such as challenges, successes, and opportunities. The subsequent discussion section critically evaluates the findings, drawing connections and identifying patterns to grasp their significance. It takes into consideration the distinct socio-cultural, economic, and political factors that shape the smart city landscape in Jordan.

Table 2: Summary of findings

	Factor	Previous Studies	Important	Not important
Governmental	Lack of cooperation and coordination	Harrison et al., 2010; Kogan & Lee, 2014; Rana et al., 2019	A1, A2, A3, PU1, PU2, PU5, PR1, PR4	
	Unclear smart city vision	Kogan & Lee, 2014; Manville et al., 2014; Rana et al., 2019; Shin, 2012; Webb, 2011	A1, A2, A3 PU1, PU2, PU3, PU4, PU5, PR3, PR4	
	Political instability	Aghimien et al., 2020; Kogan & Lee, 2014; Letaifa, 2015; Monzon, 2015;	A1, A3, PR1	PU1, PU2, PU3, PU4, PR2, PR3, PR4
	Poor private-public participation/knowledge transfer from the private sector	Chen et al., 2017; Koppenjan & Enserink, 2009; Kummitha & Crutzen, 2019; Lee et al., 2014; Rana et al., 2019	A1, A3, PU1, PU2, PU4, PU5, PR1, PR4	
	Assessing party and sponsorship management	Correia, D., Teixeira, L., & Marques, J. L. (2022).	PU1, PU2, PU3, PU4, PU5, PR1, PR2, PR3	
Economic	Lack of competitiveness	Caragliu et al., 2009; Monzon, 2015; Nicolas et al., 2020; Rana et al., 2019; Silva et al., 2018	A3, PU2, PU3, PR1	A2, PR3
	Global economy volatility and foreign investments	Ferrara, 2015; Höjer & Wangel, 2015; Joshi et al., 2016; Liu et al., 2018; Rana et al., 2019; Scuotto et al. ,2016; Tan and Taeihagh, 2020	A3	A2, PU1, PU2, PU3, PR1, PR2, PR3
	Budget constraints and financing issues	Chatterjee, & Kar, 2015; Hamza, 2016; Khan et al., 2020; Kumar, 2017; Mishra, 2019; Tekin Bilbil, 2017	A3, PU5	A1, PU4, PR1, PR3
Social	Community involvement	Komninos et al., 2013; Kogan and Lee, 2014; Schuurman et al., 2012; Praharaj et al., 2017	A1, A2, PU1-4, PR1-4, PR7	
	Degree of inequality	Glaeser et al., 2009; Monzon, 2015	A3, PR1, PR3	A1, A2, PU1-4, PR2, PR4

	Technology illiteracy	Peprah et al., 2019; Chatterjee and Kar, 2015; Rana, 2019	A1, A3, PU5, PR7	A2, PU1-4, PR1-4
	Skilled human capital	Kummitha & Crutzen, 2019; Kumar, 2017; Tekin Bilbil, 2017; Chintagunta, Raj & Narayanaswami, 20 19	PR2	A1, A2, PU1-4, PR1, PR3, PR-4
Technological	Privacy and security issues	Balta-Ozkan et al., 2013; Chourabi et al., 2012; Elmaghraby and Losavio, 2014	A2, A3, PU1, PU2, PU3, PU5, PR1, PR2, PR3, PR5	A1, PU4, PR4
	Integration and convergence issues across IT networks	Chourabi et al., 2012; Kogan & Lee, 2014; Lee et al., 2014; Zanella, et al., 2014; Nyberg, 2018	A2, A3, PU1, PU2, PU4, PR2, PR3	A1, PR1, PR4, PU3
	Poor data availability and scalability	Janssen et al., 2017; Pereira et al. 2017; Rana et al., 2019	A1, A3, PU1, PU2, PU4 , PR1, PR3, PR4	A2, PU3, PR2
	Old technology and improper access to new technology	Chourabi et al., 2012; Monzon, 2015; Idele & Mboup, 2019; Joshi et al., 2016; Reddy et al., 2016; Zan et al., 2015		A1, A2, PU1-4, PR1-4
	Lack of database and centralised analytics system	Mak & Lam, 2021; Lindman & Rossi, 2013; Máchová & Lněnička, 2017; Ahlgren et al., 2016; Neves et al., 2020; Ubaldi, 2013; Yadav et al., 2017; Verhulst & Young, 2016	A1, A3, PU1, PU2, PU5, PR2, PR3	A2, PU2, PU3, PU4, PR1, PR4
	Technology-related infrastructure readiness/poor IT infrastructure	Nam & Pardo, 2011	A3, PU1, PR4	A1, A2, PU2-4, PR1-3
Legal	Open data and their accessibility	Gasiola et al., 2019; Founoun & Hayar, 2018	A3, PU1, PU2, PU5, PR1, PR2, PR4, PR7	A2
	Lack of transparency and liability	Chen, 2021; Ferrara, 2015; Rahmayanti et al., 2020	A3, PU1, PR3, PR4,	
	Lack of regulatory norms, policies, and directions	Silva et al., 2018; Nambiar et al., 2018	A2, A3, PU1-5 PR1-3	

	Approvals, implementation duration, fees, and taxes	Rjab, A.B., Mellouli, S. and Corbett, J., 2023	A3, PU1-3, PU5, PR1, PR3-6	
	Trust in the use of e-products in governmental institutions	Habib et al., 2020; Puthur et al., 2020	PU1, PU5, PR3, PR5, PR6	
Environmental	Lacking ecological view in behaviour	Yoon, 2015; Mandal, 2016; Kylili & Fokaides, 2015	PU3	PU2, PU4, PR3
	Growing population problems	Toli & Murtagh, 2020; Yigitcanlar & Kamruzzaman, 2018	A2, PU3, PR3	A3
	Carbon emissions effect	Monzon, 2015; Khan et al., 2020	PR2, PR3	PU3
	Degradation of resources	Caragliu et al., 2009; Harrison et al., 2010; Kogan & Lee, 2014; Rana et al., 2019; Tachizawa et al., 2015; Webb, 2011	PU3, PR3	PR4
	Physical infrastructure and land ownership	Tan & Taeihagh, 2020; Praharaj & Han, 2019; Kumar, 2017; Chang, 2018; Hoelscher, 2016	A1, A2, A3, PU1-5, PR1, PR3, PR5, PR6	

There was a disagreement of opinion regarding the importance of the factors. Academics and professionals in the public and private sectors held different views due to their backgrounds, expertise, experiences, and priorities. For instance, academics focused more on the planning of the project, whereas the public and private sector interviewees prioritised governmental issues. Such differences in opinion were also seen among group members, e.g. in the academic group. For instance, an academic with expertise in information technology highlighted the point that the individuals responsible for implementing projects related to smart cities lack sufficient comprehension of this concept, while an academic specialising in urban planning emphasized the importance of plans and the utilisation of geographic information systems. Another example relates to one the legal dimension factors. While both the public and private sectors acknowledge the significance of Open data and its accessibility, one academic considers it a crucial factor while the other deems it irrelevant. This can be attributed to the backgrounds of both individuals. The academic, who has previously engaged in artificial intelligence projects, recognized the aspect as significant due to his expertise in the field. The urban planner disregarded this due to their lack of sufficient knowledge about the necessary data and their tendency to generate their data independently. Such differences highlight how complex projects are and the difficulties of synthesizing viewpoints coming from different disciplines and sectors in a single vision and plan.

4.1 Governmental Factors

Governmental factors play a crucial role in the success or failure of smart cities in Jordan. These factors include cooperation, coordination, clear vision setting, public-private participation, and the regulatory environment. Collaboration and cooperation between the IT sector and the business sector are particularly highlighted as essential in defining smart cities, as both sectors' visions are needed to implement smart solutions that enhance citizens' lives (Caragliu et al., 2009; Harrison et al., 2010). The lack of cooperation and coordination is identified as a significant challenge in smart city project implementation in Jordan, especially in Amman. The importance of clear and transparent collaboration between local and central government is emphasised, as stated by Shin (2012) and supported by the findings of this study. Participants from the governmental sector, private sector, and academia all stress the need for a reliable resource platform that provides background information for planning and structuring smart projects. Previous research suggests the importance of alliances, sharing experiences, and fostering innovation between sectors, particularly between the private and public sectors. As PU2 explained "*sharing data between different institutes is a tough matter because of the different coding styles used by each party. To make sharing the data doable, there should be a unified coding and storage style of data applied by everyone, which in its turn will make gathering all the data in one place easier and achievable.*" Also, an unclear smart city vision is recognised as a major obstacle to the transformation of cities into smart cities. Many interviewers stated that the unclear smart city vision is one of the major factors that affect the transformation of the city to a smart city. Clearly, as stated by PR6 "*there is no clear vision to the details of the project implementation, although there might be a general vision for the project, but the details are not clear nor well studied*". Aligned with this view, PU3 stressed that "there is a need for a clear and specific vision and application strategy to detect the primary problems that need to be solved before the application of smart solutions". As a result, it is necessary to have an urban plan in place before implementing a smart city transformation plan to ensure that the city's technological infrastructure aligns with the virtual maps used as data references. Consequently, poor private-public participation is considered a significant factor, with a notable impact on smart city projects. A number of participants deemed this factor as important. Most parties stated that there is a problem with the data sharing between the private and public sector, especially those needed in the project application. However, political instability is not found to be a major factor affecting the implementation of smart city projects in Jordan.

Assessing party and sponsorship management: The findings revealed that assessing party and sponsorship management is an important factor in the Jordanian context. To our knowledge, this factor is specific to Jordan. Based on the information gained through the semi-structured interviews, the lack of budgeting is forcing parties implementing smart projects to depend on funding and sponsorship, which requires numerous approvals and is very time consuming to obtain. In the absence of assigned budgets, political parties are forced to make difficult choices about financial matters, resulting in frequent delays and compromises during the implementation of projects. The lack of efficient budget processes inhibits the effective allocation of resources, which can result in delays. In addition, this creates distress among the implementing parties. As stated by PU5 "*the absence of a cohesive implementation strategy*

and a designated assessing party has historically hindered smart project execution due to governance fluctuations."

Another challenge is the need for an assessing party to monitor and manage the budgeting of smart solutions in Jordan as a whole, to spot implementation issues, and to give impartial criticism related to project execution. The absence of a designated authority to oversee the use of funds and track the advancement of projects impedes the timely identification of shortcomings from the intended objectives. In the absence of effective supervision, there is a significant likelihood of resources being allocated improperly and project outputs falling short of their full potential. The interviews have also illustrated how the individuals who are responsible for making critical decisions regarding the city's future often lack a comprehensive understanding of the concept of smart cities, which hurts investments. Limited comprehension results in selecting solutions that necessitate greater financial investment, rather than identifying cost-effective solutions, increasing the demand for further finance and consequently increasing the time required to secure permissions and other related matters. PU1 and PU4 strongly agreed that there is a need for a separate committee to oversee the implementation, budgeting, and management of smart city projects in Jordan. Although foreign investment and sponsorship are not seen as a major factor in the failure of smart urbanisation in Jordan, the process of sponsorship is viewed as time consuming or difficult depending on the party applying for the sponsorship. The lack of clear guidance and assistance increases the difficulties experienced by those seeking sponsorship, emphasising the necessity for simplified procedures and improved clarity. One issue participants raised was the lack of inclusion of smart project implementation in the governmental budgeting plan. The participants stated that there is a greater chance of obtaining the necessary funding for smart implementation through a third-party private company. This company can manage the project's implementation, instead of public parties.

4.2 Economic Factors

Becoming a smart city requires national and international funding. For that purpose, there are several funding programs. Monzon (2015) argued that economic funding and competitiveness play a great role in the smart urbanisation of cities and the implementation of smart projects. Although our findings supported this claim, the economic aspect of our report did not seem to be a factor affecting smart projects in Jordan. In this group, most economic factors were not deemed to be crucial factors affecting the application of smart city projects. As for the lack of competitiveness, participants believed that Jordan has a high rate of economic competitiveness. PR1 added that the service providing parties have a great economic effect in Jordan at the moment, and since smart city projects need large capital and a strong infrastructure they might also impact the application of smart city projects with their funding and knowledge aid. Regarding global economic volatility and foreign investments, participants viewed these as irrelevant to Jordan's status in relation to smart city projects. Where the global economy and its volatility has a great role in affecting the smart project implementation, especially those related to energy choices, regulatory conditions and the global economy (Gassmann, 2015), as listed in the findings above, global economy volatility does not seem to

be a contributory factor in Jordan. Similarly, the interviewees agreed that foreign investments and the investment factor were not crucial factors that might hinder smart city project applications. Most participants agreed that budget constraints are insignificant. They did not see prioritising smart city projects financially or governmentally as a crucial factor, but a few of them did view this as an obstacle that Jordan faces. Regarding the global economy, it does not seem to be an influential factor in Jordan because there are many private companies willing to share their experiences and innovations as well as provide foreign funding for a clear and well-planned smart project. PU2 explained that "*implementing subprojects related to the smart city transition on limited areas in the capital city as a model project is a good way to attract investors interested in implementing the model project on a larger scale*."

4.4 Technological Factors

Based on the findings, poor data availability, a centralised database, integration, and convergence are the main challenges in the technological group of factors. A centralised analytics database that presents and processes data is not available in Jordan. This issue leads to convergence and integration challenges. In Jordan, there are several companies and institutions that work on smart projects separately. Many participants highlighted the significance of integration and convergence issues across IT networks. In the public sector, PU1 pointed out that "*there is no centralised system containing all the needed data for the ministerial agencies yet and the national centre started collecting data in 2022, gathering them and storing them in a centralised system*." PR3 stated that "*there is no one centralised database for the presentation of the data and there is a lack in proper processing for the data*." This finding is consistent with those of previous studies, in which integration and convergence across IT networks were highlighted as a challenge that hinders the advancement of smart city projects (Chourabi et al., 2012; Kogan & Lee, 2014; Lee et al., 2014, Zanella, et al., 2014). The findings also confirmed that the data required for smart city applications are not available when needed. This is because of a lack of datasets that store the relevant data. Additionally, there is a shortage of spatial data, which can affect implementation.

Privacy issues should be taken into consideration while applying smart city projects. However, this is not a major challenge hindering the implementation of smart city projects in Jordan. Some participants agreed that privacy and security are an important factor, but they are not a critical challenge because smart city projects are in their first stages and citizens' concerns about privacy issues have not been explored yet. PR3 expressed concerns by saying that "*this could restrict the use of the technological aspects of smart city projects since the citizen feels that he/ she is under surveillance all the time.*" PR1 said that "*the government takes serious steps to protect the privacy and to govern the process of sharing personal information since people will not accept that easily.*" When it comes to security, the participants feared that the leakage of certain governmental data might harm the city. This fear was shared by both the government and citizens. Moreover, the findings revealed that Jordan is not mature enough when storing data and dealing with sensitive information, which gives rise to a fear of cyber-hacking and cybercrimes. Another general fear, which studies have also noticed, is the sharing of citizens' data with different parties for analysis and data gathering purposes (Gupta, et al.,

2019). This fear about sensitive governmental data is greater in the Jordanian region compared to other countries. The results showed that obtaining approval for smart technologies, such as the import of drones, is difficult because of security issues.

With respect to technology-related infrastructure readiness, all participants confirmed that this is a significant factor. Most of the participants expressed their satisfaction regarding technology-related infrastructure readiness in Jordan. PR2 expressed satisfaction regarding the technology-related infrastructure readiness in Jordan, emphasising that "*technology-related infrastructure in Jordan is satisfying and the 5G connectivity is somehow good and it does not affect implementing smart city projects*." Among the factors in this group, a lack of technological knowledge among planners was found to be an insignificant factor because there are several local and international workshops to help planners and officials remain up to date on new smart technologies. Regarding old technology, all participants indicated that they did not consider this factor as significant. PU1 stated that "*the old technology can be easily replaced and in Jordan all sectors attempt to use new technologies that help them in implementing smart city projects.*"

4.5 Legal Factors

The findings of the study revealed that all the factors in this group are considered important. Open data and their accessibility, lack of transparency and liability and lack of regulatory norms, policies, and directions are key factors in implementing smart projects in Jordan. Participants confirmed that some groups of people have reservations about smart city projects, especially regarding opinion sharing and censoring. There are some concerns about sharing data. The participants mainly discussed regulations and laws related to privacy and data sharing. The findings showed that the lack of legislation to facilitate the right to access information and the right to share data among government institutions is a barrier that hinders the implementation of such projects, since legislation is the basis for the success of smart city projects. Jordan needs a legislative revolution in this field. PR1 believes that "*there are laws which do not fully control the transition to smart cities, but support smart transformation in the city. Such legislation follows international standards in the transition to smart cities. It is not perfect and needs improvement, but then again this comes with experience and learning how much through applying the regulations*." Such findings are in agreement with previous studies (Founoun & Hayar, 2018; Gasiola et al., 2019). Regarding the lack of transparency and liability, the participants argued that this is an important factor for the success of smart city projects. They suggested that we are in need of a set of laws that are only concerned with smart applications. Such laws would govern communication companies, users' privacy, and the city's infrastructure. PR6 stated that "*today, Jordan is implementing different IoT based projects and smart projects, yet there are no regulatory norms that will help citizens if there might be a breach in the security system, but also those that clarify the rules related to the citizens and their connection with smart applications from a legal point of view."* Previous studies also suggested that the lack of transparency and liability is a crucial factor (Chen, 2021; Ferrara, 2015; Rahmayanti et al., 2020).

Approvals, implementation duration, fees, and taxes: Approvals and implementation duration was one of the factors that participants commonly agreed upon. Gaining approval for different stages in the implementation process, from dataset requests, to budget and funding approval, is difficult. The participants argued that the taxes imposed on different smart projects can be reduced when they are approved by the government for implementation to help fund the project. Gaining approvals is time consuming for any smart project in Jordan. Participants agreed that this sometimes leads to missing deadlines. Another problem mentioned was the hierarchy for dealing with approvals. PR1 stated that in general the approval hierarchy for the different phases is very time consuming and sometimes it might exceed the given timeline. In Jordan, some projects use a private company or a shell company to make the approval process easier. Amman Vision obtained funding and approvals through this strategy. The interviewees mentioned the repeated usage of the private company strategy for quicker project implementation, but no direct relation was noticed between this strategy and the obstacles faced with regulations and approvals. Small companies face several problems regarding imports of smart applications and services, which require a long procedure that may last years and be very costly. PU5 stated that "*when foreign funding is required, the analysis duration between the plan submission and the funding approval is quite long as sometimes the approval might take 1-2 years and it is also followed by another year or 2 to implement the project, which leads to the delay in project implementation*."

In comparison, the government faces a problem regarding identifying companies that deal with smart technology because the relevant information is not clearly listed in the companies' commercial registration. To tackle this issue, one recommendation is to inform those companies about establishing a shared platform for registration. This will identify their work clearly when it comes to establishing its relevance to smart cities. The government can easily determine whether those companies should get approvals or not. Another recommendation is to reduce the taxes imposed by the government.

Trust in using e-products in governmental institutions*:* This factor was mentioned by the participants as an important one regarding the implementation of smart projects in Jordan, especially with regard to the usage of e-products. The findings showed that the correct usage of IoT and adequate infrastructure to implement smart projects make the process faster and more accurate. The participants stated that e-products and app usage can be implemented to obtain live data from citizens about issues "on the ground", e.g. related to infrastructure. A number of participants explored this issue during the interviews. Most people and decision makers and even some governmental entities have not yet accepted digital transformation. There appears to be a lack of trust in e-documents and e-transactions.

4.6 Environmental Factors

Participants and the literature agreed that the environmental group of factors is important in the development of smart cities. They saw it from two perspectives: either as a barrier to the development of smart cities or as a problem that smart cities can solve. The findings of the study showed that most factors in this group can be seen as an opportunity, with smart cities aiming to improve environmental behaviour in Jordan rather than being a set of barriers.

Participants confirmed that the environment does not pose a challenge but offers an opportunity to mitigate the environmental impact of projects, e.g. by providing solutions to traffic crises. In the case of issues such as the growing population, the effect of carbon emissions, and the degradation of resources, participants agreed that the growing population factor in Jordan may affect the implementation of smart city projects. PU3 stated that "*the population increase in Jordan has exceeded the natural growth rates which the government expected when developing the comprehensive plan due to the increase in the number of refugees inside the country*" . Previous studies (i.e. Toli & Murtagh, 2020; Yigitcanlar & Kamruzzaman, 2018) also shed light on this factor and examined its impact on the implementation of smart projects. Participants argued that climate agendas are important in Jordan, and there are strategies to reduce emissions, such as the Green Growth strategy and the Climate strategy for Amman. The importance of climate agendas may stem from them being a source of funding for projects. PR3 sees that "*there should be a focus on low carbon emissions and support for clean energy in such projects*." On the other hand, PU3 stated that in Jordan, "*the per capita share of carbon emissions is not high yet, and this factor does not affect us*".

In addition to that, the availability and degradation of resources was found to be a problem for smart city solutions according to the participants. For instance, the lack of water resources in Jordan is an important barrier that may affect the implementation of smart projects. PU3 considers the lack of water resources in Jordan as an important barrier, while PR4 believes that, if implemented correctly, smart city solutions will solve environmental issues such as resource degradation and increased carbon emissions into the atmosphere.

Physical infrastructure and land ownership: The physical infrastructure was one of the factors that concerned the participants. There was a common view among participants that a lack of solid physical infrastructure data that can be used in smart project planning and implementation is a major obstacle facing Jordan. They unanimously agreed that a lack of solid physical infrastructure data is a crucial barrier facing Jordan, which different parties such as the GAM are working on. Participants noted that the digital infrastructure data needed to implement smart city projects is not fully up-to-date. According to the participants, Amman is still undeveloped when it comes to storing physical infrastructure data in a digital form. Additionally, the difference in storage style from the available styles adds to the problem. PR6 stated that a lot of time there is a mismatch between the on-ground infrastructure reality and those on paper, which poses a problem when proper infrastructure needed for the project is being executed. However, PR5 stated that not all places in Jordan have a prepared infrastructure for smart project implementations, and that most of the areas are quite old and are in need of proper infrastructure renovation, which is costly. Most smart projects which have succeeded were those that were built from scratch so that the infrastructure is built adequately.

It should be noted that there have been projects by the GAM targeting this issue. For example, the Amman is Listening smart project aims to digitise Amman as an interactive map that different parties can access. The data can be added to or used for different purposes. Citizens can add their suggestions or complaints related to land issues, and GAM and other

parties can use this data when needed to target specific areas or put forward a smart solution. Another major factor is the ownership of land. Based on GAM information, in Amman, citizens own 80 percent of the land. Thus, when implementing a smart solution, it is difficult to gain approval. Sometimes, large sums of compensation are paid to obtain the land needed for project implementation. According to Dawodieh and Al-Kurdi (2020), urban planning policies in Jordan are pushing towards centralising the capital city of Amman, disrupting the balance in other cities. To solve this problem, the researchers suggested developing new urban planning strategies that can implement smart growth in the economy and benefit other cities in Jordan. Another factor regarding physical infrastructure is the high cost of implementing smart projects in crowded cities. The existing infrastructure is facing problems and is not prepared for smart projects. The high cost seems to be due to compensation issues. In contrast, projects that have been applied in empty spaces, such as Al-Hussein Business Park, have been implemented successfully with no significant problems.

5. Discussion and Contributions

5.1 Discussion

This research examined the challenges and barriers of smart cities in Jordan from different vantage points. Our findings agree with previous work such as that by Tan and Taeihagh (2020), which suggested that effective management for smart city projects in developing countries requires robust planning related to the social, economic, legal dimensions. In order to ensure successful implementation there is a need for an agreed strategy. Still, this is not a trivial task as there may be differences in opinion as to the importance of certain factors that need to be prioritised. For example, in recent work Gupta and Hall (2020, 2022) and Vu and Hartley (2018) found that the professionals interviewed had varied priorities when it came to overcoming challenges. Such differences may occur within groups, but also among groups. Our findings reflect the differences in understanding and the diversity of the points of view of different stakeholders who participated in the interviews among Jordanian practitioners, government authorities and academics. Several factors could explain such differences, such as the participant's area of work and role, experience, and background. Including academics in the interviews, as compared to previous studies, made it possible to obtain a more holistic approach and put things into a Triple Helix perspective (Etzkowitz, 2003). A triple helix calls for a more prominent role for the university in innovation, on a par with industry and government in a knowledge–based society, and a movement toward collaborative relationships among the three major institutional spheres, in which innovation policy is increasingly an outcome of interaction rather than a prescription from government. Insights provided by academics enabled better planning and a more comprehensive perspective on innovation. This could be because they need to remain up-to-date with changes and explore new avenues through research, which may not be as constrained as practice, due to the latter being focused on delivering results.

With regards to the factors themselves, our findings suggest that there is range of challenges that need to be considered in the case of Jordan. These challenges encompass various aspects such as inadequate implementation methods, limited finance, and insufficient economic growth, as highlighted by Hamza (2016). Additionally, issues of efficiency,

environmental concerns, and infrastructural limitations are prevalent, as noted by Vu and Hartley (2018) and Yadav et al. (2019). Moreover, obstacles related to policy concerns, technology limitations, and social constraints further complicate smart city endeavours, as indicated by Razmjoo et al. (2021) and Gupta and Hall (2022). These range from resource management and partnership issues to institutional, scheduling, and execution challenges, spanning the social, financial, political, and technological domains. In some cases, different entities inside the developing countries such as Jordan, have less harmonisation in planning and could have conflicting interests, which could generate issues of coordination and decision-making. Another possible explanation for this is that, in some cases, national smart city initiatives face challenges related to bureaucratic obstacles, which make the achievement in this kind of projects slow and lead to increased costs or delays in project implementation.

The other noticeable finding to emerge from the analysis is the difference between the issues faced by a developing country like Jordan and evidence from developed countries (Table 3). This especially applied to coordination, resources, technology, legislation, citizen engagement, and environmental considerations. Developed countries show better cooperation, have a clearer vision, and a more robust infrastructure compared to a country like Jordan, which struggles when aligning organisational goals, attracting investments, and navigating conflicting objectives. This contradiction sheds light on the challenges faced by developing countries, where resource scarcity and legislative gaps hinder the implementation process (Chourabi et al., 2012). These results provide further support for the notion that while developed countries may face obstacles in smart project applications, the nature of the challenges differs in developing countries, often revolving around resource insufficiency and legislative gaps.

Table 3: A comparative analysis between developed and developing countries

Factors	Similarities	Differences	New
Governmental	Problems aligning organizational goals and project plans with multiple or conflicting objectives.	*Literature*: exhibits better cooperation, coordination, and clear smart project vision. *Jordan*: communication problems and unclear project visions hinder investment attraction and financial assessment.	Land ownership issues and corruption, which raise trust issues, and hinder the project's approval process.
Economic	Attracting foreign investments and financial aid to support smart city project implementation.	*Literature*: due to their clear project visions, financial aid is granted. Mostly, they get affected by global economic issues.	Jordan faces challenges in accessing substantial funding options for smart city projects due to its economic circumstances and

		Jordan: faces a shortage of foreign investment or financial aid due to a lack of communication and unclear project vision.	limited public-private partnerships.
Social	Citizen engagement is essential for the successful implementation of smart projects.	*Literature*: exhibits a high percentage of hybrid approaches between bottom-up and top-down smart project implementation. *Jordan*: mainly uses the top-down implementation approach, which best fits the government and its financial ability rather than the citizens' benefit and feedback.	Jordan started using the hybrid approach and gets the citizens' feedback to provide useful updated versions of the smart project implementation, such as the Amman is Listening interactive map project.
Technological	Challenges related to data availability, centralisation of databases, integration, and convergence.	*Literature*: exhibits a need to develop and update the cyber security system to protect users' information. *Jordan*: faces trust issues between the citizens and government in relation to sharing their personal information online, or with the government themselves.	Jordan faces challenges related to privacy and security, which are further complicated by the issue of citizen-government trust.
Legal	Lack of open data accessibility, transparency, and liability, and the absence of regulatory norms and policies	*Literature*: the availability of open data accessibility and transparency has helped develop better smart project usage to overcome national issues. *Jordan*: often lacks the necessary legislation to facilitate the right to access information and share data among government institutions.	Jordan is in need of legislation updates that extend beyond open data policies, shipment, and tax laws, encompassing areas such as transparency, liability, land ownership, and smart project implementation.

Environmental	Sustainable development goals are to be achieved through smart projects.	*Literature*: exhibits a comprehensive approach toward sustainable development and well-developed green economy plans. *Jordan*: encounters challenges in formulating comprehensive action plans for sustainable development and a green economy.	Jordan uses the high refugee influx and water shortage as an opportunity to show the benefit of smart projects in dealing with such issues.

5.2 Theoretical and practical contributions

The theoretical implication of this study is its contribution to the existing literature by providing a comprehensive understanding of the barriers that hinder the implementation of smart projects in a developing country, particularly in the Arab world. By focusing on these specific challenges, the study fills a knowledge gap and expands our understanding of smart city dynamics beyond developed countries. The insights gained from this research offer valuable information on the factors that impede the successful implementation of smart projects in such a setting. This knowledge can be used by policymakers, city planners, researchers, and stakeholders in these regions to anticipate and address the specific challenges they may face. By understanding these barriers, appropriate strategies and interventions can be developed to overcome obstacles and ensure the effective implementation of smart city initiatives. The inclusion of interviews from diverse sectors enriches our understanding of the factors that influence smart city implementation. This multi-perspective approach provides a holistic view of the challenges and allows for a deeper analysis of the interactions between different stakeholders. Also, it emphasises the importance of collaboration and cooperation among the public, private, and academic sectors in addressing the identified barriers and working toward successful smart city projects.

Based on the empirical evidence and the findings generated, a number of practical recommendations can also be put forward. For the governmental group, promoting a clear vision of future project plans to citizens and to private companies that may be interested in financing or implementing projects is necessary. To address the governmental barriers, there must be cooperation between the government and companies that implement smart city projects. The government must also clarify its vision to private companies that may be interested in financing or implementing projects. This will facilitate the development of solutions to the city's problems using smart technology and encourage the participation of the private sector. As for the economic barriers, effective promotion of smart city project opportunities is important to attract the necessary funds and should be conducted appropriately. Attracting sufficient funding is important for overcoming economic barriers and will facilitate the implementation of necessary smart city projects and infrastructure development. Also, it is necessary to build trust and the credibility of the institutions who manage funding allocations. From an economic point of view, to avoid nepotism and enhance suitable financial aid

planning, anonymous smart project applications and a reviewing system are required. With regards to social factors, there is a need to increase the active involvement of citizens in projects. Citizens should first understand smart city applications and the potential value they can bring, and then be trained to use them so that they can realise the promised benefits. There was strong emphasis on the need for citizens' participation through valuable feedback on local issues, which they are more aware of, compared to the government or private companies. Continued efforts are needed to make smart applications more accessible to citizens. The government should advertise the use of smart applications and encourage all citizens to use them by actively demonstrating their benefits. The technological factor contains the most important barriers to the implementation of smart city projects in Jordan. There is a need to tackle the problem of relevant skills and capacity, while similarly there should also be improvements to the spatial infrastructure of data quality to make it easy for the applications to function properly. Furthermore, there is a need for a unified data storage system for all sectors to make the analysis and usage of data easier, and improvement in spatial data quality related to the physical infrastructure. As for the legal factor, the government should introduce laws that provide a more consistent working framework across smart city applications, in order to ease their implementation and diffusion across the country. Finally, to address the harsh topographical environment and inadequate infrastructure issue, alterations to the application process of the project need to be made, rather than by rebuilding the infrastructure of the area and changing the environment itself.

6. Conclusion, Limitations and Future Research Avenues

This study has examined the governmental, economic, social, technological, legal, and environmental factors related to smart city implementation in Jordan. By undertaking semi-structured interviews with interviewees from the public and private sector as well as academics we were able to get a holistic understanding. Our analysis not only examined the importance of the factors discussed in the literature but also made it possible to identify new ones. It also aimed to shed light on the relative importance of these factors and why there may be different viewpoints as to their weight. Such contextual insights are valuable not just from a practical perspective, but also from a theoretical one, as it helps to put the findings in the literature from different parts of the world into perspective.

This study has its own limitations. It was restricted to a single case study, which may limit the generalizability of the findings to other developing countries. More research is needed to include a broader sample of developing countries and enhance the applicability of the results. Considering the variation within countries, it is important to acknowledge that not all smart projects within the same country are identical, and the identified factors may manifest themselves differently. Further research should examine these factors at the project level to capture the specific nuances and variations within a country. To gain a deeper understanding of the factors, further exploration is needed to examine their practical implementation and investigate how they impact on the success or challenges faced during the implementation of smart projects. This will provide more insights into the operational dynamics of these factors. Lastly, to complement the expert perspectives, future studies should incorporate more interviews and gather feedback from users to incorporate the user perspective. Comparing

expert viewpoints with user experiences will offer a more comprehensive understanding of the factors and their impact on smart city projects.

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