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LIVABILITY AND FUTURES STUDIES OF WORN-OUT URBAN TEXTURES: SCENARIO ANALYSIS FOR EVALUATING THE LIVABILITY SYSTEM AND ACHIEVING SUSTAINABILITY

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Abstract. Urban worn-out textures, due to their ancient and historically valuable physical structures, exhibit low adaptability to urban developments and advancements. Tehran, as a city with a rich historical background, also boasts considerable worn-out textures. Due to economic, geographical, and political conditions, a large population resides in these textures. In this regard, the present research aims to investigate the livability status of residents, identify key indicators, and design scenarios in the worn-out textures of Tehran city. This paper proposes a new approach to MicMac that promotes driving forces to scenarios. The results indicate that the livability of residents in worn-out textures of Tehran city, particularly in central regions, is in undesirable conditions. Furthermore, the analysis of the MicMac matrix showed that housing prices, residents' income, investment, and an increase in economic activities, as well as the role of urban management, are driving forces that have a vital impact on the livability of residents in worn-out textures. These driving forces have depicted three scenarios for the livability of worn-out textures in Tehran city until the year 2032.

Keywords: urban livability, sustainability, worn-out urban textures, structural analysis, indicators, scenario planning, futures studies.

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1. Introduction

Various studies have sought to answer the question of what factors contribute to the concept of urban livability. These inquiries have been discussed from the perspectives of economic geography, social geography, urban design, spatial psychology, culture and tourism, or a combination thereof. However, the concept of urban livability remains ambiguous, and a precise definition of it is not found in the theoretical literature (Gieling & Haartsen, 2017). Therefore, experts from various fields and in different societies have presented diverse understandings of this concept (Hashemkhani Zolfani et al., 2022). This concept has received attention as a paradigm with extensive variables (Paul & Sen, 2018) among many urban theorists. This group of experts, including planners and designers, consider livability as the foundation for the formation of a sustainable community, asserting that without it or without considering it, citizens cannot thrive in that society (Mosehlane, 2020). Thus, the concept of urban livability is widely reflected in government guidelines and political discourses today, aiming to improve the quality of the urban environment and attract economic and social capital (Istrate et al., 2021; Lowe et al., 2015). Internationally, a diverse range of indicators is used to measure and compare the livability of cities and different regions (Lowe et al., 2015).

The concept of livability was introduced in 1950 by the Greek scientist Doxiadis in relation to the order of human settlements (Wang et al., 2023). Livability refers to the broad characteristics and conditions of a community or environment that make it suitable for living. The term encompasses a wide range of factors, including economic, social, and physical dimensions. Therefore, livability is a collection of economic, social, and physical characteristics that create a living environment that is safe, comfortable, convenient, and prosperous (Allen & O'Donnell, 2020). In this regard Jianxiao et al. (2020) state that livability is a multi-dimensional and hierarchical concept, and the dimensions sometimes vary in different studies. However, it is important to note that from a broad perspective, three dimensions of livability are often implicitly or explicitly included in the selection of livability indicators in previous studies: social, economic, and physical and environmental dimensions. Additionally, some researchers categorize

livability indicators into two dimensions: objective and subjective (Paul, 2024). The objective dimension examines how the physical characteristics of cities, neighborhoods, and housing can positively or negatively impact human behavior. The subjective dimension focuses on residents' perceptions of how their environments affect the livability they experience, which is a cognitive construct of livability (Amini et al., 2021; Allen & O'Donnell, 2020). The notion of livability as a multifaceted concept has led to its overlap with similar concepts such as quality of life and sustainability (Dsouza et al., 2023; Paul & Sen, 2020; Ruth & Franklin, 2014). However, there are differences between livability and the concepts of quality of life and sustainability. Quality of life typically refers to the social-psychological well-being of individuals and is measured by dimensions such as happiness, life satisfaction, and sense of belonging (Shucksmith et al., 2009; Gieling & Haartsen, 2017). Quality of life is a more subjective and comprehensive concept (Kovacs-Györi et al., 2019). Livability is a specific type of quality of life that generally focuses on the external conditions and characteristics of a community or environment (Sheikh & van Ameijde, 2022; Yi et al., 2021). Another concept that has a significant overlap with livability is sustainability. Livability and sustainability are complementary concepts that both aim to improve the quality of life for individuals and communities. Livability is a subset of sustainability that focuses on immediate and tangible conditions, while sustainability considers long-term development and the ability to meet future needs (Almashhour & Samara, 2022). It is important to note that livability, quality of life, and sustainability have many overlapping layers when addressing individual satisfaction, resident assessment of the environment, safety, health, place quality, public popularity, and policy making.

By reviewing and examining studies in the field of urban livability, we have concluded that the focus of livability research has changed over the past few decades. Initially, the emphasis of urban livability studies was on social issues, with Jacobs (1961) being a leading figure in this regard (Istrate et al., 2021). Subsequently, during the 1980s, research by urban design and planning experts emerged, placing greater emphasis on physical dimensions (Hashemkhani Zolfani et al., 2023; Allen & O'Donnell, 2020). Therefore, designers, architects, and urban planners have placed more emphasis on the five dimensions of Kevin Lynch's framework (vitality, sense, fit, access, and control) in their studies on urban livability (Al-Thani & Furlan, 2020; Balsas, 2004). However, with the acceleration of globalization and economic liberalization, the assessment of the economic-environmental impacts of urbanization on livability has received increased attention (Paul & Sen, 2020). Therefore, in recent studies on urban livability, there has been a major focus on environmental factors, particularly climate change and ecological factors. Most conducted research has limited its analysis of livability to a specific timeframe, examining the existing and past conditions. Consequently, there is a lack of analysis on the temporal dynamics of urban livability (Cao et al., 2021; Yang et al., 2021). It seems that a Future Study approach could be a suitable tool for addressing this matter.

Future Studies, also known as futures thinking or futurology, is a systematic study and research of potential futures that can replace "predictive thinking". Its goal is to facilitate orientation towards the future, especially in relation to alternative developments and preparedness for the future (Heinonen et al., 2017). From Ben Martin's perspective, one of the early theorists in the field of Future Studies, Future Study is a systematic effort that takes a long-term view of the future in the domains of technology, economy, environment, and society. Its objective is to enhance and improve strategic research and emerging technologies with the highest economic and social efficiency (Sokolov & Chulok, 2016). Today, futures studies serve as a tool for science, technology, and creativity (Aguilar & Pifarre Turmo, 2019), a social cognitive process (Peter & Jarrat, 2015), a participatory approach to creating long-term common knowledge and insights (Calof et al., 2012), predicting environmental changes (Dufva et al., 2015), addressing organizational futures, and social challenges (Andersson et al., 2014).

In the field of futures studies and livability, it should be noted that, on the one hand, livability aligns with approaches such as quality of life, sustainable and healthy cities, all of which have emerged as critical responses to undesirable urban policies and the negative side effects of urban development (Le at al., 2023; D'Amico et al., 2020). On the other hand, futures studies are an approach that is closely related to critical perspectives to a great extent, where often the perceptions and understanding of people, experts, and elites serve as the basis for action (Felknor et al., 2023). Also, considering technological advancements and the emergence of new actors in urban planning, various challenges have arisen in decision-making and implementing urban policies. Therefore, it is necessary to employ a modern future study approach to mitigate these challenges, design scenarios, foresee issues in the near future, and provide precise urban planning.

The main focus of the current research is designing scenarios for the livability of worn-out urban textures with a future study approach. The concept of livability in worn-out urban textures aims to address urban decay issues and improve environmental conditions. Worn-out urban textures face issues such as decay, lack of amenities, mismatch with the new road network, inadequate urban infrastructure development, and more. These problems result in the expansion of the impoverished population, the proliferation of social issues (theft, addiction), a decrease in the sense of belonging, a lack of local identity, deviant behavior, and a decline in investment motivation. In this regard, the concept of livability in the present study refers to improving the quality of life and creating suitable conditions for habitation in these textures. So, the concept of livability in this study, it is a multidimensional concept that enhances the quality of life for residents of worn-out textures, including indicators of built and natural environments, economic

well-being, security and social participation, sense of place, and welfare facilities in these areas.

As mentioned, the focus of livability studies has varied over different time periods, and in recent livability studies, the major focus has been on climatic and ecological factors. The results of these studies have been very valuable because they have addressed the concept of livability in various subjects and through various methods. However, there are still many research gaps. One of the research gaps is the lack of attention to the future study approach in livability studies. We can identify the best strategies for managing and anticipating the impactful consequences by employing a scenario and future study approach. Moreover, the future research approach can facilitate collaboration and interaction among various experts in the field of livability and by gathering diverse knowledge and perspectives from researchers and policymakers, we can identify the most influential and relevant indicators for livability. The next research gap in livability studies is the simultaneous lack of attention to the opinions of residents and experts. The opinions of residents and experts on livability topics can serve as an inspirational source for creating new and innovative models in the field of livability. Paying attention to the opinions of residents on one side and utilizing the experiences and knowledge of experts on the other side can significantly contribute to reducing errors and problems in planning and decision-making processes. The third research gap observed in urban livability studies is the lack of attention to the livability of residents in worn-out urban textures. As far as our knowledge has shown, there have been very limited studies regarding the livability of residents in worn-out urban textures. Literature reviews have shown that the most important and closely related studies include two papers: Hekmatnia et al. (2022), and Yeganegi (2018). In 2018, Yeganegi examined the livability status of worn-out urban textures and identified the distribution type of indicators using Moran's I method. Hekmatnia et al. (2022) analyzed livability indicators using the AHP Fuzzy model. As observed, there have been limited studies in this area. Therefore, considering the existing research gaps in the field of livability in worn-out urban textures, the present research proposes innovations in three areas:

1. Utilizing expert opinions (Delphi method) to determine research indicators and identify key drivers for livability in worn-out textures.
2. Using residents' opinions to evaluate livability in worn-out textures.
3. Designing and envisioning future scenarios for the livability of worn-out textures until the year 2032.

2. Research methodology

In this section, we present the study area, data collection methods, research steps, and data analysis.

2.1. Case study

Tehran is the capital city of Iran, located in the northern part of the country (Alijani et al., 2020). It is also one of the largest cities in Western Asia and the 19th largest city in the world (Naddafi et al., 2012). The current urban area of Tehran covers 615 square kilometers. The population of this city exceeded 9 million people as of 2020 (Information and Communication Technology Organization of Tehran Municipality, 2022). In terms of administrative divisions, Tehran is divided into 22 regions (Figure 1). As seen in the figure, the northern and western regions have a larger area compared to the central and southern regions. Among these, the central regions have smaller regions.

Figure 2 depicts the extent of worn-out urban textures in the 22 regions of Tehran city. According to Figure 2, worn-out urban textures are observed in all regions of Tehran city. Among these, the largest areas with worn-out textures are predominantly located in the central regions. One reason for this is the historical concentration of the city's development in these central areas. Therefore, the central regions, especially Region 12, are often referred to as the historical heart of Tehran. Consequently, these regions contain numerous historical textures. According to the statistics of the Tehran Urban Renewal Organization, approximately 32.68 square kilometers of the city of

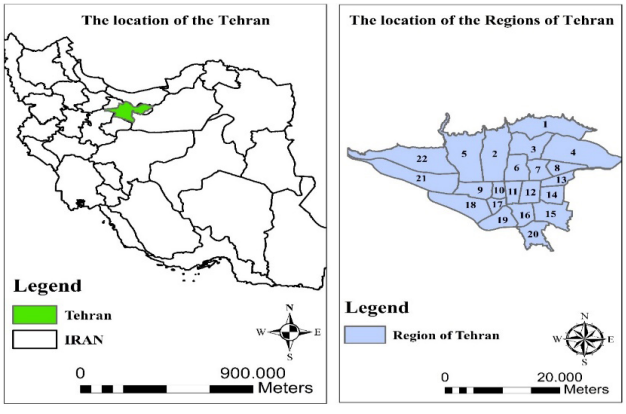

Figure 1. The spatial location of Tehran city and the 22 regions (source: Figure by authors based on data extracted from Tehran municipality website)

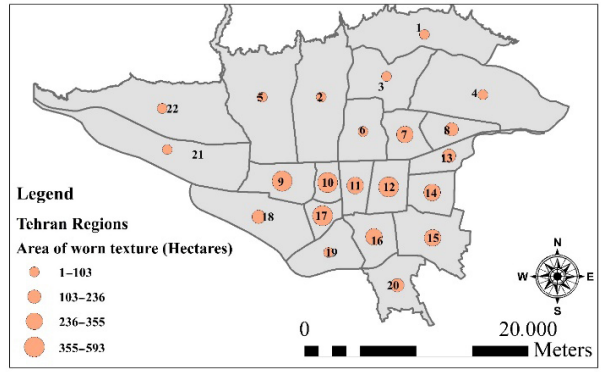

Figure 2. The area of the worn textures, categorized by the 22 regions of Tehran city, in hectares (source: Figure by authors based on data extracted from Tehran municipality website)

Tehran are considered deteriorated. This area accounts for 5% of the total area of Tehran (the area of Tehran is 615 square kilometers). Additionally, the total number of urban blocks in Tehran is 31,452, out of which 4,845 blocks are classified as deteriorated. This indicates that more than 15% of the urban blocks in Tehran are deteriorated. Another notable point is that over 54% of the deteriorated blocks have residential land use (Information and Communication Technology Organization of Tehran Municipality, 2022). Also, about 37% of the population of 8679936 million people of this metropolis live in worn textures (Information and Communication Technology Organization of Tehran Municipality, 2022). Additionally, in the latest reports from the Tehran City Police, neighborhoods located in worn-out urban textures have higher rates of murder and theft.

2.2. Data collection

In the present study, two questionnaires were used to collect data: an expert questionnaire and a citizens' (residents') questionnaire.

Sample population and citizens questionnaire

To assess the status of livability indicators in worn-out urban areas, the perspective of the residents was utilized. Hence, we employed a questionnaire. The sample population in the citizens' questionnaire consisted of residents of worn-out urban areas in Tehran. The sample size was calculated using the Cochran formula. Additionally, the number of sample members was selected using a stratified and proportional sampling method.

Considering the population of residents in the worn-out urban texture (3,478,000 individuals), a minimum sample size of 385 was calculated (the calculation method is presented in the formula below). Therefore, with questionnaires distributed separately in different regions, a total of 420 questionnaires were distributed, and ten questionnaires were excluded due to incomplete responses. Given the varying populations of residents in the 22 different regions of the worn-out urban texture, a Proportionality method was employed for questionnaire distribution. Consequently, regions with larger household populations received a higher number of questionnaires. Table 1 presents the allocated number of questionnaires for each of the regions.

Cochran formula:

$$N = \frac{(3478000)\cdot(1.96)^2\cdot(0.5)\cdot(0.5)}{(3478000-1)(0.06)^2+(1.96)^2\cdot(0.5)\cdot(0.5)} = 384.12 = 385.$$

Sample size and experts questionnaire

To identify the most important influencing indicators and design scenarios for the future of livability, the views of experts were used. In this study, 15 experts were selected based on purposive sampling. The statistical population of experts included professionals in the fields of urban planning, geography, architecture, futures studies, and the revitalization of worn-out textures. Experts were chosen based on their knowledge and experience in the research topic and their willingness and availability to participate in the study. The Delphi method process in this research consisted of the following four stages:

Matrix design: at this step, the experts' opinions were used to design a binary matrix of indicators.

Sending the first questionnaire: it was imperative to undertake structural-interpretive modeling to elucidate the interactive relationships between these indicators. Therefore, the experts were asked to assess the quantitative correlation of the indicators. The response was described as a spectrum ranging from –3 to +3 (–3: strongly restricting influence; –2: moderately restricting influence; –1: weakly restricting influence; 0: no influence; +1: weakly promoting influence; +2: moderately promoting influence; +3: strongly promoting influence).

Sending the second questionnaire: in this phase, the initial matrix responses were once again presented to the experts. During this step, experts had access to the responses of their peers, enabling them to reconsider their perspectives in light of their colleagues' feedback.

Table 1. Number of questionnaires disaggregated by 22 regions of Tehran city

Regions	Number of households	Number of questionnaires	Regions	Number of households	Number of questionnaires
1	2014	26	12	1389	18
2	2556	33	13	912	12
3	1302	17	14	1863	24
4	2719	35	15	2325	30
5	2165	28	16	1360	18
6	1242	16	17	1035	15
7	1164	15	18	1390	18
8	1,145	15	19	895	13
9	654	12	20	1804	23
10	1075	14	21	844	13
11	901	13	22	698	12

Decision and approval: in this final stage, we compiled and shared the conclusive results derived from the Delphi study with all the experts. Subsequently, the gathered data were input into the MicMac and Scenario Wizard softwares for comprehensive analysis.

2.3. Research steps

The research stages are summarized in Figure 3.

First step. Selection of livability indicators: after reviewing the literature, an initial list of indicators was extracted. This initial list contained numerous indicators. The effort at this stage focused on selecting indicators that are relevant to the specific characteristics of Tehran city. Since evaluation indicators vary in different locations due to history, politics, culture, traditions, etc., a screening stage was conducted. Experts were also consulted during this stage. In the end, a total of 20 indicators were selected.

Second step. Citizens survey distribution: in this step, a citizen survey was conducted to assess the livability status. The questionnaire was designed based on the 20 livability indicators selected in the previous stage. After designing the questionnaire, a pilot test was conducted with 36 respondents to assess the reliability of the questions. Cronbach's alpha was used to evaluate the reliability of the questions, and a coefficient of 0.910 was obtained, indicating that the questionnaire had very good reliability. The remaining questionnaires were then distributed among residents of the worn-out urban textures.

Third step. Expert survey distribution (first questionnaire): in this step, involves identifying key (influential) indicators (drivers) related to the futures study approach. Experts have evaluated the interactive relationship of indicators in a binary matrix.

Fourth step. Expert survey distribution (second questionnaire) involves designing scenarios using the Scenario Wizard software: this step involved designing scenarios. Based on the identification of effective indicators in the previous stage, the second expert questionnaire was distributed for the purpose of designing scenarios. The central question in this stage was: if situation A1 of key factor A occurs in the future, what impact will it have on the occurrence or non-occurrence of situation B2 of key factor B? We had considered a time range until 2032 for designing the scenarios.

2.4. Data analysis

SPSS, MicMac, and Scenario Wizard software were used for data analysis. SPSS was used to analyze the citizen survey data. In this software, Binomial test and Kruskal-Wallis test were used to examine the status of livability indicators and to rank the areas. MicMac was also used to evaluate the livability system and identify key indicators from the experts' perspective. Scenario Wizard software was used to design the scenarios.

3. Results

The results of this research, based on the research steps and objectives, include 4 sections: 1) Selecting indicators; 2) Examining the status of livability indicators; 3) Identifying key indicators; 4) Designing scenarios.

3.1. Selection of research indicators

As mentioned earlier, after a thorough and comprehensive review of the literature related to livability, an initial list of indicators was extracted. This initial list comprised over 40 indicators collected from various reputable scientific sources. In the next stage, considering the specific characteristics of Tehran's worn-out urban texture and aiming to select appropriate indicators relevant to this texture, the indicators were screened with the input of experts. In this step, experts were asked to evaluate the extracted indicators in terms of importance, compatibility with Tehran's worn-out urban texture, and measurability based on their experience and expertise. Eventually, 20 indicators were selected. In Table 1, the research indicators are presented in various dimensions. In Table 2, the research indicators are presented in various dimensions.

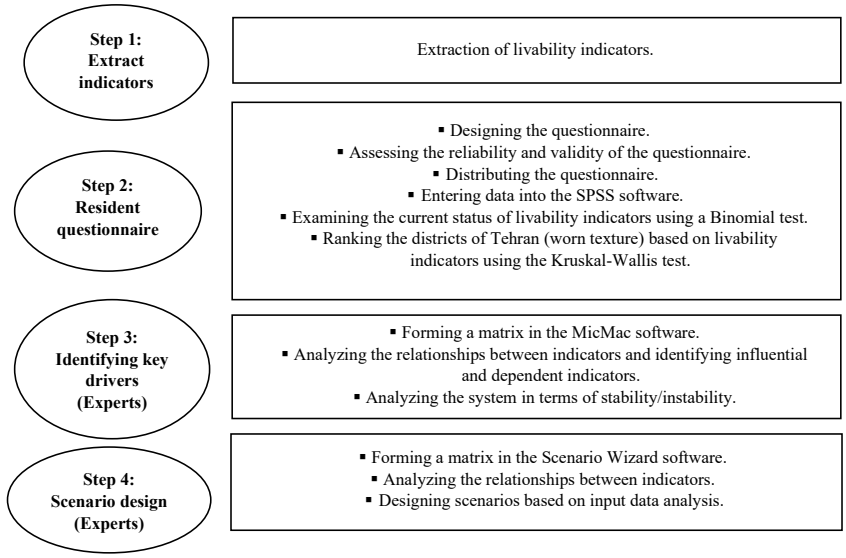

Figure 3. Steps of the research method
(source: Figure by authors)

Table 2. Research indicators

Dimensions	Indicators	Reference	Operational definition
Economical (A)	Investment and economic activities (A1)	Wang et al. (2023)	It refers to enthusiasm for investment by private companies and organizations and the growth or expansion of various economic endeavors and transactions within an economy. This can include an increase in production, trade, investment, employment, and overall economic output
	Job diversity (A2)	Ruth and Franklin (2014)	It refers to the existence of a wide range of job opportunities and occupations
	Housing prices (A3)	Raji et al. (2016); Furlan and Petruccioli (2016)	Housing prices refers to the cost or value of residential properties or homes in deteriorated urban areas. It represents the monetary amount that individuals or potential buyers would need to pay in order to purchase or rent a house or apartment
	Market diversity (A4)	Hashemkhani Zolfani et al. (2023)	Market diversity signifies the availability of different options, choices, and alternatives for consumers. It can include diverse brands, product categories, price ranges, and market segments, allowing consumers to choose according to their preferences and needs
	Residents' income (A5)	Yi et al. (2021); Okulicz-Kozaryn (2012)	It refers to the income level of residents in worn textures
Social (B)	The role of urban management (B1)	Doost Mohammadian and Rezaie (2019); Maleki et al. (2020)	The role of urban management in solving problems, renovating, and recreating the worn texture
	Social security (B2)	Zhan et al. (2018); Romig (2022)	Security refers to the state of being protected from potential harm, danger, or threats
	Social participation (B3)	Blanco (2012); Ahmed et al. (2019b)	Social participation refers to individuals' active involvement and engagement in social and community activities, initiatives, and decision-making processes
	Residents' sense of belonging (B4)	Tan (2022); Ahmed et al. (2019a)	Residents' sense of belonging refers to the feeling of attachment, connection, and identification that individuals have towards their community or place of residence
Physical (C)	Quality of facilities (water, electricity, gas, telephone, internet) (C1)	Baig et al. (2019); Kuijlenburg (2020)	It refers to the desirable quality of facilities
	Access to transportation stations (C2)	Hashemkhani Zolfani et al. (2023); Borghetti et al. (2021)	Access to transportation stations refers to the availability and convenience of reaching various modes of transportation, such as bus stops, train stations, metro, and other transportation hubs
	Diversity of recreational places (C3)	Hashemkhani Zolfani et al. (2023)	It refers to the variety of leisure and recreational venues or locations available for people to enjoy and engage in recreational activities. It implies the presence of different types of recreational facilities such as parks, amusement parks, sports complexes, theaters, museums, and other entertainment venues that offer a range of options for individuals to unwind, have fun, and engage in leisure activities
	Structural strength of housing skeleton (C4)	Allen and O'Donnell (2020); Raji et al. (2016)	It refers to the stability and durability of the structural framework or skeleton of a building or dwelling
	Diversity of land use (C5)	Huang et al. (2018); Hashemkhani Zolfani et al. (2023)	It describes the presence of multiple and distinct land uses within a specific area or region. Land use can include residential, commercial, sports, cultural, educational, recreational, and natural areas
	Quality of passages (C6)	Çoteli (2023)	It refers to the condition and various characteristics of passages, including surface smoothness, pavement condition, asphalt coverage, lighting, safety equipment, and other factors that can impact passages' comfort, safety, and efficiency
	Housing heating and cooling system (C7)	Sharma and Purohit (2014)	Housing heating and cooling system refers to the system or infrastructure in a residential property that provides both heating and cooling functionalities
Environ-mental (D)	Park (access to green space) (D1)	Yu et al. (2024); Lee (2021)	It refers to the availability and accessibility of parks and other green spaces within a walking distance of less than 15 minutes
	Clean air (no air pollution) (D2)	Staricco and Brovarone (2020); Ahmed et al. (2019a)	It refers to the presence of clean air free from pollution. Clean air means the absence of polluted particles, contaminants, harmful chemicals, smoke, toxic gases, and other factors that can impact air quality, human health, and the environment
	No noise pollution (D3)	Amir et al. (2023); Nour (2015)	It refers to the presence of environments that are free from unwanted and disruptive noises. Sound pollution includes unwanted and unnecessary sounds caused by sources such as roads, industries, events, commerce, buildings, and other noise sources
	Proper sewage and waste disposal system (D4)	Valcárcel-Aguiar et al. (2018); Nour (2015)	This indicator refers to the development of the sewage network and timely waste collection

3.2. Evaluation of livability indicators in worn-out urban textures

After identifying the livability indicators, a citizen questionnaire was designed. In this section, the focus was initially on the status of livability indicators from the perspective of residents. The questions in this section were formulated as follows: what is the status of livability indicators in worn-out urban fabrics? To answer this question, the Binomial test was utilized. The second question about the which areas are in favorable livability conditions and which ones are not? Specifically, worn-out textures, categorized by regions, are evaluated in terms of livability. In other words, it addresses essentially ranking them. Therefore, the Kruskal-Wallis test was employed to examine the status of regions in livability indicators.

What is the status of livability indicators in worn-out textures?

A Binomial test was employed to assess the livability status of residents in worn-out urban textures. According to the 5-point Likert scale's theoretical median response (Cut Point), which is set at 3, the respective indicator is considered desirable if the average score for any of the indicators is greater than 3. Conversely, if the average score for any of the indicators is less than 3, it is deemed undesirable. Table 3 shows a significant relationship exists for most research indicators (with a Sig value less than 0.05). However, most indicators have been assessed as undesirable. The results of the Binomial test showed that out of the 20 examined indicators, only six indicators (market diversity, the role of urban management, quality of facilities, diversity of land use, access to green space, proper sewage and waste disposal system) were in a desirable state. Among them, the status of indicators (affordable housing prices, increase in economic activities, investment, access to transportation stations, social participation, clean air (no air pollution), and quality of passages) is highly undesirable. In other words, the status of these six indicators is critical since more than 70% of the residents of worn-out urban textures evaluated these indicators as unfavorable.

How are the regions of Tehran ranked in terms of livability? (Ranking of regions)

The Kruskal-Wallis test was used to answer the above question. The results of this test are presented in Table 4. The significance level (Sig) in the studied regions is less than 0.05, indicating a significant difference in the indicators. The spatial distribution of the livability status of the regions is presented in Figure 4.

According to the findings of this test, the livability status in central areas is highly undesirable. Among these central areas, the livability status of regions 10 and 12 is even more critical. By comparing the Mean Rank of the Kruskal-Wallis test, it can be concluded that the northern regions are more favorable compared to the central and southern regions. Furthermore, based on the Mean Rank of the Kruskal-Wallis test, regions 22 and 21 are in a more desirable condition compared to other regions. One of the reasons for the critical conditions in central areas is the presence of numerous historical fabrics in these regions. Additionally, the central

Table 3. Binomial test results

Indicators	Category	Observed prop.	Sig	Indicators	Category	Observed prop.	Sig
Investment and economic activities	<= 3	74	0.003	Quality of facilities (water, electricity, gas, telephone, internet)	<= 3	22	0.001
	> 3	26			> 3	78	
Job diversity	<= 3	61	0.007	Access to transportation stations	<= 3	74	0.006
	> 3	39			> 3	26	
Housing prices	<= 3	91	0.000	Diversity of recreational places	<= 3	61	0.003
	> 3	9			> 3	39	
Market diversity	<= 3	19	0.000	Structural strength of the housing skeleton	<= 3	70	0.000
	> 3	81			> 3	30	
Income	<= 3	76	0.004	Diversity of land use	<= 3	28	0.001
	<= 3	24			> 3	72	
				Quality of passages	<= 3	74	0.007
					> 3	26	
				Housing heating and cooling system	<= 3	58	0.002
					> 3	42	
The role of urban management	<= 3	45	0.000	Park (access to green space)	<= 3	32	0.001
	> 3	55			> 3	68	
Social security	<= 3	64	0.001	Clean air (no air pollution)	<= 3	73	0.003
	> 3	36			> 3	27	
Social participation	<= 3	71	0.001	No noise pollution	<= 3	69	0.000
	> 3	29			> 3	31	
Residents' sense of belonging	<= 3	60	0.003	Proper sewage and waste disposal system	<= 3	29	0.001
	> 3	40			> 3	71	

Table 4. Kruskal-Wallis test results

Regions	Mean rank	Sig	Regions	Mean rank	Sig
1	196.514493	0.000	12	122.583333	0.006
2	198.666667	0.000	13	173.518519	0.004
3	209.512166	0.002	14	164.250000	0.001
4	202.445652	0.000	15	165.222222	0.001
5	212.277778	0.001	16	134.166667	0.000
6	182.222222	0.002	17	184.401316	0.000
7	171.000000	0.002	18	177.794118	0.001
8	172.222222	0.003	19	181.032609	0.003
9	126.607143	0.000	20	171.441176	0.007
10	124.111111	0.005	21	254.000000	0.005
11	128.166667	0.001	22	277.500000	0.000

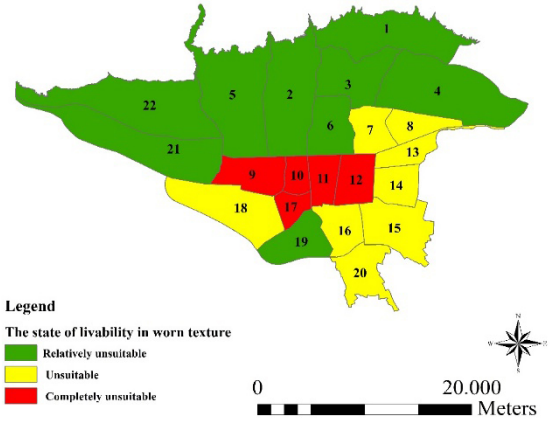

Figure 4. The livability status of worn texture residents by region based on the Kruskal-Wallis test results (source: Figure by authors)

regions have been the nuclei of Tehran's urban development. Therefore, providing services, renovation, and revitalization in these areas face various challenges. However, regions 21 and 22 are considered new regions. The purpose of establishing these regions was to address the service deficiencies in the western area of Tehran and to relocate some of the population residing in the worn-out fabrics of central Tehran. Consequently, the area of worn-out texturesin these regions is limited.

3.3. Identification of key (critical) livability indicators

In this section, the question of which indicators are the most influential on livability was addressed. Therefore, the examination of the interactive effects between the 20 indicators from the perspective of experts was conducted. To accomplish this, we employed the MicMac software for system analysis. Initially, the indicators were inputted into the MicMac software, and experts completed the 20×20 matrix detailing the mutual effects of these indicators. The saturation level of the matrix, after two iterations, stands at 68.72%, indicating a high level of questionnaire validity and reliability. Out of a total of 253 assessable relationships within this matrix, 147 relationships yielded a zero value, indicating that these factors had no influence on one another. The positions of these indicators, as derived from the matrix of mutual effects, are illustrated in Figure 5. As seen in Figure 5, these indicators are categorized into four groups based on their placement within the matrix.

Zone coordinates and system stability

The bimodal indicators are situated in zone 1 (northeast) and exhibit both significant influence and high susceptibility. In this research, these indicators comprise housing prices, investment and increase in economic activities, and residents' income.

The zone 2 indicators, positioned in the northwest, possess very high influence but low dependency(referred to as influence variables). In zone 2, there is only one indicator: the role of urban management.

In zone 3, the independent indicators (excluded or independent variables) are positioned in the southwest, characterized by low influence and susceptibility. The independent variables in this study include quality of facilities, access to transportation stations, diversity of recreational places, structural strength of the housing skeleton, diversity of land use, quality of passages, housing heating and cooling system, access to green space, clean air, no noise pollution, and proper sewage and waste disposal system. These indicators

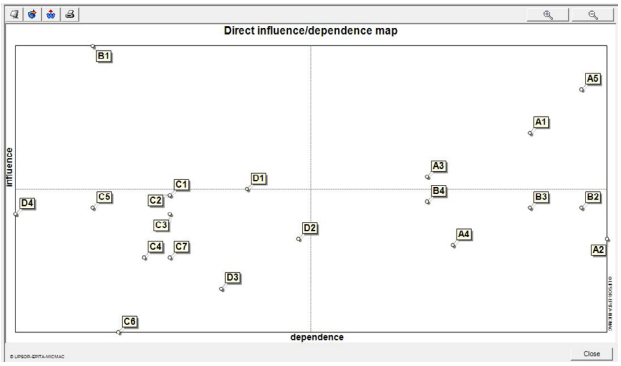

Figure 5. The position of the indicators after analyzing the matrix of mutual effects (direct effects) (source: Figure by authors)

are recognized as neutral indicators (not sufficiently influential or not sufficiently dependent on other indicators).

However, the indicators in the fourth zone, located in the southeast, have a minor influence on the system and themselves are dependent on changes in other indicators (they have low effectuality but high susceptibility). They are recognized as dependent variables. In the present study, the indicators of job diversity, market diversity, social security, social participation, and residents' sense of belonging are considered dependent variables.

Furthermore, based on expert opinions, the status of the unstable system was evaluated. In the graphical analysis of MicMac, if it is possible to draw the letter "L" on the indicators, it signifies that the system is stable. If the components are scattered along the diagonal, it means that the system is unstable (Barati et al., 2019). According to Figure 7, the indicators are scattered along the diagonal, indicating the instability of the livability system in worn-out urban textures.

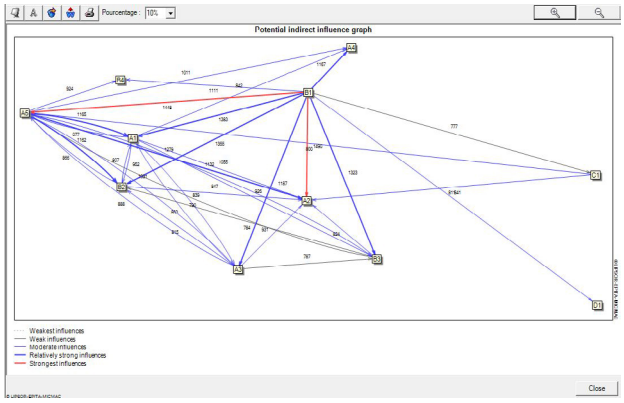

Figure 6. Indirect relationships between indicators (source: Figure by authors)

However, a very important point that should receive the attention of managers and decision-makers in Tehran's worn-out urban textures is bimodal indicators. Indicators such as housing prices, investment and increase in economic activities, and residents' income have been identified as bimodal indicators. These indicators have a high level of both influence and susceptibility. In fact, these indicators are instability indices in the livability system of Tehran's worn-out urban textures. Due to their interdependencies with other indicators, they quickly absorb and transmit effects. In other words, the speed of their influence and susceptibility makes them highly capable of mitigating system instability. Therefore, bimodal indicators are considered strategic indicators that, through manipulation and control, can significantly impact the dynamics and transformation of the system.

Graph of influence analysis

The influence graph illustrates the relationship between the indicators (factors) and how they influence each other. This graph is depicted using red and blue lines, indicating the extent of the influence of each indicator. The red lines represent strong influence, while the blue lines, with variations in thickness, indicate moderate to weak relationships (Figure 6). What is presented in this figure indicates a very strong influence of the indicator "The role of urban management (B1)" on other indicators, particularly on Residents' income (A5) and Job diversity (A2). This indicates that the indicator "The role of urban management (B1)" is the most influential indicator in the current study. In continuation, the ranking of influential and dependent indicators has been addressed in Table 5.

Table 5. Ranking of effective and efficient indicators in (direct and indirect relationships)

Rank	Label	Direct influence	Label	Direct dependence	Label	Indirect influence	Label	Indirect dependence
1	B1	1141	A2	794	B1	1032	A2	797
2	A5	967	A5	769	A5	882	A5	774
3	A1	794	B2	769	A1	726	A1	744
4	A3	620	A1	719	A3	624	B2	737
5	D1	570	B3	719	B2	596	B3	711
6	C1	545	A4	645	B3	575	A3	642
7	C2	545	A3	620	C1	564	A4	640
8	B4	521	B4	620	D1	551	B4	602
9	B2	496	D2	496	B4	543	D1	446
10	B3	496	D1	446	C3	528	C1	418
11	C5	496	D3	421	C2	499	C4	408
12	C3	471	C1	372	D4	451	D2	400
13	D4	471	C2	372	C5	449	C7	385
14	A2	372	C3	372	A2	438	C2	361
15	D2	372	C7	372	A4	395	C3	357
16	A4	347	C4	347	D2	361	D3	351
17	C4	297	C6	322	C4	290	B1	343
18	C7	297	B1	297	C7	284	C5	308
19	D3	173	C5	297	D3	201	C6	305
20	C6	0	D4	223	C6	0	D4	262

Identification of key drivers (indicators) of livability (examination of direct and indirect relationships)

Influential indicators: out of the 12 indicators, several have been identified as key (influential) indicators affecting livability. The examination focused on both direct and indirect relationships of these indicators, revealing that all influential indicators reappear in both direct and indirect impacts (Table 8). The only difference lies in their rankings. What matters most is that the key influential indicators in direct and indirect relationships are similar. According to experts, the key influential indicators in livability include the following: investment and increase in economic activities (A1), housing prices (A3), residents' income (A5), and the role of urban management (B1).

Dependent (susceptible) indicators: dependent indicators, much like influential indicators, are also reiterated in both direct and indirect impacts, with very minor differences in their rankings (Table 8). The dependent indicators encompass the following: investment and increase in economic activities (A1), job diversity (A2), residents' income (A5), social security (B2), and social participation (B3).

3.4. Scenario analysis

In this section, the question of what scenarios depict the future of livability in Tehran's worn-out urban fabrics was addressed. To answer this question, the results of previous sections were provided to the experts. They were then asked to evaluate the effects of different states of the indicators on each other based on the current status of the indicators.

It is worth mentioning that a scenario offers a descriptive portrayal of the future state of a system, taking into account its past, present, and future actions. Coates and Godet (1994) identified two types of scenarios: exploratory and normative. This article uses the normative scenario method to define the future state of livability in the worn-out textures of Tehran. A normative scenario defines the future state based on different versions of the future. Therefore, in this research, scenarios have been designed based on four key indicators (according to the results of the analysis in the MicMac matrix). For each scenario, probable situations have been taken into account. Probable situations should be considered from the best to the worst. Figure 7 displays the probable situations. Therefore, in the Scenario Wizard software, the impact of different situations on each other was evaluated, and scenarios were identified.

Based on calculations, we are faced with three strong scenarios. These scenarios demonstrate the future of livability for Tehran's deteriorated worn-out urban textures.

Scenario No. 1 (Desirable)

We have named these scenarios the "Desirable and ideal scenario" (Table 6). The envisioned future in the first scenario for the worn-out urban textures of Tehran is such that all key drivers of livability (housing prices, residents' income, investment and increase in economic activities, the role of urban management) are in a favorable state. In this scenario, with investment in worn-out urban textures, there will be a significant increase in economic activities. With the growth of economic activities, residents' income is also expected to increase. Additionally, the municipality and the Cultural Heritage Organization will play a crucial role in reducing housing prices through the preparation of redevelopment plans. This is because many housing units will become habitable, and with increased housing supply, housing prices will also experience a downward trend. Also, with the increase in economic activities, the construction sector will also thrive. This growth can lead to an increase in housing construction and greater supply in the market, which will mitigate the upward trend of prices. Based on this scenario, we will witness the promotion of sustainable livability in the worn-out urban fabric, with key drivers in favorable and ideal conditions.

Table 6. The elements of the scenario (No. 1)

Economic activities:	Increase in economic activities
Housing prices:	Decrease in housing prices
The role of urban management:	Preparation of sustainable redevelopment plans
Income:	Increase in residents' income

Scenario No. 2 (Bad)

It can be said that the envisioned future in this scenario for the livability of Tehran's worn-out urban textures is undesirable (Table 7). In this scenario, key drivers, such as housing prices and the role of urban management, are in a critical state. Economic activity indicators and income continue the current trend. From the perspective of residents (Table 3), the current status of these indicators in the worn-out urban fabric is also undesirable. The current state of economic activity indicators indicates that investment in worn-out urban textures is characterized by uncertainty in profitability and high risk. These risks may be due to market unacceptance (due to inadequate income levels of residents) and inflexibility in the use of spaces and facilities (due to the historical values of the textures). These risks lead to less predictability and control for investors and may result in financial problems and losses.

Descriptors:	variant [1]	variant [2]	variant [3]
Economic activities	Increase in economic activities	Continuation of the current trend	Decrease in economic activities
Housing prices	Increase in housing prices	Continuation of the current trend	Decrease in housing prices
The role of urban management	Preparation of sustainable redevelopment plans	Continuation of the current trend	Neglect of Worn-out Textures
Income	Increase in residents' income	Continuation of the current trend	Decrease in residents' income

Figure 7. Probable states of key indicators (source: Figure by authors)

It appears that a decrease in investment and economic activities will have a negative impact on housing prices. However, the increase in housing prices may be due to various factors, including inflation, non-implementation of housing redevelopment plans, and housing shortages in worn-out textures. Therefore, in this scenario, the process of livability is undesirable, and the worn-out fabric is losing its historical, architectural, and economic values.

Table 7. The elements of the scenario (No. 2)

Economic activities:	Continuation of the current trend
Housing prices:	Increase in housing prices
The role of urban management:	Neglect of worn-out textures
Income:	Continuation of the current trend

Scenario No. 3 (Critical)

The future envisioned in this scenario for Tehran's worn-out urban texture is characterized by all key drivers of livability being in a critical state (Table 8). If this scenario becomes a reality, the livability of the worn-out urban texture in Tehran will be highly undesirable.

In this scenario, the worn-out fabric will distance itself from its historical identity and authenticity, undergoing significant changes. It will lose its vitality and functionality across all indicators. Also, the worn-out textures remain unused and abandoned. No facilities will be provided by urban management, and the private sector will have no interest in investing in the texture. Thus, the worn-out texture will not receive the necessary financial support for its livability. People's income will also decrease due to reduced investment and economic activities. Furthermore, due to the lack of attention from urban management toward the redevelopment of worn-out textures, the legal regulations and tools will be extremely weak. The redevelopment laws will fail to facilitate the redevelopment process and create obstacles for implementing redevelopment plans for worn-out textures. Moreover, the redevelopment plans will lack common goals, and the lack of coherence in the redevelopment process will hinder the implementation of redevelopment in the worn-out texture. In this scenario, we will witness migration, poverty, unemployment, and the loss of Tehran's worn-out urban texture.

Table 8. The elements of the scenario (No. 3)

Economic activities:	Decrease in economic activities
Housing prices:	Increase in housing prices
The role of urban management:	Neglect of worn-out textures
Income:	Decrease in residents' income

4. Conclusion and discussion

We focused on investigating the livability conditions of residents in these areas, identifying key drivers (indicators), and designing scenarios for future livability. Therefore, we prioritized the opinions of residents and experts in the research process.

The results showed that the key indicators of livability in Tehran's worn-out textures include housing prices, residents' income, investment, and increase in economic activities, as well as the role of urban management. These indicators have a close relationship with each other, and the status of each indicator can impact other indicators.

As mentioned, residents' income is one of the most influential indicators. Residents' income has a significant connection to investment and the role of urban management. However, the findings show that the state of economic activities in worn-out textures is undesirable and lacks significant prosperity. Due to these areas' economic, social, and physical conditions, investment and construction entail high risks for investors. While the return on investment is crucial for investors, the current situation in worn-out areas does not economically justify it for the private sector. Factors such as low buyer demand, high residential unit prices, lack of interest, and low resident participation contribute to this situation. On the one hand, the lack of investment and the reduction in economic activities directly affect residents' income. Additionally, the impact of reduced economic activities and lack of investment on housing prices is entirely evident. This is because, in worn-out urban textures, the decrease in construction activities has had a negative effect on the production and supply of residential units while simultaneously driving up housing prices. As Asadov et al. (2023) point out, a decrease in investment can have a negative impact on economic growth. They demonstrated that fluctuations in housing prices can significantly influence economic fluctuations, which may adversely affect long-term economic growth and housing prices. Although in worn-out urban textures, in addition to reduced investment, unfavorable economic conditions of residents, the critical inflation situation (the current inflation rate is over 46%), and the inconstancy in land prices have exacerbated the undesirable status of housing and income indicators.

However, what residents have emphasized greatly is the role of urban management in improving conditions. From their perspective, urban management can play a key role in job creation, income, housing, and street renovation, providing interest-free loans and reducing municipal taxes. According to residents, since many of the worn-out urban textures are considered historical sites, urban management can create various jobs based on the tourism potential of historical sites. From their perspective, urban management has not effectively improved livability conditions. Therefore, from the residents' point of view, the role of urban management in livability has been relatively desirable. Even with the presentation of new incentive packages by the municipality, which include a 50% to 100% reduction in construction fees and the provision of one to two-story density incentives, residents have not shown interest. From their perspective, these incentive packages benefit investors and property owners with large areas.

According to experts, the most important key indicator was the role of urban management, which the residents of worn-out textures also emphasized. Doost Mohammadian and Rezaie (2019) acknowledge that urban management projects play a significant role in improving infrastructure and livability in cities. From their perspective, urban management, through innovative sustainable projects, strengthens urban infrastructure, addresses challenges such as poverty and environmental issues, and ultimately enhances livability and quality of life in cities. In the present study, scenarios have also identified the role of urban management as a key factor and driver in increasing economic activities, income growth, and reducing housing prices. Therefore, considering the close interrelation and influential nature of these indicators on each other, it is crucial to consider the scenarios. Thus, based on scenario analysis, the first scenario, the worn-out texture of Tehran, achieves desirable and ideal conditions. However, the second and third scenarios indicate undesirable and unstable effects in the worn-out texture and the city of Tehran. Therefore, the first scenario is the best option for enhancing livability and preserving the values of worn-out textures. In this scenario, Tehran's urban management will provide the necessary groundwork for realizing a sustainable livability approach by utilizing global experiences and localizing sustainability. The problems of residents in the worn-out texture gradually decrease with increased participation from organizations and management institutions. Residents' incomes increase due to economic prosperity, providing access to suitable housing as well.

As mentioned in the introduction section, based on the literature reviews conducted, no study has been conducted on the livability of residents in worn-out urban textures using a future study approach. Literature reviews have shown that the most important and closely related studies include two studies: Hekmatnia et al. (2022) and Yeganegi (2018). Yeganegi (2018), conducted a study examining the livability status of worn-out textures and used the Moran's I method to determine the type of indicator distribution. The results of his studies showed that the livability status of the studied worn-out urban texture (Zanjan) is desirable, with indicators of leisure and recreation, participation, healthcare and medical services, social security, and sense of place, which relate to the social dimension, being of greater importance and priority. In this study, the physical and economic dimensions ranked lower. Therefore, the results of Yeganegi's study (2018) do not align with the findings of the present research. Because our study results indicated that the livability status of residents is undesirable, and the impact of economic indicators has been greater than social indicators. However, the results of the study by Hekmatnia et al. (2022) are almost similar to the findings of the current research regarding the livability status. They, by examining the livability status of a worn-out texture in their study (Shahin Dej), concluded that the worn-out texture in their studied city faces significant challenges in various dimensions according to experts' opinions. This study highlights income and private sector investment as key factors for improving residents' livability. Notably, the authors assess the strengths and weaknesses of the worn-out texture. Low resident income, building instability, and lack of planning are identified as major weaknesses. However, increased private sector investment is considered a strength. According to the authors, these weaknesses contribute to the undesirable and unstable livability situation. Our research also identified low resident income as a significant factor in livability instability. Furthermore, our first scenario, which prioritizes investment and economic activity, aligns with the strengths identified by Hekmatnia et al. (2022).

It is necessary to mention that the aforementioned studies have several weaknesses, particularly in their methodology and data analysis methods. What distinguishes the results of the current research from the above studies is the examination of livability indicators from the perspectives of both residents and experts, scenario design, as well as the emphasis on a futures study approach. Therefore, based on the findings of the present study, some suggestions are proposed for improving and enhancing the livability of Tehran's worn-out urban textures:

- The most important research recommendation is to consider scenarios for the future livability of worn-out textures in Tehran. The first scenario emphasizes the role of urban management in developing redevelopment plans, increasing investment, boosting economic activities, and enhancing income. Therefore, to realize the first scenario, urban management (municipality, cultural heritage organization, government institutions) plays a key role in providing services, regulating laws, and supervision. Urban management in Tehran can, with the participation of all stakeholders, including the government, municipality, and residents of worn-out textures, prepare redevelopment plans.
- Consideration of incentive packages for the private sector: the municipality can encourage the private sector to invest in worn-out textures by considering incentive packages. For example, by providing financial facilities, granting loans at lower interest rates, granting land or buildings with lower rent, financial exemptions (such as income tax, profit tax, value-added tax), and facilities related to obtaining permits.
- Creating employment opportunities through the development of historical tourism. Considering that a significant portion of the worn-out urban textures consists of historical sites, the Cultural Heritage Organization, in coordination with the Tehran Municipality, can invest in historical sites to create various jobs in the historical tourism sector.

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Methodology and software, S. M. H. K.; formal analysis, S. H. Z., S. M. H. K.; resources and data pre-processing, S. M. H. K. and S. H. Z.; writing-original draft preparation, S. M. H. K., S. H. Z.; writing-review and editing, S. H. Z., J. A.; supervision and project administration, S. H. Z. and J. A. All authors have read and agreed to the published version of the manuscript.

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