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ORIGINAL ARTICLE

Housing development and the smart city: A case study of Tehran, Iran

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ABSTRACT

Iran has one of the oldest civilizations in the world, and many elements of today's urban planning and design have their origins in the country. However, mass country-city migration from the 1960s onwards brought enormous challenges for the country's main cities in the provision of adequate housing and associated services, resulting in a range of sub-standard housing solutions, particularly in Tehran, the capital city. At the same time, and notably in the past decade, Iran's main cities have had significant involvement in the smart city movement. The Smart Tehran Program is currently underway, attempting to transition the capital towards a smart city by 2025. This study adopts a qualitative, inductive approach based on secondary sources and interview evidence to explore the current housing problems in Tehran and their relationship with the Smart Tehran Program. It explores how housing has evolved in Tehran and identifies key aspects of the current provision, and then assesses the main components of the Smart Tehran Program and their potential contribution to remedying the housing problems in the city. The article concludes that although housing related issues are at least being raised via the new smart city technology infrastructure, any meaningful change in housing provision is hampered by the over centralized and bureaucratic political system, an out of date planning process, lack of integration of planning and housing initiatives, and the limited scope for real citizen participation.

KEYWORDS

citizen participation; technology infrastructure; Smart Tehran Program; housing policy; urban planning

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1. Introduction

The smart city concept assumes that a city will be more "livable" and better able to respond to

challenges through improvements in digital technologies, vital infrastructure, social capital, and the resultant increased employment of citizens. The Smart Cities Council (2015) defines a smart city as "a city that uses information and communications technology to enhance livability, workability, and sustainability" (p. 6). While technology is the key enabler for smart cities, it is not an end in itself. The point of a smart city is to improve the lives of residents and businesses through the application of advanced technologies. A smart city uses an integrated approach to coordinate all essential services. It modernizes digital, physical and social infrastructure to make delivery of city services more efficient, innovative, equitable, connected, secure, sustainable and exciting (Vince and Morrissey, 2020). Directly or indirectly, this should bring about improvements in the city's housing stock and the lives of the those living there. As Moosavi (2013) notes "over the past recent years, a desire for sustainability of human settlements, and tackling against the environmental threats, has become a matter of global concern" (p. 95).

Tehran, the capital city and political center of Iran, had a population of 9.38 million in 2022 (MacroTrends, 2023), and ranks 28th among the world's most populous cities. The land reforms of the 1960s gave rise to massive country-city migration in Iran, and the lack of adequate housing, particularly in Tehran, became a key issue in the years leading up to the 1979 revolution, epitomized by the slogan "bread, housing, freedom" (Farahani and Yousefi, 2021, p. 46). In the post-revolutionary period, a series of National Development Plans and associated policies have made some attempt to address housing supply issues, but it has mainly been the private sector that has been the provider of housing, sometimes supported by state subsidies and financial incentives. Today, however, the provision of adequate housing remains an acute problem in Tehran. Although there are some high-quality residential areas, the majority of housing is characterized by poor quality construction and lack of adequate services, and informal shanty developments exist in some parts of the city (Ghaedrahmati and Zarghamfard, 2021). At the same time, the city has been actively involved in the smart city movement, and the city's Smart Tehran Program (STP) is currently underway, with the aim of becoming "a livable and sustainable city for everyone with engaged collaborative citizens" (TMICTO, 2020, p. 3).

Against this backdrop, this article sets out to examine the housing issues in Tehran and assess the impact of the smart city initiative in confronting these issues. More specifically, the article addresses two main research questions (RQs). Firstly, how has housing evolved in Tehran and what is the current status of housing provision? And secondly, what are the key aspects of the Smart Tehran Program that are impacting housing development? Following this brief introduction, the next section provides background to the research and reviews literature and web sources relevant to the two RQs noted above. Section 3 then outlines the methodology used in the study. In Section 4, the findings are set out, focusing first on housing provision in Tehran and then on an assessment of the STP, and if and how it is addressing the housing issues in the city. Section 5 then identifies and discusses key issues emerging from the research findings. Finally, Section 6 provides a brief conclusion to the study.

2. Review of literature

2.1. History and evolution of housing development in Tehran and Iran

The need for high-density housing systems due to rising population became a central issue in

most of the world's major cities in the second half of the 20th century (Hirschman, 1994; Wynn, 2017). The "residential complex" or "housing estate" rapidly became one of the most important prototypes of modern urban development in towns and cities in both developed and developing worlds. Across the Middle East, a similar pattern of development in the major cities emerged. Kilinc and Gharipour (2018), in their study of social housing in the Middle East, assessed the situation thus: "from Egypt to Iran, signature tall buildings, urban renewal projects, gentrified neighborhoods, coastal tourism infrastructure, massive shopping malls, and informal settlements are the main markers of Middle Eastern urbanism of the new century, while privatization increasingly takes hold of public spaces. Issues of security, the growing number of refugee camps, and rural migration to cities are also entangled with the generalized lack of decent housing" and concluded "even in oil-rich countries of the Persian Gulf, a shortage of adequate and affordable housing remains an enduring yet largely unaddressed problem" (p. 1).

In Iran, building affordable housing in the capital has been a major challenge for the State and the construction industry since the 1970s, when the Iranian land reforms resulted in peasant impoverishment, rural destitution, and mass migration to the cities (Majd, 1992). A number of initiatives have been tried by successive Iranian government administrations over the years to alleviate the problems in the housing sector—including subsidies for the supply of land, construction materials and energy provision, as well as financial incentives, tax exemptions and discounts, and, on a much smaller scale, public and rent-to-own housing projects, and sheltered housing initiatives for vulnerable groups. These activities have had some success, but overall have not been able to address the country's growing housing problems, as they have been based on non-coordinated interventions rather than adopting a comprehensive integrated approach (Alaedini, 2021). Farahani and Yousefi (2021) claim this "failure is due primarily to the State's market-oriented approach toward housing" (p. 45). The private sector has remained the dominant player in housing provision, with the State playing a minor secondary role (**Figure 1**).

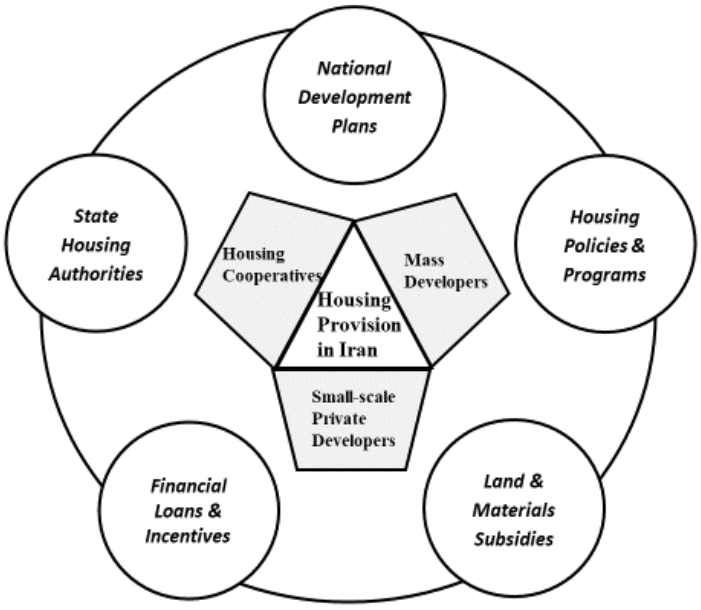

Figure 1. State intervention and private sector entities (shaded grey) in housing provision in Iran.

Nevertheless, at the macro-level, housing has featured as a key component of national development planning in Iran. There have been twelve development plans, five of them before, and seven of them after, the 1979 Revolution. Not until the third National Development Plan (NDP) (1963–1967), was there any specific focus on housing, in which the private sector was given the lead role in providing 96% of the supply of housing, building 260,000 housing units in urban areas in the plan period (**Table 1**). This pattern was repeated under the fourth NDP (1968–1972), through which the private sector was to build a further 275,000 housing units (250,000 in urban areas and 25,000 in rural areas). One initiative here was state support for the construction of apartment buildings and residential complexes, and the target was in fact exceeded with 293,000 dwellings being constructed. The ensuing construction boom led to a considerable rise in the price of land, which accounted for 30% to 50% of the cost of housing in Tehran and major cities. The fifth NDP included proposals for the allocation of state-owned land for housing projects, imposing levies on unused urban land and creating incentives for the industrialization of construction activity (Encyclopaedia Iranica, 2012).

Table 1. House construction in the 3rd–9th National Development Plans (NDPs).

Plans	Years	House construction target	Housing units constructed
Third NDP	1963–1967	No target was set.	260,000 housing units were built by the private sector (Alavi et al., 2018).
Fourth NDP	1968–1972	275,000 units.	293,000 units were built (Alavi et al., 2018).
Fifth NDP	1973–1977	1,050,000 units.	810,000 public sector housing units were constructed by state housing authorities (Alavi et al., 2018). 495,000 private sector houses were built (Alavi et al., 2018).
Sixth NDP	1989–1993	2,285,000 units.	1,690,900 were constructed (Vejdani Irani, 2017).
Seventh NDP	1995–1999	2,460,000 units.	985,800 units were built (Vejdani Irani, 2017).
Eighth NDP	2000–2004	No data available.	2,025,000 units were built by the private sector (Alavi et al., 2018).
Ninth NDP	2005–2009	Mehr Housing Plan (MHP) launched in 2007.	Around 2,200,000 MHP units were built by 2017 (Alaedini, 2021). Some MHP activities continued to take place during the tenth and the first part of the eleventh NDPs.

In the sixth NDP (the first after the Islamic Revolution), covering the period 1989–1993, the government introduced a series of new measures for the granting of easy loans, distribution of construction materials at government prices, extensive sale of land at low prices, and approval of housing cooperatives. These measures lowered the price of housing and had a positive quantitative, as well as qualitative, effect, but led to the horizontal expansion of cities (Mirjalili, 2022). The seventh NDP (1995–1999) saw the introduction of, and subsidy for, the "PAK" (small unit) housing initiative, aimed at lower income groups. The developers in this plan were a combination of government agencies (47%) and private sector operators (53%). The eighth NDP (2000–2004) aimed at a reduction of government intervention, strengthening of housing institutions, elimination of monopolies, regulation of markets, creation of investment security, and raising of ecological standards and protection of wildlife (Encyclopaedia Iranica, 2012). The ninth NDP (2005–2009) featured the Mehr Housing Program (MHP), which aimed to provide housing for low income groups, with a view to omitting the land price from the total cost of housing, which was covered

by government subsidies. The construction of Mehr units started in 2007 and the scheme was closed in 2021 (Tajrishy and Vesal, 2021). Some MHP activities continued to take place during the tenth (2010–2015) and the first part of the eleventh NDPs. A large number of housing units came to be rented out, rather than occupied by their supposed low-income owners, while some informal settlements appeared right next to certain MHP sites (Alaedini, 2021).

The eleventh NDP (2016–2021) ushered in the Revised Comprehensive Housing Plan, which tried to address a number of housing related issues, including the cost and availability of land for housing, and the spread of illegal, informal settlements (Alaedini, 2021). This plan aimed at providing 400,000 small- and medium-sized apartments (70–100 square meters in size) across the country, and particularly in Tehran, where housing prices have risen most sharply (Abdi, 2021). The twelfth NDP (2022–2026) introduced the National Housing Movement, a new government initiative aimed constructing four million residential units in four years (Parto News Agency, 2022). The first phase of the National Housing Movement began in August 2022. Of the four million residential units, 3.2 million units will be constructed in cities and 0.8 million units in villages (Abdi, 2022). Nearly half of the said houses were to be constructed in Tehran's new towns, with the participation of the private sector (Abdi, 2021).

A range of policies and plans have thus been adopted to confront the housing crisis in Iran (Zarghamfard et al., 2020), with the construction targets growing significantly since the 1990s. Policy initiatives in the post-revolutionary period, contained within the NDP framework, include Mass (P.A.K.) Housing, Cooperative Housing, New Towns, Mehr Housing, the Revised Comprehensive Housing Plan and the National Housing Movement. The provision of housing in Iran today is undertaken in the main by a combination of government subsidies and incentives and private sector operators (**Figure 1**). The government has experimented with various policies, strategies, programs and projects throughout the decades, but little attention has been paid to the principle of sustainable housing. In Tehran, the need for a sizeable supply of low- and middle-income housing is particularly acute (Adarsh Group, 2018). However, although there is a considerable amount of literature that discusses various aspects of housing provision in the city, there is no comprehensive account that sets out the key issues that have impacted housing development and provides an overview of the resultant urban landscape. By drawing on existing sources and interview material, this article makes a small contribution to filling this gap in the literature.

2.2. Sustainable housing and smart city initiatives

Sustainability is a topical issue globally as it affects the different facets of human life of which shelter is a major concern. Edwards and Turrent (2000) defined sustainable housing as "housing that meets the perceived and real needs of the present in a resource-efficient fashion while providing attractive, safe, and ecologically rich neighborhoods" (p. 21). The underpinning idea is that housing provision today should have minimal impact on the natural environment, thereby allowing the next generation to provide the required housing sustainably (Mahmoudi et al., 2013).

The smart city movement is often seen as the manifestation in the urban environment of "digital transformation", and the Smart Cities Council (2015) concluded that "all the city functions (including energy, transportation, telecommunication, health, human services, waste management, payments, and finance, as well as public safety) that smart cities promise to improve are enabled

through the power of technology" (p. 26). The key role of technology is emphasised by Townsend (2013), who defines smart cities as "places where information technology is combined with infrastructure, architecture, everyday objects, and even our bodies to address social, economic, and environmental problems" (p. 15), and Paskaleva (2011) argued that smart city investments generally occur in six arenas: the economy, mobility, the natural environment, human or social capacity, urban environments, and governance. With the population of major cities projected to continue to grow significantly in the coming decades, the development of smart cities is urgently needed. The effective provision of housing is a fundamental requirement in a smart city. Without it, the city's ability to thrive and expand is severely hampered.

Hitherto, however, housing has not been seen as a key focus of smart city initiatives, in contrast to transportation, street lighting, and communications networks, for example. However, this is changing as smart cities shift their focus from connected infrastructure and technology innovations toward a broader conception of quality of life (Wray, 2019). Indeed, Alizadeh and Sharifi (2023) recently introduced the concept of "societal smart city" to "advance the ideas of human-centric or people-centric approaches" to smart city development. In a case study of Tehran, their questionnaire-based research indicated that four key factors, namely citizen centric governance, inclusive services, resilient infrastructure, and information literacy, were the main underlying factors of social justice in Tehran. A number of recent studies have more specifically examined the interaction between smart city initiatives and housing issues. Lung-Amam et al. (2021), for example, in their study of low-income communities in West Baltimore, examined how community engagement can improve smart city planning and investments to disadvantaged groups and neighborhoods. The study reports that in 2017 and 2018, discussions were held with community-based organizations to assess their concerns and priorities, their technology use and access, and potential smart city solutions. Ten focus groups were conducted with 172 participants, and surveys were also undertaken. The research concluded that community engagement was critical to progressing an equitable, community centered and place-based smart city agenda that recognized existing social and spatial conditions as well as technology constraints. It highlighted the need for smart city planners and policymakers to improve access to affordable technologies to aid low-income residents in opportunity searches and to harness the creative capabilities of residents. The study stressed the value of engaging residents in setting the agenda for smart city priorities and investments.

A slightly different focus was taken by Jonek-Kowalska (2022), who studied the quality of housing infrastructure in Polish smart cities, noting "this is an issue that is far less frequently described in the literature than issues of IT or ICT solutions or environmental protection" (p. 925). In conclusion, the author found that in Polish smart cities, "the quality of housing infrastructure can be influenced by the historical conditions of urban development, the shorter the history of the city the higher the quality of this infrastructure", and called for "international comparisons and qualitative analyses oriented toward the creation of smart housing infrastructure oriented toward improving the quality of life of residents" (p. 943).

Housing policy is an essential instrument in promoting sustainable urban development (Ghaedrahmati and Zarghamfard, 2021). With its central role in society, housing now accounts for more than 60% of a city's total land area (Sheykhi, 2007). One of the main goals of the smart city mission is to ensure that people have safe and affordable places to live. Addressing basic housing requirements, improving residents' health and access to social services, and providing security for

the household's financial future are all ways in which smart city initiatives can have a major impact on people's standard of living. Providing adequate housing is now among the primary objectives of the smart city mission. However, there is a dearth of literature on the relationship between smart city initiatives and potential solutions to urban housing problems, and very little research appears to have been conducted in this field. This article contributes to addressing this gap in the literature in the context of Tehran, by examining existing sources and gaining insights from interviewees regarding the positioning of smart city plans and projects against the urgent need for new housing initiatives in the city.

3. Methodology and setting

The overall aim of this research is to examine the evolution of Tehran's residential areas, identify key issues in housing provision today, and assess the current and potential impact of the Tehran smart city initiatives in addressing these issues. The study adopts a qualitative, inductive approach using a literature review, document analysis, field observation, and interviews with ten individuals with relevant knowledge and experience. Interviewees included three senior academics (A1–A3 in **Table 2**) currently working in universities in Tehran, three students (S1–S3) studying urban planning

Table 2. Interviewee occupation and experience.

Code	Occupation	Relevant experience
S1	Master's student in Urban Planning, Bojnourd University, Iran.	Research interests in smart cities, housing and the economy, and urban network analysis.
S2	Graduate in Urban Planning and Design, University of Tehran.	Knowledge of urban planning policies and practice in Tehran.
S3	Graduate in Environmental Planning, University of Tehran.	Independent researcher.
P1	Urban and regional planner.	Analytics experience in a non-profit consulting firm which contributes to smart city solutions.
P2	Currently PhD student, RMIT University, Melbourne, Australia, but has practitioner experience.	Principle researcher and urban and regional planner at different public and private companies in Iran.
P3	Founder and Director of Architecture & AI Laboratory, University of Science and Research Branch, Islamic Azad University, Tehran.	Experience of application of AI in architecture. Instructor of architecture and AI.
P4	Currently studying for an MSc in Urban Planning, but has worked in Tehran as practitioner.	Worked for engineering and planning company for 2 years and in the Smart City Council of Iran in Tehran. Involved in teaching of Urban Planning at the Tehran University.
A1	Assistant Professor, Faculty of Architecture and Art, Science and Research Branch, Islamic Azad University, Tehran.	Worked on United Nations Habitat programme focusing on smart cities in Iran.
A2	Assistant Professor at Iranian Research Institute for Information Science and Technology (IRANDOC).	Worked on Artificial Intelligence projects as a practitioner. Experience of smart cities and cybersecurity issues.
A3	Associate Professor, Faculty of Civil Engineering, Architecture and Art, Science and Research Branch, Islamic Azad University, Tehran, Iran.	Some of her master's students in urban planning have presented their theses in the field of housing and smart city.

or a related discipline, and four practitioners (P1–P4) based in Tehran. These classifications overlap somewhat as, for example, all three academics have also worked as practitioners in the past and all ten have also been students at some time.

First, however, the extant literature was assessed and Bell et al. (2018) have observed that a literature review can provide "a means of gaining an initial impression" of relevant themes and that "the narrative review may be more suitable for qualitative or inductive researchers, whose research strategies are based on an interpretative epistemology" (p. 97). A case study was the main applied methodology "to develop sharper and more insightful questions about the topic" (Yin, 2018, p. 13). The validity and generalisability of case studies has been discussed widely in the literature (Gray, 2016; Yin, 2018). Flyvbjerg (2006) has suggested that cases should not necessarily be used for generalisation beyond the case study environment studied, but rather should focus on the generation of a deep understanding of the complexity of the case, producing "concrete, context-dependent knowledge" (p. 223). This is of particular relevance here, as this is in essence a sole case study and does not provide the basis for generalising about smart cities and housing globally.

Relevant publications and web sources were reviewed to establish the depth and breadth of current literature relating to urban housing development and the smart city initiatives in Tehran (and more generally in Iran). This was a scoping review aimed at identifying the degree of overlap between these two main themes, and clarifying the overall research aim. Scoping reviews "are best employed when there is limited literature to inform the research question of interest" (Hanneke et al., 2017, p. 5), and can help provide the basis for subsequent research. Internet surveys were conducted using Google as the search engine with appropriate search strings in January to March 2023. This allowed the identification of a set of key issues and the two main research questions noted above. These were then used as the basis for developing the questionnaire which comprised four open questions concerning housing provision in Tehran and four relating to the STP. There followed ten summary statements with which the respondents to the questionnaire were asked to agree or disagree on a five-point Likert scale. The final section invited further comment or information of relevance. The questionnaire, in English, was emailed to the ten respondents, with whom follow-up interviews were held via SKYPE within a three-week period. The completed questionnaires were used as the basis for discussion in the interviews, when additional annotated notes were added to the returned questionnaires. All respondents answered the questionnaire in English, and nine of the ten interviews were conducted in English. The tenth interview was conducted in Persian, the transcript for which was translated by one of the research team, and double-checked by a second researcher.

Selection of interviewees was done through the professional networks of the authors. It was considered that a combination of practitioners, academics and students would provide a range of perspectives on relevant issues. This was "purposive sampling" in which the interviewees "are chosen because they have particular features or characteristics which will enable detailed exploration and understanding of the central themes and puzzles which the researcher wishes to study" (Ritchie et al., 2003, p. 78). Semi-structured interviews were seen as the best way of eliciting qualitative data with the highest possible level of knowledge being acquired in a flexible manner. Interviewees were able to give their perspectives on housing and smart city issues in Tehran, including less obvious factors giving interviewees a "voice" in the study (Lee and Lings, 2008). Finding interviewees willing to openly express their opinions was not easy in the current political climate in Tehran, and the authors considered that 10 in-depth interviews were enough to allow the development of

answers to the research questions. This is supported by Guest et al. (2006), who found that "saturation occurred within the first twelve interviews" but that "basic elements for metathemes were present as early as six interviews" (p. 59). The subsequent data analysis entailed the summarizing and structuring of the data to address the research questions (Bell et al., 2018; Saunders et al., 2018). All interviews took at least one hour. The quotations in the Findings and Discussion sections are taken from the questionnaire responses, notes added in the interviews, or from the interview recordings.

The setting for the study is the city of Tehran, which comprises 13 "wards", defined by main transport routes reflecting the historical growth of the city (**Figure 2**). The Central Ward, the main business and administrative centre of the city, is surrounded by the streets of Enghelab, Karegar, Shoosh and Shahrivar, and contains the Bazaar, the parliament, the law courts, universities, embassies, and the main commercial activities of the city. Adjacent to the Central Ward are the four Inner Wards, beyond which are the eight Outer Wards. However, there are also 22 administrative "Districts" that have been superimposed on this framework, and these are referred to in some of the academic literature. Amiraslani (2021), for example, notes that "growing from its small area, Tehran has gradually incorporated adjacent areas (including villages) and been expanded fast. The city has absorbed surrounding areas to create 22 districts with varied shapes, size areas, and urban amenities." The author also notes that "three co-centric nested zones based on their geographical locations" can be identified, those being "central (historical), intermediate and peripheral (marginalized) zones" (p. 109).

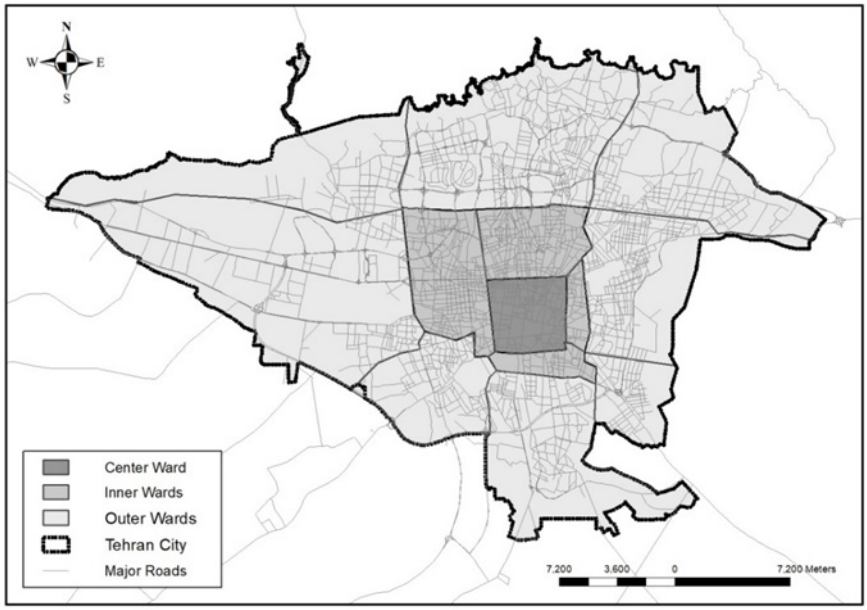

Figure 2. The main wards of Tehran (based on: Mirmoghtadaee, 2009).

4. Findings

4.1. Housing development in Tehran

Tehran houses have historically ranged from the traditional courtyard dwelling—seen as introverted, secluded, and faceless on the outside—to the frontage houses of which the current non-descript apartment houses are a descendant. From the mid-twentieth century onwards, frontage

houses started to replace the courtyard house, new housing types which faced outside rather than within the courtyard, with more apertures and exterior ornamentations. Traditional house design started to be abandoned as apartment buildings became more prevalent. In the new type of residence, each household had a smaller living area and a shared courtyard (as opposed to the individual courtyard of traditional houses), which is communal space shared by all families living in an apartment building. New building regulations, which allowed buildings to cover 60% of the land parcel and left 40% for open space, had a great effect on the spatial organisation of houses as well as on urban design. The building form evolved from (1) an inward-looking, low-rise courtyard house to (2) an outward-looking, medium-rise house with a courtyard, to (3) high-rise apartment buildings (Ghadami et al., 2020; Mirmoghtadaee, 2009).

The mass migration of people in search of a better life saw Tehran's population double between 1956 and 1970, and then grow from 3.3 million in 1970 to over 5 million in 1980 (MacroTrends, 2023), and to almost 10 million in 2023. Migration to Tehran has continued due to the substantial economic and social decline in many rural and urban regions of the country, creating an acute shortage of housing in the city, particularly for the younger generation of low-income social classes (Sheykhi, 2007; Zarghamfard et al., 2020). These challenges are evident across the Tehran Metropolitan area, one of the most rapidly growing agglomerations in West Asia and the Middle East. As S3 notes "aggregation of resources and services in Tehran has drawn people from all around the country, especially from isolated parts. Obviously, the city doesn't have the capacity to accommodate the increasing population in standard housing."

Some of the first residential complexes in Iran were built in Tehran, notably those designed and constructed by foreign companies for accommodating their staff in the time of the Shah in the 1960s and 1970s. A second group of residential complexes was constructed for the accommodation of Iranian citizens (Moosavi, 2013). Some of the largest complexes are located in the outer wards of the city, including Gharb Town, A.S.P towers, Ekbatan and Apadana housing estates. Gharb Town was constructed in the early 1960s in the north-west of the city. It comprises modern luxury apartment blocks and villas and is one of the most affluent neighborhoods in Tehran. It is well equipped with service infrastructure, having easy access to the main cross-city communication routes and nearby hospitals, and has large shopping centers, numerous parks, cinema and cultural centers, police and fire stations, and post offices. Subsequently, to the north-east of the city, construction of the Apadana Complex started in the 1970s, and was first occupied in 1981. The estate was built in six phases, each containing seven or eight blocks, and has a population of 15,000 residents. It additionally includes three shopping centers, seven schools and a mosque. A.S.P. Towers—consisting of three main buildings named A, B and C—was built in the 1960s and was one of the first high rise residential complexes built in Iran. It has housed some of the most well-known Iranian figures over the years (Mirmoghtadaee, 2009; Wikimapia, 2022).

Ekbatan, located in the west of Tehran (**Figure 3**), is one of the largest residential complexes in the Middle East and is an early example of a modern residential complex influenced by Le Corbusier. Built during the late 1970s as part of the Shah's push toward western-style modernization, Ekbatan consists of 15,500 housing units, shops, services and parks. The housing is based around one common design template constructed in different configurations. Architecturally, Ekbatan is a controversial development that bridges the divide between north and south Tehran. The north was the focus of the Shah's attempt at "cosmopolification", with tree-lined sprawling boulevards, while

the south is a working class neighbourhood characterized by dense and polluted streets. Ekbatan was placed precisely on the very axis that divides them and is therefore not part of either. This sense of community is reinforced by the fact that, to a certain degree, Ekbatan is its own self-sufficient neighbourhood, providing the same services—parks, malls, gyms, doctors, schools—that are offered by the city as a whole. As Ackley (2006) observed, "Ekbatan may be traumatic architecturally, but its test-tube urbanism proves to be functional within the context of Tehran. This is a result of its positioning in the city, the completeness of the community and its difference from the other housing projects that are being hastily built to accommodate Tehran's population explosion." (p. 2).

Figure 3. Ekbatan residential complex, Tehran (Photo: Zahra Hosseini).

In contrast to these relatively well-equipped residential complexes, there are, as Ackley (2006) intimates, many poor-quality estates, particularly to the south side of the municipality and in the new towns located outside the municipal boundary. Tehran's urban landscape today is typified by dull and non-descript apartment buildings in multi-storey blocks, mostly facing onto minor streets. S3, who lived in the city whilst studying for her Masters degree, observed: "Inside the houses people suffer from small space, and from outside, if you walk through the streets and neighbourhoods, except for the upmarket ones, visual disturbances will bother you. Small, compact housing, many without even a centimetre distance between them, in varied height, poor materials and limited size have made the appearance of the city unpleasant." With limited space between adjacent buildings, blocks of houses sit in densely packed rows on regular land plots, with minimal open space either outside or within. A shared staircase and elevator on the front offer residents access to upper floors. There are no spacious lobbies, balconies, or gardens, in contrast to some of the high-end north Tehran apartments featured in architectural magazines. Although they may comply with the minimum requirements of building regulations as regards square footage, safety, light and air, access and egress, these buildings have poor tectonics and are often built with low, at most, average quality construction materials, poor joinery and heating provision, and poorly executed final finishing. A1 highlighted "construction quality" as a key issue, noting that this had produced "heat islands" in the city. In addition, housing blocks often adopt similar floor plan arrangements, space layouts, and interior connections, thus creating identical drab living accommodation, distinguishable from their neighbors only by superficial and kitsch decorations (Khorshidifard, 2015).

In 2000, the creation of new towns was approved by the Iranian parliament with the Ministry of Housing being charged with overseeing the implementation of the policy. 26 new towns were planned and constructed in the country as a whole, including four outside Tehran (**Figure 4**) at Parand, Pardis, Hashtgerd and Andisheh (Asadzadeh et al., 2014). These typically comprise 8-storey blocks (**Figure 5**), often overcrowded and lacking adequate educational, social and health care services. They appear as "huge islands of soaring sky-scrapers and indiscriminately developed apartments filled with crowds of people and cars" (Shakeri, 2020, p. 2). Inhabitants include families relocating from Tehran city and new migrants from other parts of Iran. The population of Parand has doubled over the past six months, reaching 200,000. S2 observed "there is a shortage of decent and standard homes because many people are migrating to Tehran. In order to supply enough homes

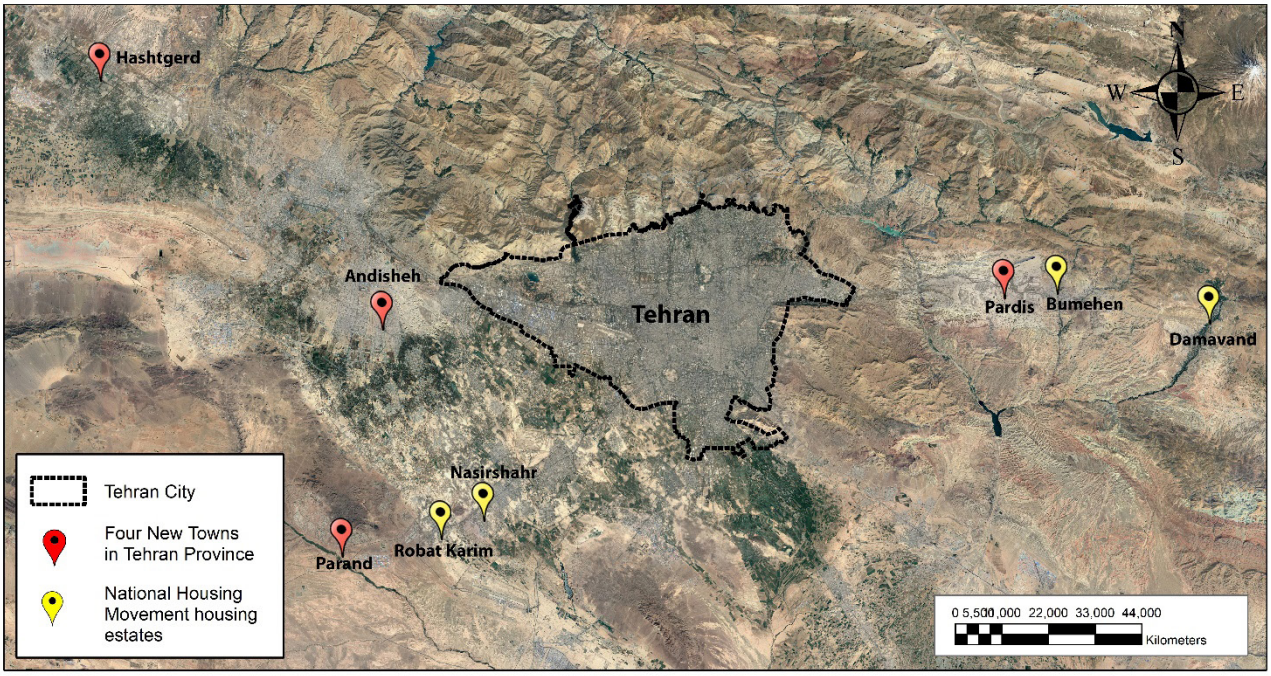

Figure 4. New towns and NHM housing estates in Tehran Province.

Figure 5. The urban environment at Andisheh new town, west of Tehran (Photo: Zahra Hosseini).

throughout the city, high-rise buildings are being built and every spot of the land is used to build. In this situation, most homes are being built regardless of safety considerations. In fact, they are not resilient towards earthquakes." A2 also highlighted the lack of adequate road and rail infrastructure, noting "the problem of transportation adds to the problem of housing, and pollution is also a major issue particularly with inversion in the autumn."

Within the regulatory framework provided by the National Housing Movement, noted in Section 2, a number of initiatives have been embarked upon in Tehran. In the Chitgar neighbourhood, north-west of Tehran city centre, 15,000 apartments are being built with construction to be completed by 2025. A loan of 450 million Tomans has been made available by the government to developers to finance the work (Iran Press, 2022). Outside of Tehran city, but in Tehran province, four further developments are under construction at Boumehen, Damavand, Nasir-Shahr, and Robat-Karim (Tehran Times, 2022) (**Figure 4**). As P2 observed that "the quality of housing for the new generation is terribly low. For working class and new workers, who do not have savings, housing quality is at its lowest level. Sometimes, two or three people are sharing one room! … residents have to adjust their housing location based on rent price and transport time. That is why more and more working class and new workers are priced out in the central city and kicked out of the city. Suburban areas and even other cities in the region are the destination of these groups."

The rapid pace of urbanization in Iran has created unhealthy and sub-standard housing and, in some locations, shanty towns constructed illegally by the shanty dwellers themselves (Sheykhi, 2007). Amiraslani (2021) notes that "by the early 1960s, the city was growing in every direction completely unregulated, and has continued to grow in the same trend since then." (p. 113). In 2007, the Mayor of Tehran was quoted as saying that the population of the spontaneous settlements on the outskirts of the city had reached 3.5 million people (Shargh Daily Newspaper, 2007, p. 30). Zebardast (2009) notes that "the emergence of these informal settlements, and thus an informal market for land and housing, is mostly a result of the inability of the formal market to meet the demands of the urban poor." (p. 307). Today, even within Tehran municipality, there remain areas of shanty developments, for example at Farahzad, in District 2, near the northern border of the municipality (**Figure 6**). P4 noted such settlements exist in Districts 21 and 22, but also in the Districts 1 and 2, referencing a settlement known as Islamabad that was built by the residents

Figure 6. Illegal housing at Farahzad in the north of the Tehran municipality (Photo: Zahra Hosseini).

themselves. P4 noted "I can say that there is a neighborhood called Islamabad which is located in the heart of the District 2 and nobody believes that because the second district of Tehran is known as a wealthy district."

The state-sponsored housing programmes have produced high density, incongruent communities, and poor-quality residential buildings that lack effective infrastructural bases, architectural character, inside amenities, and public spaces. Concurrent non-subsidised private construction has proved little better. Except for a few photogenic buildings (featured in architectural journals), most private construction is unattractive. As observed by Shayesteh and Steadman (2013), "the lack of an overall plan for street facades, the absence of coordinated developments in the demolition of single or multiple family terraced houses and the redevelopment of terraced apartments, have left many residential streets in Tehran with very chaotic skylines." (p. 93). In addition, construction quality has been negatively affected by building material shortages, high costs, and instability and uncertainty in Tehran's housing market.

Housing provision has failed to adequately meet the burgeoning demand for accommodation since the mass in-migration into the city from the 1970s onwards. A range of state intervention measures has tried to stimulate and subsidise house construction, which has been dominated by private sector operators. The result has been a predominance of low quality, minimal dimension apartments in multi-storey blocks. As P1 noted, "housing has unfortunately turned into a business marketplace in which there are no stakeholders apart from the local government. Hence, fewer and fewer people will be able to afford a place to live."

4.2. Smart Tehran Program: Key aspects impacting housing development

Iran introduced measures relating to smart city development in the eleventh NDP (2016–2021), which were also evident in the Tehran City Five-Year Plan (2019–2023), in which "livable city", "social and cultural sustainability" and "safety and increased resilience" were set as objectives (Tehran Urban Research and Planning Center, 2017). These municipal plan objectives are reflected in the STP, which set out a range of flagship and proof of concept projects intended to provide a regulatory and executive framework for investment and development of innovative smart city services. The vision is to become "a city with higher quality of life, more efficient mobility systems and integrated infrastructure with an effective urban management and dynamic economy" (TMICTO, 2020, p. 3). A new entity, Smart Tehran Center, was set up to oversee the planning, implementation and integration of STP projects. There are six main objectives: to maximize transparency and citizen engagement; to provide citizen satisfaction; to eliminate silo-based development through appropriate partnership models and collaboration; to promote digital transformation; to facilitate innovation in the urban ecosystem; and to generate sustainable data driven urban development.

The STP is meant to benefit all main stakeholders in the city ecosystem (citizens, businesses, innovative groups, policymakers, regulators, decision-makers, and investors). It is a program "to transform Tehran into a more sustainable and livable smart city for all citizens and businesses" (TMICTO, 2020, p. 4). There is a three-tier structure for intervention in the urban area. At the top level, there are five main initiatives: Smart Citizen and Digital Services; Innovative Tehran; Smart Mobility; Smart Environment, Energy and Safety; and Municipality Digital Transformation. Linked to these five initiatives are 12 plans and 63 defined projects, spread across three phases, spanning the period 2018–25 (**Figure 7**). In outline, the five main initiatives are as follows:

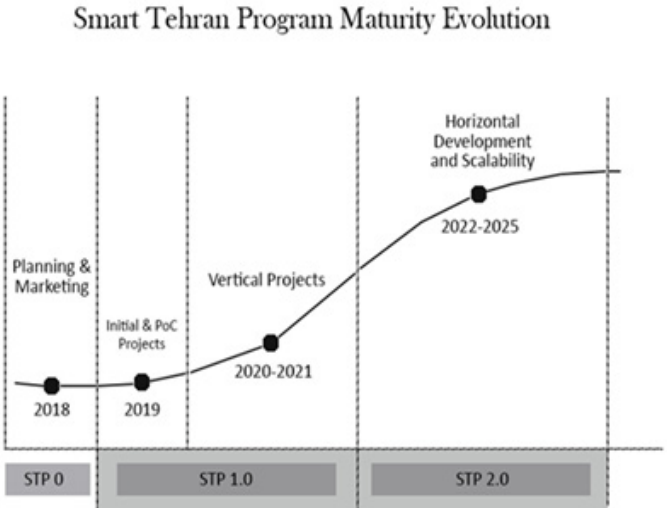

Figure 7. The three phases of the Smart Tehran Program (based on: TMICTO, 2020).

- Smart Citizen and Digital Services: This initiative aims to empower citizens through interactions via two plans featuring online websites—Citizenship Services Platform (known as "MyTehran") and Neighborhood and Citizen Engagement (known as "Baham"). The intention is to "facilitate interactive communication between citizens and local government and to improve accountability and responsibility to public needs and subsequently to increase citizens' engagement" (TMICTO, 2020, p. 8).
- Innovative Tehran: There are two main plans here. One of these plans, the Smart Urban Zones and Centres plan, includes projects on Urban Living Labs, Smart Urban Zones and Smart Technology and Innovation Centers. Other aspects of this initiative include innovation in creating digital markets and startups in the city, such as Snap, which is similar in nature to Uber.
- Smart Mobility (intelligent management and intercity transportation): The focus of this initiative is on smart transportation services and clean transportation. A smart urban traffic system has been introduced in certain areas of the city, as well as the smart placement platform for companies that currently deliver purchased goods to the public.
- Smart Environment, Energy and Safety: Intelligent management of waste, energy and environment, as well as safety promotion and urban crises warning systems, are among the plans and projects of this initiative. The main focus is on tackling environmental problems in the city.
- Municipal Digital Transformation: The overall aim here is to provide the basic infrastructure to support the transition to a smart city. The Smart City Infrastructure Development plan includes projects for WiFi Network, Data Center Development, Unified Communication Networks, and Digital Signatures, for example. In addition, the Smart Urban Construction Services plan includes projects for Construction e-Services, Smart Construction Regulation and Control, and Smart Remedies for Building Code Violations.

A common feature of these five initiatives is recognition of the value of citizen participation. Providas and Farjood (2021) observe that "founding such initiatives on citizen needs is crucial—demonstrating that truly smart cities recognise that their greatest asset is their population. This is the basis of collective intelligence. By opening up innovation and engagement processes, we can build

better products and services." The authors also note that "the MyTehran integrated Digital Services Platform allows the city to shape digital public services through citizen feedback and engagement." (p. 4), and that "the InnoTehran initiative has set out more than 400 technical and operational needs of the city, and matches startups with the city and other partners. This ensures that the public, private, and civil society sectors are able to work effectively together" (p. 6).

This perspective is supported by P1 who notes "the resolution of Smart Tehran is the key to integrating all subordinating sections of the private and public sectors in terms of information-sharing protocols which, in fact, raises the integrity and transparency among all. And subsequently, the housing patterns are going to be included more than they used to be." S2 gave a balanced view on the value of the STP, stating that "I do not think this program can directly improve the housing situation, but it seems to me that it may have positive effects on current problems. It simply means that living in a smart city gives people a chance to be aware of important plans and also allows them to get involved in the decision-making process about housing."

The question remains as to how effective these initiatives are, and more pointedly if and how the plans and projects can contribute to addressing the housing issues in the city. The MyTehran and Baham platforms aim to improve the quality of life by using Android or iOS applications, which include the gathering and exchange of people's opinions on housing issues. More specifically, in a section of the MyTehran platform, there is a space to put forward ideas to improve the current urban housing provision, notably issues such as access, urban traffic and pollution. By using these applications, key issues, problems and complaints can be recorded. In the northern parts of Tehran, where there is a high population density, based on such citizen feedback, the municipality has put forward plans for the next 5 years to improve urban housing conditions. Indeed, UN Habitat (2022), in their assessment of the STP, note that the Baham and MyTehran platforms have "not only increased the visibility of municipal projects", but also "supported neighbourhood development plans", and concludes "such inclusive online services facilitate a more equitable, bottom-up decision-making process, promoting citizen participation and dialogue with municipality officials, and improving the socio-economics and culture of disadvantaged communities" (p. 4). However, Danilina and Majorzadehzahiri (2019), in their study of the 50 key characteristics that typify a successful smart city, found that "Tehran has only a relatively good status in eight characteristics. In other words, 84% of the characteristics in Tehran are not well-suited", adding that "there is no long-term plan for Tehran, and the relationship between people and government and the authorities is not related to partnership and cooperation" (para. 1).

As part of the InnoTehran initiative, the Smart Urban Zones and Centers plan aims to lead, coordinate and empower the "innovation ecosystem" in order to facilitate the use of smart technologies, devices and solutions to confront urban challenges, including those associated with high density housing zones. In this context, S3 suggested the STP can help the housing situation "by, for example, detecting the most populated areas, estimating their demand in housing and finding vacant houses, projecting the future cost of housing in different areas and some solutions to control it". More specifically, P4 pointed to the example of Bahamestan, which is "a non-profit organization that advocates citizens' rights to the city, especially for those groups and interests that are marginalized" (Madanipour, 2015, para. 12). It is located in District 9, just to the south west of central Tehran, and aims at "representing the marginalized groups through negotiating with the decision makers, and mobilizing social capital in support of its causes" (para. 12). The organization

attempts to address specific urban issues, including housing, by acting as a bridge between public authorities and local activists, as well as academics and journalists.

The Urban Living Labs project allows the creation of simulated urban environments in which there is scope for testing, validating, developing and co-creating all stages of designing and commercializing urban products and services. In this way, citizens can participate directly and indirectly in activities, processes and mechanisms centered on urban development, including housing. This also fosters a common approach and is a connecting mechanism to support cooperation between existing institutions in the city, including businesses, research and academic centers, government centers and municipalities, as well as citizens in the wider Tehran society. The Smart Urban Zones project also sits under the InnoTehran initiative and features the generation of plans based on the use of digital layers. Densely populated areas can be located using software such as GIS, facilitating appropriate planning of new house construction. As part of the Municipality Digital Transformation initiative, there are a number of plans and projects that support the use of digital data to forecast future housing needs and housing densities. The goal of the Smart Urban Construction Services plan is to make it possible for all stakeholders to access shared and open urban data. Also, data exchange platforms will be connected together to develop data-based services and facilitate better informed decision-making in urban management.

Many of the projects are aimed at the provision of smart urban infrastructure that can have an indirect but positive impact on housing in the city. There are many aspects to infrastructure provision. For example, measures are being introduced to ensure fire alarm systems for houses are connected to the main networks, so that alarms are responded to appropriately. In a broader context, S2 suggested that "the major benefit of smart cities is related to the sustainability aspect of it, which considerably helps our surrounding environment to be clean and resilient. Such an ambitious plan is really necessary to be implemented in Tehran, to mitigate the negative impacts of urban development." However, these initiatives still have their limitations. The MyTehran platform is somewhat complex to use, especially for the elderly. There is free public access to the Internet only in some areas, such as at Imam Khomeini airport, which challenges the smart city principle of increasing the accessibility of all citizens to urban facilities. Nevertheless, the majority of interviewees agreed that the STP "will upgrade infrastructure in the city and this will improve the quality of life in the city's housing estates" (**Table 3**, Statement 7), and that the "future sustainability of the city is a key objective of the Smart Tehran Program" (**Table 3**, Statement 10). As A3 observed "it seems that it [the STP] cannot help directly, but indirectly the Smart Tehran Program has an impact on the qualitative and quantitative development of residential environments."

5. Discussion

A number of issues emerge from the findings discussed above that are worthy of further discussion and illustration. Firstly, the lack of integration and collaboration between authorities, their plans and actions were highlighted by many of the interviewees, supporting the view that "the problem that is most prevalent today in the field of urban management in developing countries, including Iran, is the multiplicity of different authorities and institutions responsible for implementing existing laws" (Siraki and Neginraz, 2020, p. 9). More specifically, there is a lack of co-ordination between the STP initiatives and the levers of housing policy and development

Table 3. Interviewee responses to questionnaire summary statements.

No.	Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
1	The housing problems in Tehran are the result of a lack of public (State) investment in the housing sector.	0	3	2	4	1
2	The housing problems in Tehran are the result of poor planning and urban management at the city/ metropolitan level.	6	3	1	0	0
3	The private sector developers have constructed many estates (complexes) in Tehran with inadequate internal and external spaces, using poor quality construction materials.	3	2	4	1	0
4	Some housing estates are of such poor quality in Tehran that they should be demolished and replaced by better housing.	4	3	2	1	0
5	The residents associations should play a lead role in upgrading and remodeling the lowest quality housing estates.	2	3	4	1	0
6	The Smart Tehran Program provides a way for residents to express their concerns about housing problems in the city.	0	5	2	3	0
7	The Smart Tehran Program will upgrade infrastructure in the city and this will improve the quality of life in the city's housing estates.	1	5	3	1	0
8	The Smart Tehran Program will have very little impact on the quality of housing in the city.	0	2	3	5	0
9	The Smart Tehran Program has a clear vision and strategy for improving the city.	0	4	5	1	0
10	The future sustainability of the city is a key objective of the Smart Tehran Program.	2	4	4	0	0

in Tehran. Poorahmad et al. (2018) highlight the need for the formulation and implementation of integrated policies and associated legislation to tackle Tehran's urban problems, and P1, for example, similarly identified "transparent policy-making, collaborative planning strategies, and integration among and across organizations" as key issues for addressing the housing problems in the city. Equally, P4 concluded that the "STP can make some contribution if all platforms are integrated and if all elements work in a coherent way."

This is borne out by integration of smart city initiatives and city planning in other major urban centres. In Montreal, for example, one of the key objectives of "Project Montreal 2021" was "encouraging smart densification on a human scale, including specific areas for affordable housing, in the new urban development and mobility plan", which included "a major operation of 60,000 long-term affordable housing units" (Projet Montréal, 2021, p. 12). Similarly, in Melbourne, the smart city initiative of "working with the community (residents, workers, businesses, students and visitors) to design, develop and test the best ways for you to live, work and play" (City of Melbourne, 2023, para. 2) overlaps with the 2026 Melbourne City plan which has as a priority to "provide affordable options for accommodation, food and services", and "will offer a mix of

housing, facilities and recreation to support a diverse and inclusive community" (City of Melbourne, n.d., p. 12). Such integration and co-ordination between smart city initiatives and city planning is particularly important for instigating change in housing provision.

Secondly, many interviewees suggested that a decentralization of power and authority was necessary, both within Tehran and within the country as a whole, if the housing crisis (and other development problems) are to be effectively addressed. P2 suggested that "remote working, especially after COVID-19, could be a necessary element… Also, decentralization of services and activities could enable citizens to reduce their mobility in the city." S3 took a wider perspective: "we need to decentralize services and resources from Tehran to distribute the population all around the country, which will decrease housing demand in Tehran. In the long run, after 50 years or so, when it is time to renovate the old houses, we can replace the substandard houses with better new ones." In similar vein, P2 asserted that "decentralization of power and activities from Tehran to regional cities like Mashahd, Isfahan, Tabriz and Shiraz, should be considered in national spatial development plans." It could be argued that the construction of the new towns and large housing estates outside of the Tehran municipality represent a degree of decentralization, but in reality, these developments are in the main only replicating the same problems of low quality, poorly serviced housing provision evident within the municipality.

Thirdly, the nature of the planning system was seen as weak and too theoretical, without the necessary tools and processes for effective plan implementation. Nine of the ten interviews agreed that "housing problems in Tehran are the result of poor planning and urban management" (**Table 3**, Statement 2). A2 noted "we need connection between the planning and execution layers", and S3 identified "traditional planning methods and not having and using up-to-date data in planning" as key failures. Indeed, the failure of the planning system to provide a spatial framework for housing development was highlighted by several interviewees. P1, for example, observed "planning is a significant issue… bureaucratic planning is way more popular than logical thinking among Iranian organizations", and P3 lamented "abandoned and unplanned, there is no specific plan for housing in Tehran", whilst S1 concluded "the primary reason [for the housing crisis] is that we are very weak in urban planning".

Fourthly, decision-making is hampered by poor technology and ineffective data analysis. P3 cited the "failure to use new technologies" as a key issue, concluding that "as long as the decision-making method is traditional, there is no solution." More specifically, S3 claimed "we should take advantage of data provided through smart gadgets and satellite images to make practical, up-to-date decisions for housing." P3 added that "the process of designing and drawing maps, along with the building information management process, should be done in an integrated system so that artificial intelligence can provide better scenarios in an interdisciplinary manner."

Fifthly, the provision of housing is subject to market forces with minimal State intervention. P2 observed that "the economic situation in the country has made housing a commodity or investment item, while it should have been a basic need", and that "government intervention could have improved the housing condition for lower income groups." Nevertheless, only three of the ten interviewees viewed "lack of public (State) investment in the housing sector" as a key cause of today's housing woes (**Table 3**, Statement 1). P2 maintained that "lack of suitable legislative foundations has increased speculation in the housing market", suggesting that whilst "20% of

houses in Tehran are not occupied… people who are living in the city are paying sometimes 50%–70% of their income for renting a place." P4 observed that in Iran, "houses are not only consumer goods, but they have changed to capital goods."

Sixthly, despite the optimism evidenced in the UN Habitat (2020) report that STP is "broadening and strengthening citizen participation and better integrating them in key decision-making processes, whilst realizing a mode of governance that is more responsive and representative", interviewees voiced some skepticism regarding the real extent of citizen participation. This is backed up by Noori et al. (2020), who suggest there are is limited citizen involvement in the smart city initiatives in Tehran and that "poor citizen participation is due to low trust and awareness levels" (p. 13). More specifically, as regards housing improvement schemes, such as those successfully implemented in other major cities (e.g., Wynn, 1980), P4 voiced concerns that residents may be expelled if houses are improved, concluding "gentrification is a negative… every settlement has a sense of belonging for the residents. Gentrification should not mean the relocation of residents." P4 also observed that the example of citizen involvement at Bahamestan, noted above, was "an isolated case". It is noteworthy that Amiraslani (2021), in his study of quality of life indicators across the different districts of Tehran, found that "people used a wide range of communication tools (email, phone, internet, etc.) to complain about diverse problems, from park lighting to delays in public transport to waste management" (p. 110). However, although such complaints were registered, it remains unclear to what extent they were acted upon. This also seems to be the case with the STP—although five of the ten interviewees agreed that "the Smart Tehran Program provides a way for residents to express their concerns about housing problems in the city" (**Table 3**, Statement 6), there was no evidence to date that these concerns have been acted upon. This aligns with Mohseni's (2021) study of public engagement in Tehran, in which he found that there was "little chance for turning into a bottom-up smart city" (p. 1261) in which "citizens' power and genuine participation is identifiable… as a substantial factor in the process of smart city formation and governing" (p. 1267).

6. Conclusion

This study has attempted to provide an overview of housing provision in Tehran and to assess if and how the smart city initiatives are helping to address relevant issues. The study has its limitations, being based on a review of existing sources, field observation and interview evidence from ten individuals (practitioners, students or academics) who are, or have been, based in the city. It is clear from these sources that the political system in Iran has a major impact on all housing and smart city initiatives in the country. As Noori et al. (2020) note, "Iran's rigid political ideology and administrative structure do not meet the standards for governing a smart city" (p. 13). Nevertheless, the above review and interview evidence suggest the smart city initiatives in the city may have some indirect positive impact on housing conditions.

However, the UN Habitat (2022) observation that the "STP is enabling Tehran to foster greater levels of collaboration through the engagement of all stakeholders within the smart city ecosystem", thereby transitioning from "a traditional siloed approach in the delivery of Tehran's urban services towards an inclusive, integrated and innovative open-data approach" (p. 1) appears over-optimistic. Certainly, the provision of adequate housing and services for the majority of the city's population remains beyond reach in the immediate future. Major change in the planning system, and in the

wider political environment, will likely be necessary before any significant progress can be made in these areas. As Fartash et al. (2021) conclude in their study of Tehran's transition to a smart city "there are relatively critical challenges and shortcomings to this end, that call for the cooperation and interaction of all public and private stakeholders to beat them off" (p. 361). Evidence from other parts of the world suggests that resident participation—via one means or another—in the future planning and development of existing and new residential areas will be needed, if any significant reversal of current trends is to be achieved.

Future research studies could usefully draw comparisons with other smart city plans and projects from around the world, where progress has been made in addressing housing related issues. Such studies could help identify the critical success factors and key levers and processes that are needed to transform a smart city program from a well-intentioned technology-based show project into a plan of action that will make a real difference to the lives and environment of everyday citizens. As Vanolo (2016) concluded in his analysis of the role of citizens in four alternative smart city imaginaries, "re-incorporating the voices of ordinary citizens… means finding a credible way of imagining a nexus between citizens and urban technologies that is truly empowering and respectful of citizens' wishes and hopes" (p. 33). This is of particular relevance in the quest to improve housing provision in Tehran, and nicely sums up the daunting challenge facing those charged with bringing about real change in the city through the smart city initiatives currently underway.

Author contributions

Conceptualization, MW, SZH and SMP; methodology, MW; validation, SZH and SMP; formal analysis, MW; investigation, SZH and SMP; resources, SZH and SMP; data curation, MW, SZH and SMP; writing—original draft preparation, MW, SZH and SMP; writing—review & editing, MW, SZH and SMP; visualization, MW, SZH and SMP; supervision, MW; project administration, MW, SZH and SMP. All authors have read and agreed to the published version of the manuscript.

Conflict of interest

The authors declare no conflict of interest.

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