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Strategic foresight for resilience in the Tehran Province: analyzing actor conflicts and prioritizing adaptive strategies

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Abstract

Achieving resilience in the Tehran province is impeded by wicked problems rooted in structural complexities and systemic uncertainties. Traditional planning, constrained by a technocratic lens and a disregard for the political economy of space, has reached an impasse. This research provides a critical explanation of the nexus between structural forces and actor agency, exploring how interest conflicts and power coalitions lead to institutional lock-in, steering the region toward crisis-ridden scenarios. The methodology utilizes strategic foresight across four stages: identifying key variables through Delphi and MICMAC; analyzing actor alignments and conflicts via MACTOR; formulating future scenarios using Scenario Wizard; and evaluating strategic performance with Multipol. Findings reveal that Tehran's resilience system is inherently unstable, shaped by six primary drivers: economic, socio-housing, infrastructural, cultural, environmental, and security. Actor analysis highlights a profound rift between the state bloc and social institutions, resulting in institutional paralysis. Scenario evaluations indicate a high probability of collapse and crisis scenarios. Strategies centered on smart infrastructure and a knowledge-based economy were identified as the most adaptive due to their lower political friction. The study concludes that resilience in Tehran is a political process of negotiation. To avert the collapse scenario, a transition from technical crisis management to the political management of conflicts, alongside the formal recognition of the agency of social institutions, is an unavoidable necessity.

Keywords

actors
futures studies
MACTOR
MICMAC
Multipol
resilience
Scenario Wizard

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1. Introduction

The Tehran Province, as the center of power and wealth concentration in Iran, grapples with complex challenges that traditional urban planning paradigms have reached an impasse in addressing. According to Rittel and Webber (1973), these challenges fall into the category of wicked problems: problems that lack a definitive formulation and a definitive solution. In Iran, comprehensive and detailed plans have failed to increase Tehran's resilience against systemic crises due to their physically-oriented perspective and the neglect of power dynamics. The existing research gap indicates that most studies on resilience in Tehran have focused on technical and physical indicators (Zeng et al., 2022), while what has been overlooked is the political economy of space and how stakeholders influence future scenarios. In reality, resilience is not a neutral concept, but rather an arena for the reproduction of institutional power.

This research aims to transcend descriptive analyses and present a model that elucidates the link between structural forces and actor agency. This study moves beyond purely descriptive analysis toward the production of analytical-normative knowledge, such that the research not only dissects and explains the reasons behind system instability and conflicts of interest, but by developing scenarios and prioritizing policies, it provides a prescriptive framework for transitioning from the current critical state to a desirable future.

To bridge this gap, this research shifts from a paradigm of technical reforms to structural-institutional analyses. The main problem is how conflicts of interest between institutional actors and market forces have diverted the paths of resilience in Tehran, steering the region toward institutional lock-in. The innovation of this article lies in providing an integrated strategic framework that not only identifies key drivers through structural analysis (MICMAC) but also maps the configurations of power and actor alignments in various resilience scenarios using actor analysis (MACTOR), and ultimately determines appropriate strategies for each scenario and the actions of each actor using Multipol.

Therefore, the fundamental question of this research is: In which direction does the combination of structural forces, key actors, and desired actions steer the Tehran Province among possible futures? Moreover, do the current governance frameworks possess the necessary capacity to transition to resilient scenarios or not? In the following sections, through a theoretical exploration of the concepts of futures studies and resilience, the logical foundations of this integrated framework will be explained.

2. Theoretical framework

2.1. Urban resilience paradigm: From static equilibrium to evolutionary adaptation

In the urban planning literature, there has been a fundamental transition from engineering resilience to evolutionary and institutional resilience. Engineering resilience, rooted in Holling's (1973) early ecological views, emphasized the capacity of a system to absorb shocks and return rapidly to a pre-crisis equilibrium state. In his article, Holling defined resilience as a measure of the persistence of systems and their ability to absorb change and disturbance and still maintain the same relationships between populations or state variables. This approach assumed that ecological systems exist near a single stable equilibrium state, and resilience is the ability to return to this stable state following a temporary disturbance.

However, in recent decades, scholars such as Davoudi et al. (2012, 2013) have argued that contemporary metropolises are complex and dynamic systems that inherently lack a single equilibrium state. Davoudi and her colleagues thoroughly differentiated between engineering resilience and evolutionary resilience. While engineering resilience assumes ecological systems exist near a single stable state, evolutionary ecological resilience emphasizes conditions far from any stable state, where instabilities can shift a system's behavior to a different model. This evolutionary paradigm views cities as complex adaptive systems operating in a continuous process of change and transformation, rather than seeking to return to a previous state (Batty, 2008, 2013; Woodruff et al., 2021).

Institutional fragility in the Tehran Metropolis

Based on this premise, Tehran's fragility to uncertainties (such as earthquakes, climate change, or economic shocks) is more the result of the inability of responsible institutions in organizational learning and adaptation to changing conditions than a product of physical weaknesses. Studies conducted in various districts of Tehran show that the central districts of the city, including districts 3, 6, 7, 8, 9, 10, 11, 12, and 13, have the highest distribution and frequency of lack of resilience against earthquakes (Abdoli et al., 2021; Jazayeri et al., 2018). However, beyond physical vulnerability, research on governance challenges emphasizes that one of the main challenges that urban

management faces, especially in metropolitan areas, is the fragmentation of urban management in terms of policymaking, decision-making, planning, guidance, and supervision (Keshishian Siraki & Neginraz, 2020). Abbaszadeh and Azimi (2013) identified this structural problem at the national level: institutional multiplicity and the fragmentation of urban development responsibilities at the central level. This institutional fragmentation aligns with the concept of the interdependency paradox presented by Monstadt and Wolff (2019) in analyzing urban infrastructure governance: while risks migrate across infrastructural and territorial domains and require coordinated risk management to cross organizational and territorial boundaries, the institutional fragmentation of the organizations that operate them complicates information exchange, cooperation, and the management of infrastructural interdependencies.

2.2. Strategic foresight in the face of wicked urban Problems

The Tehran Province is confronted with a set of wicked problems, which, according to Rittel and Webber's (1973) definition, lack definitive solutions and clear boundaries. Rittel and Webber distinguished ten characteristics of wicked problems from tame problems in mathematics and chess: (1) there is no definitive formulation of a wicked problem; (2) wicked problems have no stopping rule; (3) solutions to wicked problems are not true-or-false, but good-or-bad; (4) there is no immediate and no ultimate test of a solution to a wicked problem; (5) every solution to a wicked problem is a one-shot operation; (6) wicked problems do not have an enumerable (or an exhaustively describable) set of potential solutions; (7) every wicked problem is essentially unique; (8) every wicked problem can be considered a symptom of another problem; (9) the existence of a discrepancy in explaining a wicked problem; and (10) the planner has no right to be wrong.

This concept, first introduced by West Churchman (1967), emphasizes the fact that spatial planning inherently deals with unavoidable uncertainty, complexity, and normativity. Chan and Xiang (2022), in their review fifty years after the introduction of the wicked problems concept, emphasize that with all or a specific combination of these characteristics, numerous problems in planning, design, and policymaking are inherently wicked and stand in stark contrast to tame engineering and scientific problems. In such environments, traditional planning methods based on linear forecasting and the extrapolation of past trends lose their effectiveness.

Transformative resilience and anticipatory planning

Combining strategic foresight with the concepts of transformative resilience offers a vision for urban planning. Birchall (2021), in his research on anticipatory planning in the context of climate adaptation, showed that proactive planning in addressing the exacerbated impacts of climate change is beneficial. Integrating adaptation into policies can help align economic demands with climate initiatives, and participatory governance at various levels can foster progressive adaptation through enhanced partnerships.

Malin et al. (2022), in their analysis of urban resilience using the urban systems abstraction hierarchy (USAH), demonstrated that understanding the interdependencies within complex urban systems is crucial for creating genuine resilience. This systemic view aligns with the UNDP (2021) recommendation that foresight differs from traditional planning because it treats plausible, possible, probable, and preferable futures equally. Furthermore, while traditional planning tends toward robustness—meaning an effort to prevent foresight failure—resilience favors early identification and rapid recovery.

Ultimately, strategic foresight in the face of wicked urban problems is not a tool for predicting the future, but a framework for shaping the future. Backler et al. (2025) emphasize that strategic foresight enables stronger and more resilient strategies by exploring leading indicators of possible change and creatively reimagining the future through scenario planning and strategic risk management. For Tehran, this means that instead of waiting for crises to occur, foresight systems should be institutionalized to continuously identify weak signals, evaluate alternative scenarios, and guide transformation pathways before reaching critical strategic tipping points.

2.3. Political economy of space and actor coalition theory

One of the serious critiques of resilience studies is the neglect of the role of power in shaping urban space. Henri Lefebvre argued that space is a social product actively constructed by social relations, not a neutral container inhabited by people. Lefebvre describes space as a contested arena where daily life and actions create meanings, values, signs, and symbols (Lefebvre, 1991). David Harvey focused his analysis on the urban political economy and emphasized how the needs and priorities of capital accumulation impact investment

and the creation of space (Harvey, 1973, 1978, 2012).

Dreger et al. (2007), in their analysis of regional convergence and rent-seeking in Iran, showed that most rent-seeking activities are formed by establishing a type of organized business. Examples include import licenses, subsidized loans, contracts to supply goods and services to the public sector or to execute development projects, acquiring land ownership for urban uses or other land uses, and so on. The concentration of rent-seeking activities in Tehran is highly significant: even many businesses located in other regions are organized from Tehran. Although state activities can have positive effects on income levels in all regions, a substantial amount of rents generated in Tehran or transferred there remains in the capital.

Spatial inequality and the rentier economy

Rahnamaei et al., in analyzing spatial inequality in the Tehran metropolis, argue that spatial inequalities in Tehran's residential quality stem from the characteristics of Iranian capitalism and imported neoliberal policies (Rahnamaei et al., 2016). Saeedifard, in studying the effect of the rentier economy on Tehran's urban space, emphasizes that the metropolitan space of Tehran, due to a capitalist system detached from production, has become a commodity for the purposes of the rentier economy and speculation (Saeedifard, 2020). Yousefi and Farahani, in their political-economic analysis of socio-spatial inequality in Tehran, focusing on four sectors of social reproduction—namely housing, public transportation, shopping centers, and public spaces—show that these inequalities are the product of deep power structures (Yousefi & Farahani, 2022). Jafari, in his analysis of Tehran's spatial development from a transnational perspective, illustrates how the transboundary functions of local, national, and global systems shape urban space (Jafari, 2020).

This conflict of interest has led to the formation of institutional lock-in, a situation where past decision-making pathways (path dependency) hinder the emergence of structural innovations (North, 1990). Douglass North argued that institutions are the rules of the game in a society or, more formally, the humanly devised constraints that shape human interaction. North emphasizes that path dependence can be usefully applied to institutional analysis because there are increasing returns to institutions.

The path of institutional change is shaped by two factors: (1) the lock-in that arises from the symbiotic relationship between institutions and the organizations that have evolved as a consequence of the incentive structure provided by those institutions; and (2) the feedback process by which human beings perceive and react to changes in the opportunity set (North, 1990). The increasing returns characteristics of an institutional matrix that create lock-in stem from the dependence of resulting organizations on that institutional framework and the network externalities that result from it. North concludes that institutional change is more complex than technological change because the existing institutional framework and the organizations and interest groups derived from it have a stake in the existing constraints and will shape policy to that end.

Rixen and Viola (2009), in their analysis of the uses and abuses of the concept of path dependence, emphasize that North extends the concept into another dimension. While Arthur and David see path dependence as an intrinsic property of a specific class of social processes, North views transaction costs and boundedly rational actors—factors that would typically be exogenous to the institution—as sources of path dependence (Rixen & Viola, 2009).

3. Literature review

3.1. Technical and ecological studies of resilience

Early studies, such as the study by Zeng et al. (2022), predominantly focused on engineering and physical aspects, categorizing resilience into three dimensions: adaptive, absorptive, and transformative capacity. However, ignoring human agency and power structures, along with a mechanistic view of the city, is the fundamental flaw of this approach. Bourbeau (2015), referencing Evans and Reid (2013), critiques resilience as a strategy of neoliberal governance for transferring responsibility from institutions to individuals. Schulz and Siriwardane (2015) also critique dominant technocratic approaches for ignoring power imbalances in vulnerabilities. Additionally, Almazán-Casali et al. (2021) showed that technocratic decision-making is heavily reliant on infrastructure, limits participation, and is ineffective in creating long-term climate resilience.

3.2. Urban governance and institutional resilience

With the emergence of new paradigms, Meerow et al. (2016) and Ziervogel et al. (2017) emphasized the importance of governance and social justice in resilience and the critical examination of stakeholders. Meerow et al. (2019) also highlighted the necessity of paying attention to the distribution of benefits and

decision-making processes. However, these studies were mostly descriptive and lacked operational tools for managing conflicts of interest; as Woodruff et al. (2021) demonstrated, the gap between policy and implementation, and Fastiggi et al. (2021, citing Meerow et al., 2016) emphasized the practical challenges arising from differing definitions. Overall, this generation of research has failed to provide concrete methods (like power analysis models such as MACTOR) to address how to manage asymmetric power relations and prevent tokenistic participation in future scenarios.

3.3. Strategic foresight and actor analysis

Godet (2000, 2008), by developing MICMAC and MACTOR models, established structural analyses in strategic planning and argued that these tools, by stimulating imagination and reducing collective biases, help build scenarios. Although Godet considers the stages of the scenario method to include identifying variables, analyzing actors, and reducing uncertainty, and Bendahan et al. (2004) also emphasize the necessity of combining MICMAC (identifying key variables) and MACTOR (analyzing actor strategies), in practice, there is often a disconnect between the two. This separation results in scenarios that are either too technocratic or purely political, failing to respond in environments with high conflicts of interest (like Iran) as to whether powerful actors possess the motivation to influence key variables or not. Therefore, for a precise analysis of Tehran's dynamics, moving beyond the isolated use of these tools and adopting an integrated approach that simultaneously considers structural constraints and actor agency is essential.

3.4. Research background in Iran and research gap

Resilience studies in Iran have predominantly focused on earthquakes and physical dimensions, and according to the review by Moradpour et al. (2022), have paid less attention to climate hazards. These researchers identified three main gaps: methodological (dominance of quantitative approaches), temporal (focus on the status quo instead of foresight), and scalar (focus on the neighborhood instead of the whole city). Furthermore, there is a deep rift between technical-physical studies (e.g., Asgari et al., 2023; Tabibian & Rezapour, 2016) and political economy studies (e.g., Nikbin et al., 2025; Saeedifard, 2020; Jong, 2023).
Although Fallahi et al. (2024) addressed institutional power, Naderi and Khoshnevis (2025) addressed adaptive dynamics, and Ghasemi et al. (2025) addressed institutional and structural barriers, these studies lack a framework for integrating structural analysis with the analysis of actor conflicts of interest. Therefore, the main gap is the lack of a comprehensive approach that Moradpour et al. (2022) also emphasize the need for; a need that this research seeks to address by combining MICMAC, MACTOR, and scenario planning.

Table 1. Research background

Key area	Topic/paradigm	Brief description and features	Status in Tehran studies	References
1. First-generation studies (technical)	Engineering resilience	Focus on static equilibrium, physical indicators, recovery time, and green infrastructure as a machine.	51% of studies on earthquakes and 74% with quantitative and physical methods (Districts 4, 8, 12, 20).	Holling (1973), Zeng et al. (2022), Wang et al. (2022), Moradpour et al. (2022)
	Critique of the technical approach	Ignoring human agency, power structures, and the depolitici-zation of crises (technocracy).	Critiques are less reflected in mainstream Iranian research.	Bourbeau (2015), Almazán-Casali et al. (2021)
2. Second-generation studies (institutional)	Institutional resilience and governance	Emphasis on social equity, institutional adaptive capacity, and stakeholder participation. Resilience for whom?	Studies have been conducted on institutional and management barriers, but the gap between policy and implementation remains.	Meerow et al. (2016, 2019), Fidelman et al. (2014), Dehghan et al. (2025)
	Participatory governance	Collective engagement and cross-sectoral collaboration to solve complex urban problems.	Mostly descriptive; operational tools for resolving conflicts of interest at this level are rarely seen.	Sweeney & Kurniawan (2024). Esteban (2020), Jaisridhar et al. (2025)

Key area	Topic/paradigm	Brief description and features	Status in Tehran studies	References
3. Third-generation studies (foresight)	Structural analysis (MICMAC)	Identifying and ranking key and hidden variables of the system and their mutual relationships.	Used in studies like District 5 of Tehran and the city of Ardabil to identify drivers.	Godet (2000), Arcade et al. (1999), Moradi Sangachini et al. (2025)
	Actor analysis (MACTOR)	Examining actor strategies, power relations, alliances, conflicts, and convergence of interests.	Used more limitedly; often conducted separately from structural analysis.	Godet (1991), Bendahan et al. (2003), Abaft et al. (2020)
	Cross-impact analysis (CIA)	Probabilistic scenario building based on the occurrence or non-occurrence combinations of events.	Used to predict systemic behaviors in crises.	Bañuls & Turoff (2011), Amer et al. (2013)
4. Political economy of space (Tehran)	Rentier economy and space	Commodification of urban space for rentier purposes; transfer of national rent to Tehran and the emergence of megamalls.	Critical studies (Piran, Saeedi-fard) view the roots of fragility in rent and power.	Saeedifard (2020), Afrakhteh & Hajipour (2016), Nikbin et al. (2025)
	Inequality and exclusion	Concentration of capital and neoliberal policies leading to social exclusion and the reproduction of informality.	Reference to the unholy trinity of power, market, and people in the reproduction of informal settlements.	Jong (2023), Habibi et al. (2022)

4. Materials and methods

This study is applied in nature and was conducted using an integrated futures studies approach. Futures studies, as a systematic approach for examining possible, probable, and desirable futures, have gained a significant position in strategic research when addressing complex problems, structural uncertainties, and dynamic decision-making environments (Bell, 2003; Godet, 1994). Unlike forecasting-oriented approaches, which mainly rely on extrapolating past trends, futures studies emphasize the identification of driving forces, uncertainties, actor interactions, and the design of robust policy options (Godet & Durance, 2011). This characteristic makes futures studies particularly suitable for analyzing multi-actor urban issues, including urban resilience and visual management, because such issues do not typically follow linear logic and are shaped by institutional interactions, environmental changes, and multi-level decision-making processes (Healey, 2009).

In the futures studies literature, models and approaches can generally be categorized into several major groups: exploratory approaches, which focus on analyzing possible futures based on trends and uncertainties; normative approaches, which begin with a desirable future and work backward to design pathways toward it; and integrated approaches, which combine both logics (Börjeson et al., 2006). Within this framework, methods such as Delphi, scenario planning, trend analysis, backcasting, roadmapping, and CIA are among the most widely used futures studies tools (Van der Heijden, 2005; Schwartz, 1996). Recent literature shows that futures studies are not a single, homogeneous field but consist of several major strands, including forecasting, future representation and imaging, pursuit of desirable futures, understanding anticipatory processes, and radical epistemological critiques (Minkkinen, 2019). At the methodological level, recent reviews of scenario planning also indicate that this field is divided into distinct schools, each with its own logic and methodological choices (Cordova-Pozo et al., 2023).

Table 2. Futures studies schools

School/approach	Theoretical basis and logic	Main features	Application	Limitation
Forecasting school	Based on extrapolating past trends and quantitative data, focus on the most probable future (Minkkinen, 2019).	Reliance on trends, linear forecasting, and analysis of probable future.	Suitable for conditions with low uncertainty and relative stability.	Weakness in analyzing structural changes, institutional conflicts, and complex multi-actor problems.

School/approach	Theoretical basis and logic	Main features	Application	Limitation
Exploratory or scenario school	Based on identifying and analyzing multiple possible and consistent futures (Bradfield et al., 2005; Van der Heijden, 2005; Cordova-Pozo et al., 2023).	Scenario planning, uncertainty analysis, and preparation for alternative paths.	Suitable for problems with high uncertainty and dynamic environments.	Lacks explicit normative orientation; emphasizes preparedness rather than choosing the desirable.
Normative or backcasting school	Moving from a desirable future to the present and reconstructing the path to its realization (Bibri, 2020).	Goal setting, backcasting, and designing the realization path.	Suitable for policymaking, sustainable development, and long-term planning.	High dependence on precisely defining the desirable future and the possibility of subjective goals.
French school	Chain approach including structural analysis, actor analysis, scenario building, and policy evaluation (Godet, 1991, 1994, 1987; Godet & Durance, 2011).	Use of MICMAC, MACTOR, Multipol; analysis of structure, power, and strategy.	Suitable for structured, institutional, and multi-level problems with interest conflicts.	More complex execution requires expert data and multi-stage analysis.
Critical and emancipatory approaches	Critiquing dominant assumptions about the future, power, and knowledge (Minkkinen, 2019).	Focus on bias, power, epistemology, and the right to define the future.	Suitable for analyzing political and discursive dimensions of futures studies.	More limited executive application in direct decision-making.
Participatory and transformative approaches	Based on dialogue, social co-production, and collective learning (Neuhoff et al., 2023).	Stakeholder participation, public foresight, participatory scenario building.	Suitable for issues dependent on social acceptance and institutional coordination.	Time-consuming, difficulty of consensus, and potential for conflict among stakeholders.

Given the nature of the problem under study—namely, the structural complexity of resilience in Tehran Province, the multiplicity of stakeholders, conflicts of interest, and the high level of uncertainty—the use of scenario planning as the core approach of this research was considered essential. Scenario planning is employed not to predict a single definitive future, but rather to identify and analyze multiple logical and internally consistent futures and to enable the design of flexible and robust policies (Bradfield et al., 2005; Chakraborty & McMillan, 2015). This approach has been widely applied in urban studies, particularly where the future depends on the interaction of multiple variables and the behavior of diverse actors (Healey, 2009).

Among the schools of futures studies, the French School was selected for this research as it is not limited to scenario construction alone, but provides a coherent framework for problem structuring, actor analysis, scenario development, and policy evaluation (Godet, 1991, 1994, 1997). This approach enables the simultaneous examination of structural, institutional, and strategic dimensions of the problem by employing tools such as MICMAC for structural analysis, MACTOR for actor relationship analysis, and Multipol for multicriteria policy assessment (Arcade et al., 1999; Godet et al., 2007).

The selection of the French School is justified not only theoretically but also in terms of its methodological fit with the problem. Resilience in Tehran Province is not merely a physical or environmental issue, but a matter related to governance, actor relations, resource allocation, and policymaking under uncertainty. Therefore, an approach capable of examining key drivers, patterns of conflict and convergence, and robust strategies within a coherent analytical chain was necessary. From this perspective, the French School offers greater analytical capacity than single-method approaches for addressing the core research question (Godet & Roubelat, 1996; Bryson, 2004). Accordingly, the adoption of futures studies, and specifically the French School, represents not merely a methodological choice but a methodological response to the complex, multi-level, and uncertainty-driven nature of resilience in Tehran Province.

The statistical population of the study consisted of experts and managers associated with resilience in Tehran Province. Purposive sampling was employed initially, followed by snowball sampling to complete the expert panel by identifying individuals with both

theoretical knowledge and practical experience in decision-making and implementation. In this research, the quality of experts was considered more important than their quantity; therefore, participants were selected based on relevant academic qualifications, direct executive experience, and practical involvement in decision-making, implementation, and policy processes in Tehran Province. Ultimately, 20 experts participated in the Delphi process and multi-stage evaluations. Given the expert-based qualitative nature of futures studies and the attainment of theoretical saturation, this number was considered appropriate for the study (Hsu & Sandford, 2007; Nasa et al., 2021).

Table 3. Research process

Step	Method/tool	Goal	Input data	Execution process	Main output	References
Step 1	Structural analysis (MICMAC)	Identifying key drivers and levers of change in the system.	Upstream documents, theoretical background, expert opinions, and cross-impact questionnaire.	Extracting uncertainties and effective variables, determining direct and indirect relations, forming a cross-impact matrix, and performing structural analysis.	Identifying main drivers, key variables, relay variables, and dependent variables.	Godet, 1994; Arcade et al., 1999; Godet et al., 2007; Asan & Asan, 2007.
Step 2	Actor analysis (MACTOR)	Analyzing power, interests, conflict, and actor coalitions.	Actor questionnaire, data on stakeholder influence, conflict, and convergence.	Analyzing actor positions, examining cooperative and conflict relations, and processing coalition and veto power patterns.	Identifying facilitating and hindering actors, power map, and convergence/ divergence patterns.	Freeman, 1984; Godet, 1991; Godet et al., 1997; Kangas et al., 2003; Bryson, 2004.
Step 3	Scenario building (Scenario Wizard)	Formulating alternative futures and identifying logical decision-making paths.	Outputs of MICMAC and MACTOR, status of key variables, and actor positions.	Building consistent scenarios based on the combination of drivers and actor behavior, formulating future narratives.	Extracting desirable, probable, and critical scenarios.	Schwartz, 1996; Van der Heijden, 2005; Godet & Roubelat, 1996; Bradfield et al., 2005; Chakraborty & McMillan, 2015.
Step 4	Multi-criteria evaluation (Multipol)	Evaluating and prioritizing robust strategies.	Extracted strategies, criteria of effectiveness, compatibility, political friction, and adaptability.	Comparing and ranking strategies in different scenarios.	Selecting top strategies, no-regret actions, and robust options.	Godet, 1987; Belton & Stewart, 2002; Kangas et al., 2005; Lempert et al., 2003; Janssen, 2001.

The primary data collection instruments consisted of multi-stage expert questionnaires. The first questionnaire was designed for identifying and evaluating cross-impacts among variables, while the second focused on analyzing actor positions and conflicts. Additional questionnaires were later developed for scenario construction and multicriteria strategy evaluation. These instruments were progressively refined through iterative engagement with experts to improve consistency and precision.

To strengthen content validity, questionnaires and analytical frameworks were reviewed multiple times by experts and specialists. Instrument design and revisions were also examined by academic faculty members and practitioners familiar with the subject to ensure alignment between research instruments and the problem under investigation. For reliability assessment, expert agreement and internal consistency indicators were employed. The research reported a Kendall's coefficient of concordance of 0.71 and a Cronbach's alpha of 0.84, indicating acceptable expert agreement and satisfactory internal consistency according to conventional research standards (Schmidt, 1997; Tavakol & Dennick, 2011; Taber, 2018). In addition, iterative review, feedback loops with experts, and final specialist validation contributed to strengthening the credibility of findings.

Specialized futures studies and multicriteria software

were employed for analysis. MICMAC was used for structural analysis, MACTOR for actor analysis, Scenario Wizard for scenario development, and Multipol for strategy evaluation and prioritization. The use of these tools enabled systematic processing of expert-based data and moved the outputs beyond descriptive analysis toward strategic decision support. The main innovation of this study lies in applying the French futures studies framework in an integrated and sequential manner for the first time in examining resilience in Tehran Province. This integration enabled the study to move beyond variable identification and simultaneously analyze problem structure, power networks, future scenarios, and strategy prioritization. Therefore, the methodology represents not merely a descriptive method but an analytical-strategic framework for addressing wicked urban problems.

During implementation, expert participation was conducted with informed consent and under confidentiality protocols. Care was taken to avoid overgeneralization in data interpretation, and findings were interpreted solely within the institutional and geographical context of Tehran Province. Since the study was based on expert judgment and anticipatory analysis, its purpose was not to generate deterministic predictions, but rather to provide a framework for understanding problem structure, the logic of conflicts, and the design of robust strategies under uncertainty.

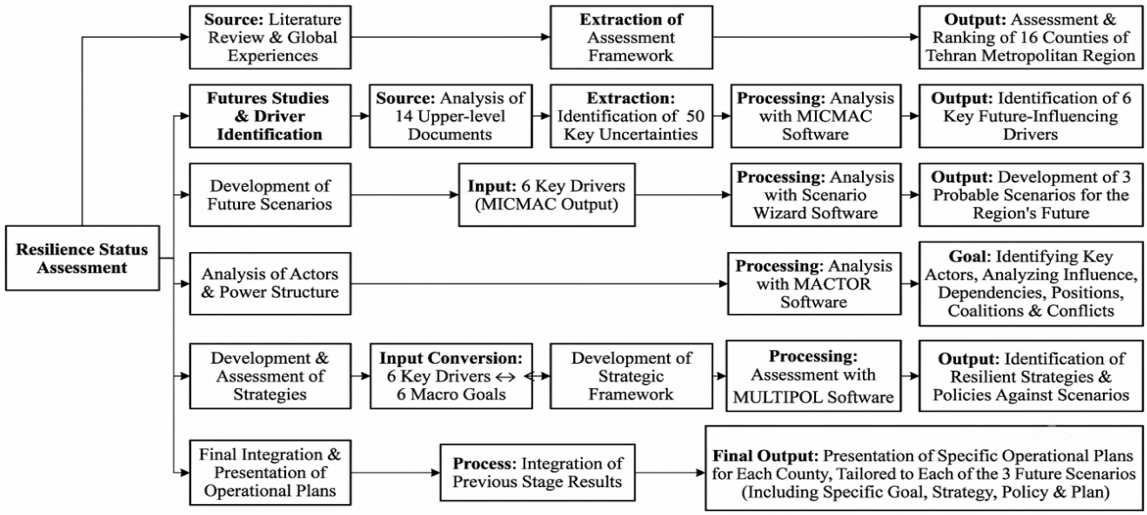

Figure 1 - Overall analysis process and findings (Source: Author)

5. Introduction of the study area

Tehran Province, based on the latest national divisions, with an area of 13,686 square kilometers (equivalent to 0.8 percent of the total area of the country), has the counties of Tehran, Rey, Shemiranat, Islamshahr, Damavand, Shahriar, Varamin, Firuzkuh, Pishva, Robat Karim, Pakdasht, Baharestan, Qods, Malard, Pardis, and Qarchak, comprising 44 cities, 23 districts, and 71 rural districts. According to the last population and housing census by the Statistical Center of Iran in 2016, Tehran Province had a population of 13,267,637, which includes about one-sixth of the country's population. Based on this census, nearly three-quarters of the population in the whole country has become urbanized; in this region, it has reached over 90 percent.

Figure 2- Location of Tehran Province on the map of the country (Source: Author)

6. Presentation of findings

6.1. Final list of uncertainties for structural analysis

Following the preceding discussions and the review of upstream documents, a set of key factors affecting the socio-economic resilience of the Tehran Province, whose future status faces ambiguity, was identified as uncertain. The transformations of these factors have significant impacts on the system, but their exact trajectory is unclear.

The final list of these uncertainties is applied as the primary input for the structural cross-impact analysis using MICMAC software. This analysis aims to identify key drivers (highly influential/highly dependent variables) to deeply understand system dynamics and determine leverage points in strategic planning. The identified uncertainties are:

- Sustainability and allocation method of water resources in the future.
- Efficiency and urban governance patterns.
- Composition of the country's energy portfolio and its security.
- Per capita destiny and quality of urban and open spaces.
- Resilience and productivity of agriculture and livestock against climate change.
- Accountability, financial sustainability, and equity in the future health system.
- Adaptability of the educational system to the future needs of the labor market and society.
- Trend of exploitation, degradation, or protection of natural resources.
- Quality and continuity of service provision and maintenance of urban infrastructure.
- Trend of air quality and success rate in controlling pollutants.
- Level and impact of genuine public participation in decision-making.
- Rate of protection, restoration, and economic status of cultural heritage in the future.
- Success rate and sustainability of local community empowerment programs.
- Rate of real growth and share of knowledge-based industries in the future economy.
- Frequency, intensity, and type of future crises.
- Future survival, competitiveness, and the role of productive workshops in the national value chain.
- Level of preparedness and efficiency of the country's crisis management system.
- Trend of reduction or exacerbation of socio-economic inequalities.
- Role and amount of oil revenues in the country's budget and economy.
- Rate of development, efficiency, and public reception of public transportation in the future.

- Trend of growth and depth of transformation and complementary industries.
- Quality, adequacy, and balanced development of transport infrastructure.
- Composition, volume, and balance of the country's trade in the future.
- Pace of progress and depth of IT penetration in various sectors of the country.
- Level of immunity and resilience of critical infrastructure against threats.
- Intensity and extent of consequences of droughts and land subsidence.
- Future trend of population concentration in metropolitan areas and their margins.
- Future trajectory of cultural policymaking and the vitality of the culture and arts sector.
- Success rate and effectiveness of urban and regional development plans in the future.
- Rate of development and equitable distribution of sports and championship infrastructure.
- Level of synergy and cooperation among governmental and public institutions.
- Future trend of spread and control of social harms.
- Trend of expansion or organization of informal settlements.
- Growth and boom of the tourism industry and its place in the national economy.
- Quality of management and specialized allocation of lands for future urban development.
- Effectiveness and effective communication of scientific and applied centers with industry and society.
- Rate of attraction, security, and volume of domestic and foreign investment.
- Quality of legislation, management, and impacts of cyberspace on society.
- Trend of national competitiveness and productivity indicators.
- Quality, level, and nature of Iran's interactions with the world in the future.
- Future status of sanctions and their impact on the economy and society.
- Future trends of domestic migration and elite/labor emigration abroad.
- Future unemployment rate and the ability of the economy to create sustainable employment.
- Financial stability, adequacy, and expansion of social security coverage.
- Future trend of inflation and household purchasing power.
- Ability to respond to housing demand and future housing prices.
- Preparedness and vulnerability of the country against potential massive earthquakes.
- Level of readiness, efficiency, and modernization of defense and security facilities and equipment.
- Success rate in implementing integrated waste and sewage management.
- Pace, quality, and renovation pattern of distressed urban fabrics.

As noted, this set of fifty uncertainties will form the basis of future analyses in the MICMAC software to identify highly influential and highly dependent variables (drivers and key dependent variables) in the socio-economic resilience system of the Tehran Province. The results of this analysis will be presented in the next section.

6.2. Structural analysis of the system and identification of key drivers

The cross-impact matrix analysis in this research indicated that the resilience system of the Tehran Province is in a state of structural instability. An examination of the scatter plot of influence and dependence of variables reveals that most key variables are concentrated in the northeast quadrant of the graph (the critical and risk zone). The high density of direct and indirect relationships in this quadrant signifies that the system has a high coefficient of variability, and any minor change in the drivers located in this area will lead to severe fluctuations throughout the system. Based on the position analysis of variables on the coordinate plane, variables such as water resources and public transportation development have taken their place in the northwest quadrant (driver zone), acting as determining and leverage elements in the system. Conversely, variables for housing, health system, urban services and infrastructure, and investment are located in the northeast quadrant (dual/risk zone), indicating their connective nature; meaning these factors simultaneously exert strong influence on system dynamics while being heavily influenced by changes in other variables, demonstrating inherent complexity and high potential for instability in Tehran.

Analyzing graphs of hidden, long-term direct and indirect relationships revealed systemic insights. The potential direct impact graph, with a dominance of strong lines and high density, illustrates the severe sensitivity of the system and rapid chain reactions among variables. In this dense network, certain variables act as focal points. Health and sanitation system variables, living costs, and urban services have strong outward lines, playing an effect-distributing

role. In contrast, variables like public participation and distressed fabrics are predominantly recipients of strong direct impacts from other factors. Furthermore, the indirect graph analysis revealed a meaningful and strong relationship between defense-security facilities and living costs, which was not observable in direct relationships. Moreover, the housing variable has high centrality in the indirect graph, acting as a key node with a dual role (influential and dependent).

Examining the displacement map and system stability analysis shows that the output or resultant variables of the system, including crisis management and population concentration, are located in the southeast quadrant and are considered a function of the performance of other sectors. A notable point in the analysis of the southwest quadrant (independent or marginal variables zone) is the placement of variables like sanctions, indicating that these factors, despite perceived subjective importance, play a lesser structural determining role in Tehran's internal resilience structure compared to internal variables.

Ultimately, based on quantitative criteria (location in the northeast quadrant and possessing high influence and dependence indices), the 50 initial variables were filtered, and 6 selected key driver categories were extracted, considering the driving engines for the region's future:

Drivers in the domain of industrial and economic development (like the growth of complementary industries and production workshops), 2) Drivers in the domain of social transformation and housing (with an emphasis on economic inequalities and housing demand), 3) Drivers in the domain of culture and education, 4) Drivers in the domain of physical and virtual infrastructure (quality of transport and service distribution), 5) Drivers in the domain of health and environment (pollutants and health equity), and 6) Drivers in the domain of security and defense (civil defense and critical facilities). This categorization serves as the primary basis for scenario planning in the subsequent stages of the research.

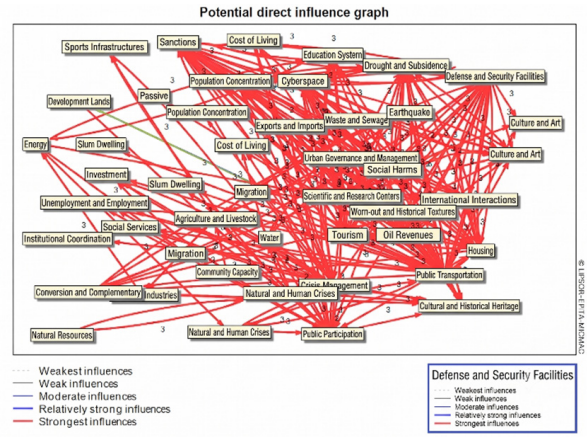

Figure 3. Graph of potential direct influence

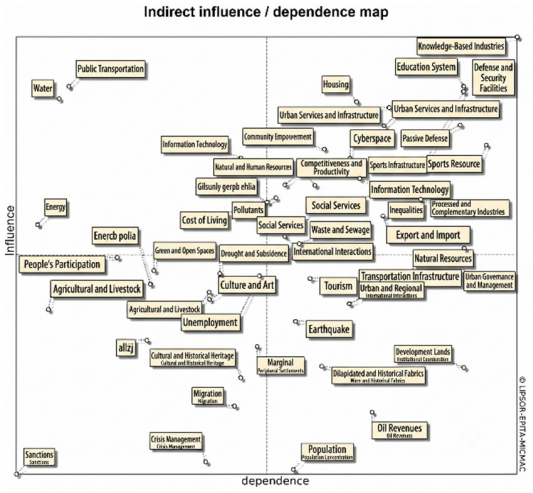

Figure 4. Map of indirect influence/dependence

The process of reducing the 50 initial variables to 6 final key axes for scenario planning was carried out based on a two-stage decision-making algorithm to prevent scenario inflation and focus on drivers possessing the greatest future-altering power. This selection was based on the following criteria:

Only variables were nominated for the final stage that were positioned in the northeast quadrant (dual and risk zone) in the direct and indirect impact analysis. Specifically, the condition for entry was possessing a total influence index higher than the system average and simultaneously having a high instability/ dependence index. This characteristic indicates that the mentioned variable is both a system driver and highly susceptible to changes itself (inherent uncertainty).

Finally, to avoid excessive complexity of the model in the Scenario Wizard software, statistically Correlated variables were merged based on cluster analysis. For instance, variables of complementary industry growth, knowledge-based production, and productivity, due to high statistical correlation, were aggregated into a single macro-axis titled industrial and economic development.

Table 4. Selected key drivers

1. Drivers in the domain of industrial and economic development:	2. Drivers in the domain of social transformation and housing:
• Growth trend and depth of complementary and transformation industries. • Future survival, competitiveness, and role of production workshops in the national value chain. • Actual growth rate and share of knowledge-based industries in the future economy. • Future trend of national productivity and competitiveness indicators.	• Future trend of reduction or exacerbation of economic and social inequalities. • Ability to respond to housing demand and future housing price conditions. • Financial stability, adequacy, and extent of social security coverage. • Success rate and sustainability of local community empowerment programs.
3. Drivers in the domain of culture, education, and research:	**4. Drivers in the domain of physical and virtual infrastructure:**
• Future trajectory of cultural policy-making and the vitality of the culture and arts sector. • Adaptability of the educational system to the future needs of the labor market and society. • Effectiveness and active connection of scientific and applied centers with society.	• Quality and continuity of service provision and maintenance of urban infrastructure. • Rate of development and equitable distribution of sports and championship infrastructure. • Quality of legislation, management, and impacts of cyberspace on society.
5. Drivers in the domain of health and environment:	**6. Drivers in the domain of security and defense:**
• Trend of air quality and success rate in controlling pollutants. • Accountability, financial sustainability, and equity in the future health system.	• Level of immunity and resilience of critical infrastructure against threats. • Level of readiness, efficiency, and modernization of defense and security facilities.

6.3. Identification and analysis of key actors influencing regional resilience

Following the identification of key drivers, the next step is analyzing the actors influencing these drivers and related objectives to understand the distribution of power, alliances, and conflicts. For this purpose, the MACTOR software was utilized, and input data was collected through expert opinions and document reviews. In this process, a broad spectrum of actors, including governmental (national and local), public, semi-state, private, and civil society entities, were identified. A precise understanding of these actors to comprehend the power dynamics in the system is essential, and their diversity reflects the complexity of the decision-making system and the necessity of incorporating various interests and perspectives in strategic planning for regional resilience.

Table 5. Categorization of key actors

Actor type	Key actors
State	Tehran Governorate, Islamic City Council of Tehran, Tehran Municipality and other municipalities, Ministry of Interior, Plan and Budget Organization, Ministry of Roads and Urban Development, Ministry of Economic Affairs and Finance, Ministry of Cooperatives, Ministry of Energy, Ministry of Health, Ministry of Industry, Mine and Trade (MIMT), Ministry of Agriculture Jihad, Law Enforcement Force (Police), Islamic Revolutionary Guard Corps (IRGC), Judicial Institutions
Public & semi-state	Utility organizations (Water & Wastewater, Electricity), special economic zones, industrial estates, Science and Technology Parks, universities and research centers, NGOs
Private	Chamber of Commerce, large corporate unions (automotive, petrochemical), the Bazaar, banks, startup companies, and venture capitalists
Civil & social	Students, youth, retirees, religious institutions, media, cultural activists, artists, Tehran citizens, and residents of provincial counties

6.4. Actor analysis and configuration of force fields

The analysis of power dynamics began by identifying and classifying key actors into four groups: state, public/semi-state, private, and civil. Based on influence and dependence maps, the main system actors were divided into three categories: Relay or linking actors, which include the Plan and Budget Organization, Tehran Governorate, Tehran Municipality, and residents of other counties; this group possesses simultaneous high influence and dependence,

indicating their central role in transmitting pressures and decisions within the system. Conversely, actors such as the Ministry of Cooperatives, Labor, and Social Welfare, the Ministry of Health, and the universities were categorized as dominant or determining actors (high influence and low dependence). Furthermore, religious institutions, guilds, and law enforcement forces fell into the dependent actors category. Analysis of competitiveness indices showed that the Plan and Budget Organization and Tehran Governorate, scoring the highest (1.3 and 1.2, respectively, in the MMDI index), have the greatest potential to mobilize resources and exert power in the system. A crucial point in this section is the high score of Tehrani citizens and county residents in the mobilization index (MMDI: 1.2), indicating the high capacity of this group to influence power equations despite the lack of formal structures.

Table 6. System actors studied

Actor categorization	Characteristics (influence/ dependence)	Example actors
Relay/linking actors	High influence / high dependence	Plan and budget organization, Tehran Governorate, Tehran Municipality, and residents of other counties in the province.
Dominant/determining actors	High influence / low dependence	Ministry of Cooperatives, Labor, and Social Welfare, Ministry of Health, Medical Education (and provincial medical universities), Science and Technology Parks, and Innovation Centers based in Tehran.
Dependent actors	Low influence / high dependence	Religious and clerical institutions, trade unions and professional associations, cultural and social activists, law enforcement, and other security and judicial institutions.

Analysis of actor positionings regarding key objectives revealed a deep rift in regional development priorities. While economic and infrastructural objectives are heavily supported by state institutions (Governorate, Municipality, Ministry of Roads, and Plan Organization), they face serious and widespread opposition from other actors. Specifically, the infrastructural development objective encounters the highest volume of opposition from actors (such as Law Enforcement, IRGC, Banks, and NGOs), indicating a lack of consensus on large-scale civil projects. Conversely, social and health objectives pursued by welfare ministries and universities face opposition from economic and security actors. The distance graph between objectives clearly shows that the infrastructural objective is placed at a significant distance from the other three objectives (economic, social, and health), illustrating an inherent conflict between physical development and other dimensions of resilience from the actors' perspectives.

Table 7. Analysis of convergences and divergences

Analysis type	Blocs and key relationships
Convergences (potential alliances)	Security-traditional-economic bloc: Strong convergence among the Islamic Revolutionary Guard Corps (IRGC), law enforcement, mosques, the bazaar, and merchants. Civil bloc: Strong convergence between students and social activists. Developmentalist-executive bloc: Strong convergence among developmentalist ministries (Economy, Interior, and Roads Ministries) and executive institutions (Governorate and Municipality).
Divergences (main conflicts)	Strong conflict between state institutions and traditional/security institutions: Plan and Budget Organization ↔ mosques and IRGC Strong conflict between state institutions and civil society: • Governorate ↔ mosques and social activists • Municipality ↔ students and activists Other notable conflicts: Ministry of Health ↔ bazaar and merchants.

Analyzing convergence and divergence graphs led to the identification of three main and distinct power blocs in Tehran's governance space: 1) The traditional-economic bloc, resulting from strong convergence among the IRGC, law enforcement, mosques, bazaar, and Merchants; 2) The civil bloc, comprising students, social activists, and NGOs; and 3) The developmentalist-executive bloc, formed from convergence among economic ministries (Economy, Roads), the Governorate, and the Municipality. Findings from the

divergence analysis show major conflicts between state institutions and civil society, the Governorate and mosques/social activists, and the Municipality and students. This configuration of forces has created a state reminiscent of institutional lock-in and fragmented governance. In this state, none of the blocs possesses absolute power to advance their programs. However, all hold veto power against the opposing party's programs, which constitutes the main barrier to forming integrated urban management.

Table 8. Analysis of actor positions relative to key objectives

Objective	Strong supporters	Strong opponents
Economic	Ministry of Interior, Plan Organization, Ministry of Economy, Ministry of Cooperatives, Students	Ministry of Health, Law Enforcement, IRGC, Engineering Organization, media, mosques, social activists, and retirees
Infrastructural	Governorate, Council, Municipality, Plan Organization, Ministry of Roads	Ministry of Cooperatives, Ministry of Health, Law Enforcement, IRGC, Bazaar, banks, Innovation Centers, mosques, and retirees
Health	Governorate, Municipality, Plan Organization, Ministry of Cooperatives, Ministry of Health, NGOs	Law Enforcement, IRGC, Bazaar, startups, media, social activists
Social	Plan Organization, Ministry of Cooperatives, Ministry of Health, universities, and students	Ministry of Energy, Law Enforcement, IRGC, Bazaar, banks, mosques, and retirees

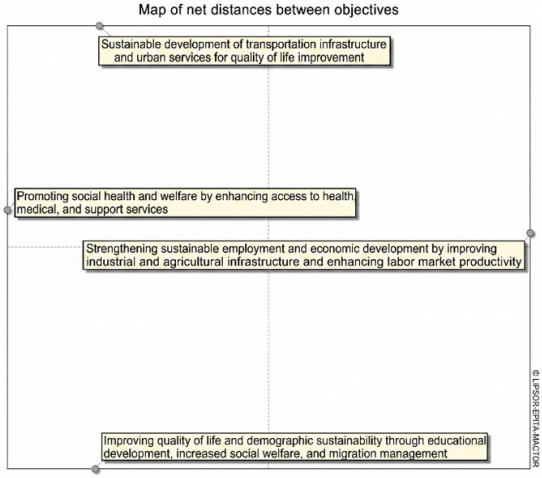

Figure 6. Net distances graph between objectives

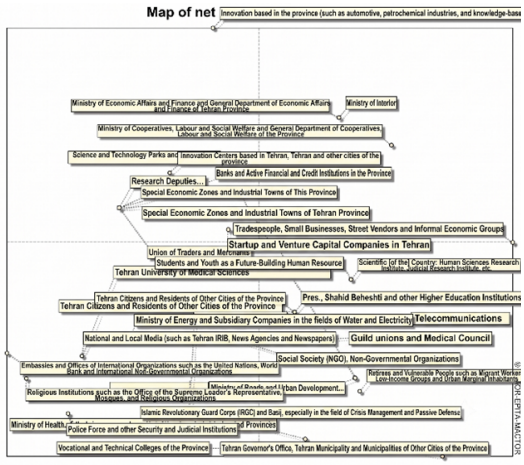

Figure 5. Net distances graph between actors

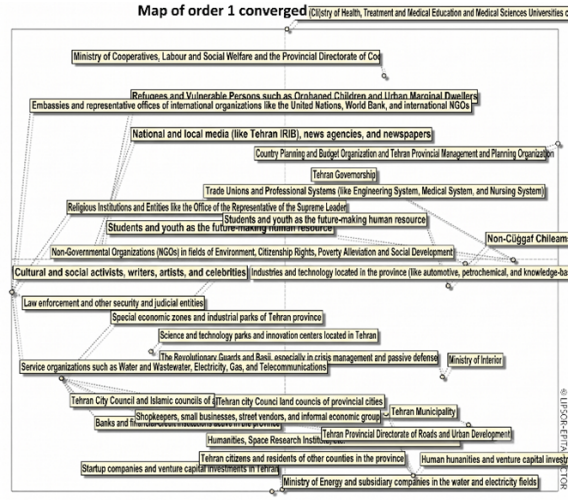

Figure 8. Convergence map between actors

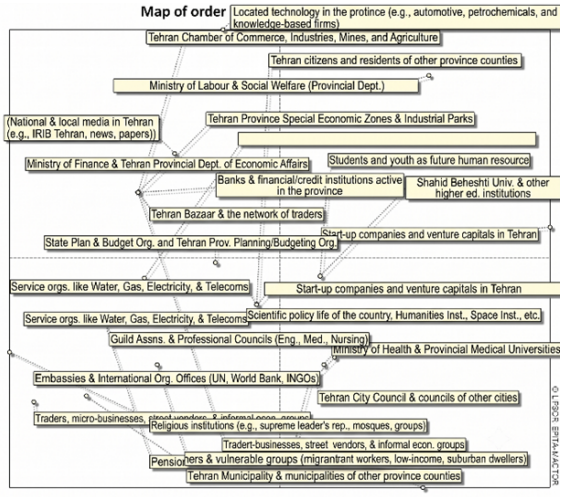

Figure 7. Divergence map between actors

6.5. Development and analysis of future scenarios

Following the identification and analysis of key drivers and actors influencing the region's resilience system, in this stage of the research, to understand alternative futures and create preparedness to face uncertainties, a scenario-based planning method utilizing Scenario Wizard software was employed. This software applies CIA to evaluate the consistency and probability of occurrence for various combinations of future driver states and identifies consistent and probable scenarios. The current analysis is presented based on the software output for the cross-impact matrix.

Selection and description of selected key drivers for scenario planning

Future resilience scenarios for the Tehran Province have been developed based on a set of selected key development drivers. These drivers, identified and introduced in the previous section based on the MICMAC software outputs, are the most important and influential factors that will shape the region's future. These key drivers were categorized into six main thematic groups as follows:

- Industrial and economic development: including (transformation and complementary industries, production workshops, knowledge-based industries, competitiveness, and productivity).
- Social transformation and housing: including (inequalities, housing, social services, local community empowerment).
- Culture, education, and research: including culture and arts, the educational system, and scientific and research centers.
- Physical and virtual infrastructure: including services and infrastructure, sports infrastructure, and cyberspace.
- Health and environment: including pollutants, health, and sanitation.
- Security and defense: including (civil defense and defense facilities).

For each of these key drivers (as a composite of them within each of these six main dimensions), various and probable future states (like desirable state, continuation of current trend state, and undesirable state) were defined and formulated. Then, the extent and manner of mutual impacts of these drivers and their various states on one another were determined through expert judgments and the formation of a cross-impact matrix, provided as input to the Scenario Wizard software. By analyzing this matrix, the software identified consistent and probable scenarios. In the continuation of this section, an analysis of the characteristics and consequences for each of the three resulting scenarios will be presented.

Scenario one: sustainable and advanced future (desirable scenario)

This scenario, named the Sustainable and Advanced Future, has a weight of 364 and a consistency value of 5, indicating the high internal coherence of its components. A total impact score of 66 for this scenario indicates that realizing it requires fundamental and extensive changes in the system. In this future, the Tehran region will transform into a green and sustainable industrial hub, focusing on modern technologies. From a social and housing perspective, the development of equity-centered satellite cities aiming to reduce inequality and improve the quality of life has been achieved. Culturally, an innovative and dynamic ecosystem is formed through the support of creativity. In the realm of infrastructure, the comprehensive development of a smart city with efficient and sustainable access to services is provided. Furthermore, the environmental status moves towards becoming a green metropolis with near-zero pollution, prioritizing resource protection, and regional security is ensured by achieving a high level of urban and social security. This scenario depicts a utopian vision of perfect harmony among actors and the management of conflicts.

Table 9. Analysis of scenario number 1: Sustainable and advanced future

Title	Description
Scenario name	Sustainable and advanced future
Key features	Weight: 364
Industrial and economic dimension	Focus on green and sustainable technologies and the region's transformation into a leading industrial hub.
Social and housing dimension	Development of equity-centered satellite cities to reduce inequality and improve the quality of life.

Title	Description
Cultural, educational, and research dimensions	Creation of an innovative and dynamic ecosystem emphasizing applied research and support for creativity.
Infrastructure dimension	Comprehensive development of a smart and sustainable city with modern, efficient, and accessible infrastructure.
Health and environmental dimension	Transformation into a green metropolis with near-zero pollution and prioritizing resource protection.
Security and defense dimension	Achieving a high level of urban and social security alongside cyber defense and advanced crisis management.
Consequences and interpretation	This scenario portrays a utopian and desirable urban future, the realization of which requires precise policymaking, massive investment, and perfect synergy among all actors.
Challenges and probability of occurrence	Despite high consistency, its natural probability of occurrence (without targeted and extensive interventions) is very low, making it evaluated as more challenging than a crisis scenario.

Scenario two: Collapse and crisis (probable/crisis scenario)

The second scenario, titled collapse and crisis, although sharing the same weight of 364, holds a consistency value of 8 (the highest degree of internal consistency for occurrence). An impact score of 52 in this scenario shows that reaching a state of collapse requires fewer changes for the system compared to the desirable scenario, making this trajectory more compatible with the system's inertia. In this dystopian image, the region faces deep structural stagnation in industries, a severe crisis in resource supply, and declining investment. The class divide and societal polarization have reached their peak, leading to the formation of widespread informal settlements. The educational and cultural systems suffer a collapse, with a severe drop in research investment. Critical infrastructures (transport, energy, and water) face extensive dilapidation and functional collapse. Environmentally, widespread disasters such as severe air and water pollution and disease outbreaks occur, and in the security domain, social and economic insecurities have intensified. The article emphasizes that, given the divergence of actors in the MACTOR section, the probability of this scenario occurring if current trends continue is very high.

Table 10. Analysis of scenario number 2: Future of collapse and crisis

Title	Description
Scenario name	Collapse and crisis
Key features	Weight: 364
Industrial and economic dimension	Deep structural stagnation in industries, severe crisis in resource supply, and decreased investment.
Social and housing dimension	Severe exacerbation of class divide and societal polarization, widespread housing crisis, and increased informal settlements.
Cultural, educational, and research dimensions	Collapse of the educational system and declining quality, cultural stagnation, and a severe drop in research investment.
Infrastructure dimension	Widespread dilapidation and collapse of critical infrastructures (transport, energy, water) and widening digital divide.
Health and environmental dimension	The occurrence of widespread environmental disasters (severe air and water pollution) and health crises (disease outbreaks).
Security and defense dimension	Significant increase in social and economic insecurities and escalation of tensions and security crises.
Consequences and interpretation	This scenario depicts an urban dystopia where crises mutually reinforce each other in a negative domino effect, leading to systemic collapse.
Warning and probability of occurrence	Very serious warning: This scenario not only has very high internal consistency but is evaluated in other analyses as the most probable and influential future, highlighting the necessity for immediate preventive actions.

Scenario three: Uneven development and fragile resilience (intermediate scenario)

This scenario holds a medium weight, reflecting the unstable and suspended state of the system. The main characteristic of this scenario is the presence of internal contradictions; a fragile balance exists in some sectors (like traditional industries versus modernity), but innovation is declining. In the social sphere, relative improvements are seen in remaining housing challenges, but access remains unequal and unjust. Culturally, there is a one-dimensional focus on technological innovation, which has led to a weakness in enhancing cultural identity. Infrastructure development occurs unevenly in a patchwork manner; some areas enjoy modern facilities while others lag. General health status has improved, but serious challenges like air pollution and dilapidated vehicles persist. In the security domain, the level of security has improved, but vulnerabilities and the need to upgrade defense systems remain. This scenario is a symbol of fragile resilience where the system neither completely collapses nor achieves sustainability, but continues to survive through ad-hoc crisis management.

Table 11. Analysis of scenario number 3 (intermediate): Uneven development and fragile resilience

Title	Description
Scenario name	Muddling through
Key features	Qualitative nature: This scenario lacks distinct quantitative scores (weight, consistency) and aligns with scenarios having weak consistency and medium weight. Main characteristic: Simultaneous presence of progress in some sectors and stagnation or regression in others, leading to internal tensions.
Industrial and economic dimension	Unstable equilibrium between tradition and modernity: Traditional and knowledge-based industries coexist, but unsustainable innovation leads to a gradual decline in competitiveness and economic fluctuations.
Social and housing dimension	Relative improvement with remaining challenges: Relative improvement in housing due to targeted policies occurs, but unequal access and challenges persist in some areas.
Cultural, educational, and research dimensions	One-dimensional focus on technology: Technological innovation grows, but this focus leads to a decrease in cultural diversity and a weakness in enhancing cultural identity.
Infrastructure dimension	Uneven and patchwork development: Some regions possess modern facilities, while others lag, leading to a deep divide in service quality.
Health and environmental dimension	Relative improvement in health: Public awareness improves health status, but serious challenges like air pollution and dilapidated vehicles remain.
Security and defense dimension	Relative security despite problems: Security level is improved, but vulnerabilities and the need to upgrade defense systems still exist.
Consequences and interpretation	A future that neither achieves desirable goals nor completely collapses; a state of isolated advancements and chronic challenges.
Main consequences	• Continuation of social and economic inequalities. Fragility of resilience against new crises. Constant need for crisis management instead of prevention. • Potential for public fatigue and frustration in society.

6.6. Multi-criteria analysis and identification of robust strategies

In the final step, to identify optimal policies for facing future uncertainties, an analysis of mutual relationships among scenarios, macro-objectives, and executive actions was performed using the Multipol method. The decision matrix comprised three main scenarios (S1: “Conflict and Instability/Crisis”, S2: “Stagnation and Decline”, S3: “Progress and Success”), 10 macro-objectives (P01 to P10), and 50 executive actions. This analysis aims to measure the degree of adaptability and efficiency of proposed actions in each of the probable scenarios and identify robust strategies.

Table 12. Macro objectives, strategies, and policies

Category	Code	Description
Macro scenario	S1	Scenario 1 (conflict and instability): Represents a future with major challenges and high uncertainty.
	S2	Scenario 2 (stagnation and decline): Shows downward trends and a lack of progress.
	S3	Scenario 3 (progress and success): Depicts a desirable future fulfilling development goals.
Macro objective	C1	Industrial, economic, and technological development.
	C2	Social, housing, and welfare development.
	C3	Educational, cultural, and research development.
	C4	Infrastructure development (transport, energy, communications, and urban services).
	C5	Environmental improvement and sustainable development.
	C6	Improvement of security, defense, and crisis management.
Strategy (macro policy)	P01	Creation and strengthening of regional industrial, technological, and innovation hubs.
	P02	Improvement of the business environment and investment attraction.
	P03	Strengthening the link between science, industry, and society.
	P04	Balanced distribution of basic services and sustainable housing.
	P05	Socio-economic empowerment of local communities.
	P06	Balanced and qualitative development of educational, research, and cultural systems.
	P07	Integrated and smart development of critical infrastructure.
	P08	Environmental protection and promotion of regional sustainable development.
	P09	Enhancement of preparedness, resilience, and integrated crisis management.
	P10	Strengthening civil defense and regional security (physical and cyber).

Clustering analysis and policy proximity

Analyzing the action/policy proximity map, which visualizes spatial synergies among strategies and actions, led to the identification of homogeneous policy clusters. Findings indicated that actions related to industrial and innovative development are clustered near economic strategies (like P01: Creating industrial hubs and P02: Improving the business environment), demonstrating high coherence within the economic policy package. This visual tool aided policymakers in extracting more cohesive operational packages from the long list of 50 actions. Priority actions were divided into three categories: 1) Desirable and robust actions like A28 (preparation and implementation of a comprehensive integrated and smart critical infrastructure plan) and A34 (creation and development of a single-window digital service portal); 2) Desirable but sensitive actions requiring adaptability, like A02 (creation and development of specialized industrial estates) and A01 (targeted spatial planning for zoning); and 3) Undesirable and sensitive (high-risk) actions like A15 (implementation of empowerment programs for vulnerable groups) which could yield counterproductive results if improperly executed.

Table 13. Robust and adaptive policy priorities

Action categorization	Example actions
Desirable and robust (resistant) actions	A28 (preparation and implementation of comprehensive integrated and long-term provincial critical infrastructure plan), A34 (creation and development of single-window provincial digital services platforms), A33 (drafting roadmap and implementation of urban and regional smart management system), A11 (execution of sustainable, smart, and affordable housing development plans), A17 (development of new technology applications to improve access and quality of social services), A12 (integrated housing, employment, and services planning), A03 (revitalization and reactivation of dormant industrial zones), and A19 (development of digital infrastructure and digital literacy in underprivileged areas).

Action categorization	Example actions
Desirable but sensitive actions (requiring adaptability)	A02 (creation and development of specialized industrial estates and science and technology parks), A46 (execution of continuous retrofitting programs and enhancing resilience of critical infrastructure and communities), A01 (spatial planning and targeted site selection for industrial and innovative hubs), A10 (mandate and support for upgrading technologies and advanced standards in industries), A04 (allocation of special zones for green and knowledge-based industries), A08 (targeted strengthening of value chains and transformation/complementary industries), and A05 (drafting and executing regional competitiveness policies).
Undesirable and robust actions	A30 (development of integrated sustainable public transport network), A35 (Continuous improvement in the quality of basic urban services), A31 (development of clean transport infrastructure), A18 (creation and strengthening of smart support platforms and networks), A06 (design and provision of regional support packages), A41 (drafting and executing comprehensive provincial waste management plan), A37 (execution of comprehensive and integrated water and soil resource management programs), A16 (support for the creation and strengthening of civil society institutions), and A36 (determination, zoning, and implementation of strict protection regulations for sensitive environmental areas).
Undesirable and sensitive actions (high risk)	A15 (execution of targeted socio-economic empowerment programs for local communities), A20 (review and balanced spatial distribution of educational, cultural, and artistic centers), A24 (support for the creation and operation of diverse cultural and artistic infrastructures and spaces), A25 (execution of cultural heritage preservation, restoration, and promotion programs), A47 (execution of comprehensive program for enhancing cybersecurity and infrastructure stability).

Scenario profile analysis and action performance

Performance evaluation of five selected key actions (A09, A06, A05, A03, and A02) across three future scenarios was conducted via the scenario profile map. Results showed that the prevailing scenario heavily influences the performance of all actions, such that all options had their best performance in S3 and their weakest performance in S1. However, relative comparison of actions contained a strategic insight: Action A02 (creation and development of specialized industrial estates and science and technology parks) achieved the highest performance score relative to other options across all scenarios, even under crisis conditions. This characteristic positions A02 as a robust and highly prioritized policy. Conversely, Action A09 (strengthening systemic links between universities and industry) showed the greatest performance drop and vulnerability in undesirable scenarios (S1 and S2), indicating its high sensitivity to environmental conditions. Final ranking of actions based on performance stability across all scenarios was extracted as A02, A03, A05, A06, and A09.

Table 14. Robust and adaptive strategies and policies

Strategy category	Example strategies
Desirable and robust strategies (resistant)	P07 (integrated and smart development of critical infrastructure), P03 (strengthening the link between science, industry, and society), P04 (balanced distribution of basic services and sustainable housing), and P06 (balanced and qualitative development of educational, research, and cultural systems).
Desirable but sensitive strategies (requiring adaptability)	P01 (creation and strengthening of regional industrial, technological, and innovation hubs), P02 (improvement of business environment and investment attraction), and P05 (socio-economic empowerment of local communities).
Undesirable and sensitive strategies (non-resistant with low adaptability)	P09 (enhancement of preparedness, resilience, and integrated crisis management), P10 (strengthening civil defense and regional security), and P08 (environmental protection and promotion of regional sustainable development).

Classification of robust and sensitive strategies

The final sensitivity analysis resulted in categorizing macro strategies based on two indices: risk and effectiveness. Desirable and robust (resistant) strategies, including P07 (integrated and smart development of critical infrastructure), P03 (strengthening the link between science, industry, and society), and P04 (balanced distribution of services). These strategies maintain their effectiveness across all scenarios and are recognized as adaptive options. Desirable but sensitive strategies (requiring adaptability), including P01 (creation and strengthening of industrial and technological hubs) and P02 (improvement of the business environment). These strategies are highly effective in the success scenario but require revision and operational flexibility under

crisis conditions.

Undesirable and sensitive strategies (high risk), including P09 (enhancement of preparedness and integrated crisis management) and P10 (strengthening civil defense). The placement of these items in the undesirable category does not mean they are unimportant but rather indicates that under current conditions and considering the power structure (MACTOR analysis), these strategies face severe implementation barriers, have a low chance of success, and investing solely in them carries high risk. Therefore, the final output of the Multipol analysis suggests that planning focus should primarily be on the first category of actions (smart infrastructure and knowledge-based economy), which are simultaneously desirable and robust against future fluctuations.

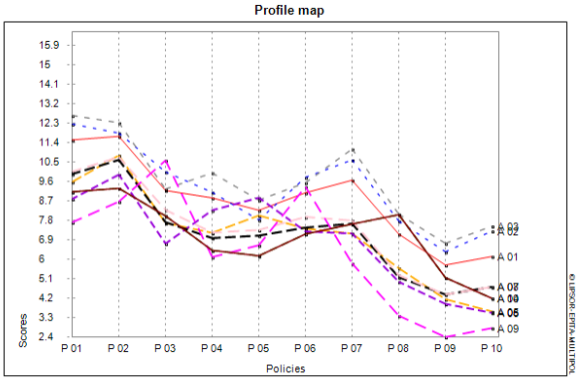

Figure 10. Scenario profile map

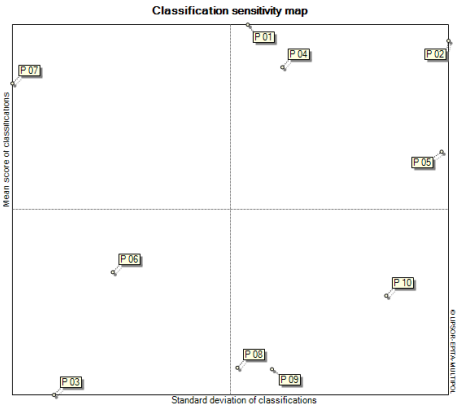

Figure 9. Sensitivity classification map of strategies

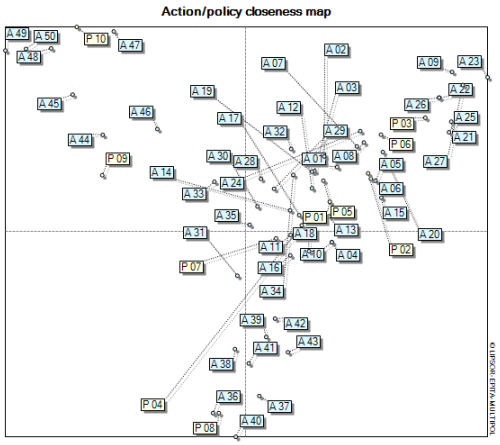

Figure 12. Action/policy closeness map

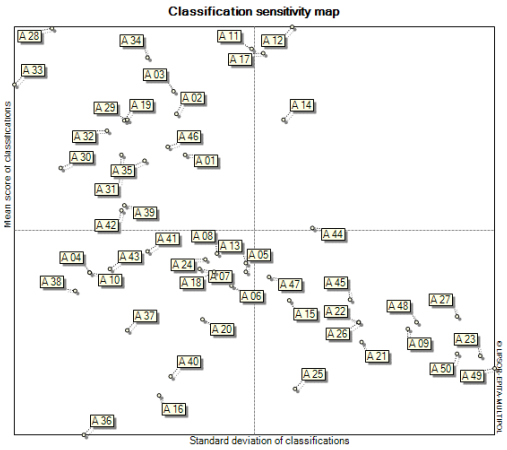

Figure 11. Classification sensitivity map

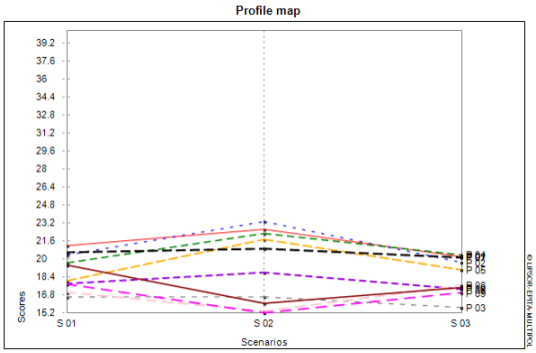

Figure 13. Scenarios profile map

7. Discussion

The findings of this study indicate that resilience in Tehran Province is not constrained by a simple shortage of physical infrastructure or financial resources but rather is shaped by deep structural instability and persistent conflicts among actors. Structural analysis applying MICMAC revealed that six major drivers—economic development, socio-residential transformation, infrastructure systems, culture-education-research, health and environment, and security—play a decisive role in shaping the province's future. At the same time, the distribution of power among the state bloc, social institutions, and other actors tends to steer the system toward crisis-oriented and collapse-prone scenarios. In this context, MACTOR analysis demonstrated that the Tehran problem extends beyond technical management or resource allocation and should instead be understood as a governance problem characterized by conflict and institutional lock-in, where imbalances in power distribution and divergent interests constrain the adaptive capacity of the metropolitan system.

The interpretation of these results suggests that, under conditions of high conflict, successful strategies are those that generate lower political friction and can create at least minimal convergence among powerful actors. The higher ranking of strategies such as knowledge-based economic development and smart infrastructure management confirms this point. Therefore, resilience in Tehran appears to depend less on expanding technical capacities than on mechanisms of negotiation, alignment of interests, and reduction of institutional conflict. In other words, when crisis scenarios gain greater probability in foresight analyses, the cause is not merely the intensity of external pressures, but the inability of governance structures to transform threats into coordinated action. This finding aligns with recent resilience theories that emphasize the political, institutional, and interactive nature of resilience and demonstrates that resilience cannot be understood solely at the level of infrastructure or physical performance.

The results are consistent with the theoretical foundations of evolutionary resilience while advancing them from a descriptive to an explanatory level. While Holling conceptualized resilience primarily as the capacity to absorb shocks and return to equilibrium, more recent perspectives, such as those proposed by Davoudi and colleagues, frame resilience as a dynamic process of change, learning, and continuous adaptation. The findings of this study support this perspective, showing that Tehran is not in a stable equilibrium but rather functions as a complex adaptive system in which change in one domain rapidly spills over into others. Accordingly, resilience in Tehran should be interpreted not as a return to a previous state, but as the continual reconfiguration of structures and power relations. This interpretation is consistent with complex adaptive systems theory and critiques of engineering-based resilience.

From a comparative perspective, the findings overlap with prior domestic studies while adding an important analytical layer. For example, Farhadi et al. (2022), in their study of Tehran's physical resilience, identified variables such as emergency evacuation capacity, relief spaces, building retrofitting, and urban permeability as key determinants. While this aligns with the present study in identifying urban instability, the main difference lies in the argument that such physical instability is itself a manifestation of deeper political-institutional instability. Thus, whereas many previous studies focused on consequences, the present research addresses root causes.

Similarly, Ghasemi et al. (2025) identified regulatory fragmentation, weak monitoring systems, and fragmented governance as barriers to adaptive capacity in Tehran. The present study is consistent with these findings. However, it extends them by demonstrating that institutional fragmentation is not merely a managerial deficiency, but part of a broader configuration of power and interests that generates decision-making lock-in. Rather than only identifying governance weakness, this research explains the mechanisms through which that weakness is produced.

Comparison with Moradi Sangachini et al. (2025) also reveals both convergence and advancement. Both studies emphasize the importance of foresight and identifying key drivers in Tehran. However, while their work focused on identifying the drivers shaping future development, the present study goes further by incorporating actor conflicts, power coalitions, and the logic of institutional blockage into the analysis. If their study addressed the question "what factors shape the future?", this research additionally asks, "which actors enable or prevent that future from materializing?" This constitutes a major analytical contribution.

In this sense, the findings are also consistent with structural foresight and actor analysis literature. Godet emphasizes that foresight gains significance not when it merely predicts the future, but when it contributes to shaping it and reducing collective biases. This study operationalizes that logic through an integrated analytical chain: MICMAC for structural diagnosis, MACTOR for power and conflict analysis, Scenario

Wizard for alternative futures, and Multipol for strategic prioritization. This methodological integration shows that foresight in resilience studies, if detached from actor analysis, leads to weak and unsustainable recommendations. In this regard, the research advances beyond studies focusing only on scenarios or structural variables.

The root causes of resilience instability in Tehran can be interpreted at three levels. First, Tehran operates as a complex adaptive system, where disturbances in one domain rapidly cascade into others, making sectoral or one-dimensional policies insufficient and sometimes counterproductive. Second, path dependency and institutional lock-in mean that even gradual reforms encounter resistance from vested interests. Third, conflicts among governmental, local, economic, and civil actors have resulted in veto power outweighing problem-solving power. Thus, the Tehran crisis is not simply a matter of resource shortages, but one of failure to coordinate resources and reconfigure interests. This interpretation is consistent with the political economy of space, path dependency theory, and critiques of technocratic approaches.

Theoretically, the study suggests that urban resilience in Tehran should evolve from a predominantly technical and physical concept into a political-institutional and relational one. Resilience is not a static condition, but an ongoing process of negotiation, conflict regulation, and reconfiguration of power relations. This insight advances current theoretical frameworks by demonstrating that adaptation without understanding conflict is incomplete, and foresight without actor analysis leads to impractical recommendations. By linking strategic foresight with the political economy of space, the study proposes a new framework for analyzing resilience in metropolitan regions of developing countries, one in which power and interests matter as much as physical vulnerability.

From a practical perspective, the findings imply the need for fundamental reform in Tehran's governance structure. First, crisis management should shift from technical response toward political conflict management. Second, adaptive and low-friction strategies—such as knowledge-based economic development and smart infrastructure—should be prioritized because they have greater political feasibility. Third, civil society, universities, private sector actors, and residents must be recognized as formal resilience governance actors; otherwise, future-oriented planning is likely to remain suspended at the implementation stage. Finally, policymakers must acknowledge that some critical but politically costly interventions can only be realized once institutional lock-in is addressed and a minimum resilience coalition is established.

Table 15. Matrix of policy inference from the intersection of structural analysis (MICMAC) and actor analysis (MACTOR)

1. Key driver	2. Status in scenarios	3. Actor dynamics & conflict of interest	4. Strategy & selected action	5. Connecting logic
1. Industrial and economic development	In S2 (crisis): Stagflation and capital flight. In S1 (sustainable): Advanced industrial hub.	Opportunity: The only area where the developmentalist bloc (state) and security/economic bloc converge (revenue generation). Challenge: Weakness of the real private sector.	Action A02: Creation and development of specialized industrial estates and science/technology parks. Action A09: Strengthening university-industry link.	As these actions are technical-economic and non-political in nature, they scored the highest robustness in Multipol. They gained consensus because they secured the interests of all the powerful actors.
2. Social transformation and housing	In S2: Exacerbation of north-south polarization and unrest. In S3: Maintenance of status quo (uneven growth).	Severe conflict: The security bloc fears marginalization threats; the municipality bloc fears service costs. Risk: High potential for conflict.	Action A11: Execution of sustainable and affordable housing development plans. Action A15: Local community empowerment.	Choosing these policies is defensive. The goal is to prevent the activation of social fault lines that could drag the entire system into the S2 collapse scenario.
3. Culture, education, and research	In S2: Elite emigration and scientific decline. In S1: Innovative ecosystem.	Divergence: Ideological conflict between official cultural approach (traditional institutions) and modern lifestyle (citizens/middle class).	Strategy P03: Strengthening science, industry, and society links. Action A20: Reviewing and spatially balancing educational centers.	Focus on the applied/skill-based aspect of education (P03) rather than cultural/ideological aspects, which are contested, in order to maintain actor consensus.

1. Key driver	2. Status in scenarios	3. Actor dynamics & conflict of interest	4. Strategy & selected action	5. Connecting logic
4. Physical and virtual infrastructure	In S3: Isolated and fragmented development. In S1: Smart and integrated network.	Main challenge: Competition over the budget and cross-sectoral management between the municipality and the state. Power: High influence of large contractors in this sector.	Action A28: Preparation of an integrated critical infrastructure plan. Action A34: Creation of single-window digital services.	Moving towards virtual infrastructure (A34) has less friction compared to physical projects and allows bypassing bureaucracy (institutional lock-in).
5. Health and environment	In S2: Unlivability and water crisis. In S3: Ad-hoc crisis management.	Weakness: Actors in this sector (NGOs and Environment) had the lowest influence power in MACTOR (dependent actors).	Action A36: Determination and zoning of environmentally sensitive areas. Strategy P08: Environmental protection.	Because actors in this sector are weak, policies in this domain were tied to security/defense policies (which have strong backers) to gain implementation guarantees.
6. Security and defense	In S2: Insecurity and high vulnerability. In S1: Smart safety.	Dominance: This domain is under the complete control of the security bloc with very high influence power (dominant actors).	Strategy P10: Strengthening civil defense and regional security. Action A47: Enhancing cyber security.	These policies were used as drivers. By satisfying the security bloc (P10), their resistance against other reform policies (like transparency) decreases.

8. Conclusion and recommendations

This research, based on an integrated strategic foresight framework, demonstrated that resilience in Tehran Province cannot be adequately explained through physical, infrastructural, or financial indicators alone. Rather, its vulnerability stems from the interaction between structural instability, institutional conflicts, and divergence among actors. Structural analysis showed that economic, socio-residential, infrastructural, cultural-educational, environmental-health, and security-related drivers shape the future of the province, while their interdependence creates systemic domino effects. Actor analysis further revealed significant gaps among government institutions, social actors, the private sector, and other stakeholders, producing institutional lock-in, decision-making paralysis, and reinforcing crisis-prone futures.

The central answer to the main research question is that resilience in Tehran cannot be achieved without reconfiguring power relations, managing conflicts, and recognizing the role of social institutions. The desirable future of Tehran depends not on purely technical interventions but on anticipatory, participatory, and multilevel governance. Strategies such as knowledge-based economic development, smart infrastructure, and mechanisms for actor coordination were prioritized precisely because they combine systemic effects with lower political friction, making them more likely to overcome institutional deadlock.

The significance of these findings lies in reframing resilience from a largely engineering concept into a political-institutional and future-oriented one. The study shows that in a metropolis such as Tehran, understanding the future without analyzing actor behavior and power conflicts remains incomplete. For policymaking, this means resilience planning must move beyond reactive crisis management toward anticipatory, coordinating, and socially embedded governance. In this sense, the study's main contribution is demonstrating that in Tehran, resilience is fundamentally a governance problem.

Despite these contributions, the study has limitations. Part of the data relied on expert judgments and qualitative or semi-quantitative assessments, which may involve perceptual bias or limited access to information. The study is geographically limited to Tehran Province, and broader generalization requires caution. Scenario modeling and strategy prioritization remain dependent on initial assumptions, input quality, and expert composition. Furthermore, actual political and economic dynamics may be more volatile and complex than represented in the models.

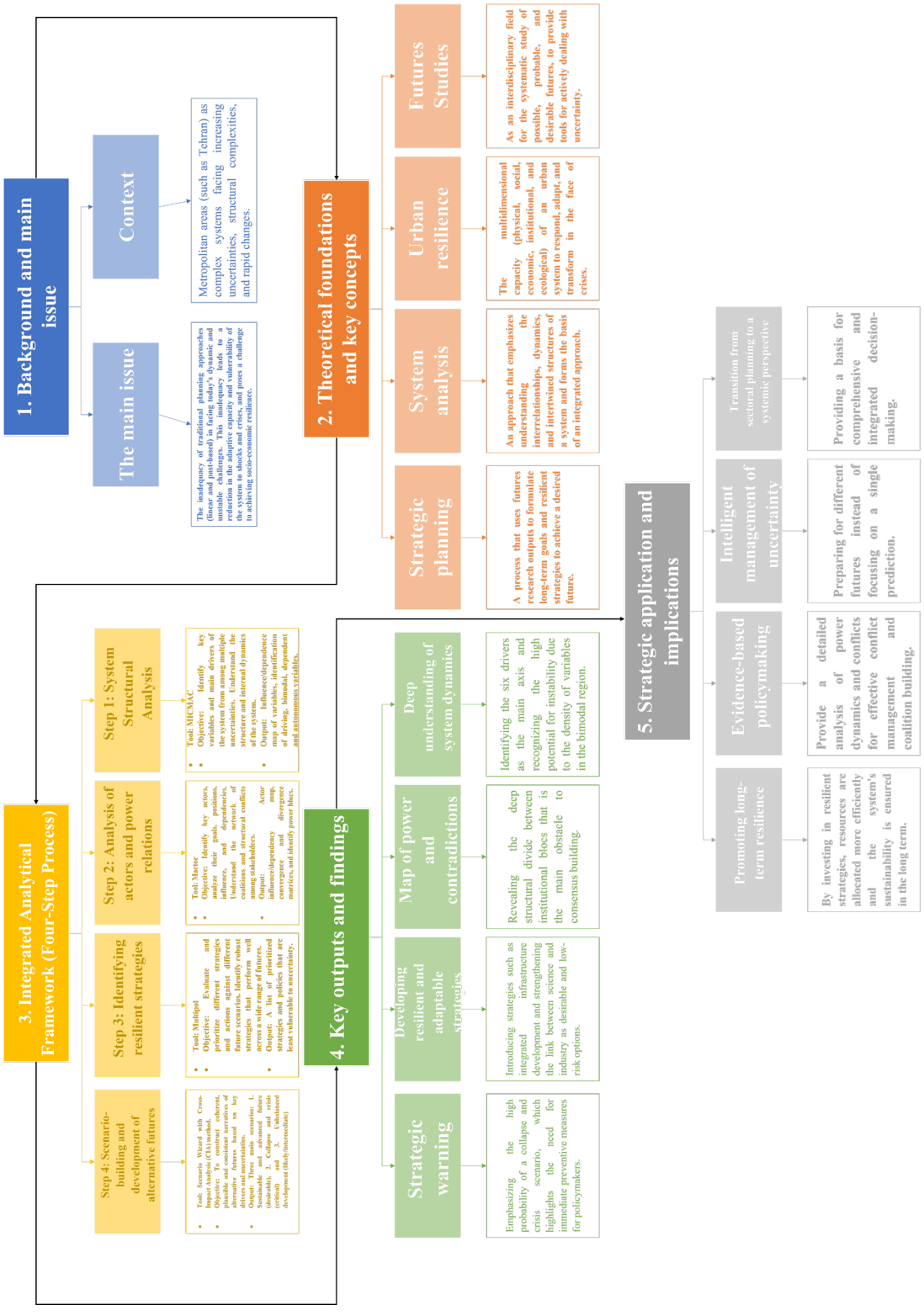

Figure 14. Integrated conceptual model of futures studies for resilience planning

Future research should pursue several directions. First, applying this framework to other metropolitan regions in Iran would enable a comparative analysis of governance conflicts and resilience patterns. Second, combining qualitative foresight with quantitative models such as system dynamics or agent-based modeling could improve the simulation of driver interactions over time. Third, a more in-depth study of

individual actors—especially social institutions, private sector actors, and local authorities—could clarify mechanisms of blockage or facilitation. Fourth, futures studies should examine the institutional implementation of prioritized strategies to better understand the gap between strategy selection and realization. Finally, further research should explore whether smart infrastructure and knowledge-based development, in the absence of institutional reform, can truly produce equitable resilience or instead reproduce new inequalities.

In conclusion, Tehran's future depends on the choice between two pathways: continuation of fragmented governance and movement toward crisis and collapse, or transition toward coordinated, interactive, and adaptive governance. The core finding of this study is that the second pathway is possible only if resilience is understood not as a technical project, but as a political-institutional and participatory process. Such an understanding can provide a more realistic basis for designing effective interventions and shaping the future management of Tehran Province.

Authors' Contributions

All authors participated in the design of the study, data collection, analysis of the results, and writing of the article, and their level of participation was equal in all stages of the research. All authors also read and approved the final version of the article.

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Conflict of Interest

The authors declare that there is no financial or personal conflict of interest that could affect the results or interpretations presented in this study. The data and information used in this study will be made available to researchers and interested parties upon reasonable request.

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