A comparative study of catalyst projects in urban centres: Imam Square in Hamedan

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Abstract. City centres are the vital social, economic, and cultural nuclei of urban spaces, and, as such, revitalisation of city centres’ economic, social, and environmental aspects can significantly improve citizens’ quality of life. Imam Square, as the most pivotal space in the historic and culturally important city of Hamedan in the west of Iran, is one such centre, playing a key role in all nearby urban functions and activities, and affecting both residents’ social lives and local economic features. The "Urban Catalyst" approach is one of the most realistic approaches to improving urban environmental qualities, and this can be used for regeneration programmes to support new urban development policies that seek to recover multiple types of public domain and which acknowledge the primacy of peripheral areas. The purpose of this paper was thus to investigate the urban catalyst project carried out in Imam Square and to compare the resulting situation with the preceding conditions with particular reference to the area’s former central role as a traffic nucleus. This allowed an assessment of the changes following urban catalytic response, another goal of this research. The methodology was based on mixed, with space syntax used to consider the urban configuration and related quantitative aspects and qualitative analysis, developed based on field observations and interviews. The results demonstrated that after pedestrianisation of the central core and the refurbishing of Imam Square, the degree of integration and connectivity of the square and surrounding areas was significantly improved, which has led to an increase in the quality of public spaces and the number of people present.

Keywords: Urban Catalyst, Urban Centres, Space syntax, Imam Square, Hamedan

1. Introduction

Hamedan is one of the most important cities in the west of Iran, and one of the most important places in Hamedan is Imam Square, located in the centre of the city. This square was the city’s first project, being designed in 1930, though it was not constructed until 1956. The most significant point about the square is that it was central to the whole city developing around it; however, over time, as the physical aspects of the town grew and automobiles were introduced to the organic structure of the city, multiple traffic issues occurred. The city centre, as a core of a system, must adapt to new waves of progress. Thus, human scale squares were replaced with traffic squares, which played a critical role in responses to the modern needs of modernised cities, and planning priorities transferred to vehicles rather than people in public spaces. This meant that multiple urban elements at a human scale such as streets, squares, and parks, were overshadowed by the needs of cars. This transmitting function in cities caused new issues

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by reducing human-appropriate spaces in urban areas. Urban centres, due to their unique capabilities, thus tended to be overcome by cars, a process that led to many complicated problems.

Much research has been undertaken on such city centres and the impact of this traffic-focus on the city as a whole [1],[2],[3],[4]. However, fewer studies have examined the impact of intervention to rebalance such urban centres, and the effects of the catalyst approach of trying to reprioritise people over cars. The current research thus attempts to evaluate all aspects of urban regeneration through catalyst changes, including the physical-spatial, economic, environmental, and social-cultural aspects. The critical questions for this study are “What is the impact of preventing vehicles from entering the urban centre (Imam Square)?” and “What events are precipitated by using urban catalytic reactions in the target area?”. These is examined by identifying differences between the situation after performing catalyst projects in the urban square and the previous situation, and comparing the two situations to identify the principals of action in urban centres.

2. Urban centre
In recent decades, the metropolises of the world, including those in Iran, have experienced many kinds of development. Generally, such transformations have tended to move thee areas from centralised to multicentric forms, yet urban centres, as one of the main elements of the creation of cities, still have a remarkable effect [5]. Urban centres worldwide are of particular economic importance; however, the expansion of cities due to population growth and urbanisation has tended to reduce the financial volume of such centres. The preservation and reconstruction of the old centres of cities with the aim of economic, social, cultural, historical, and even political revitalisation is thus of particular interest to modern urban planning, and design experts are seeking multiple solutions in this regard [6].

2.1. Urban centres as system cores
City centres have generally been the most significant part of cities, representing the focus of many features and peoples’ interests. Multiple urban functions, such as commercial trade, official business, and historical interest are generally located in these areas, supported by social attractions that bring life to the core of these cities. This is the main driver behind the attempts to return people and social interactions to these urban centres.

2.2. Squares in urban centres
The public square or courtyard has played the role in gathering household and other community elements together since ancient times. Squares are one of the most influential types of urban spaces, being prevalent in the minds of citizens to the extent that the residents of a city usually recognise different areas of the city by their squares. In terms of residents’ mental mapping, such squares are thus like virtual nodes [7]. The word square generally refers to an open space that is framed by buildings, and a square is often a small example of the city overall, being based on the needs of the local people, the shape of the land, and the surrounding architecture. What sets a square apart from other open spaces, however, is the public access and activities carried out there.

A true square is a static, integrated, and communal living area for citizens, defined by a combination of three elements: the floor, the body, and the ceiling, generally the sky[8]. A square is public and usable by everyone; this is the main difference between a square and an open and private space in a residential or commercial building. Most city squares are also spaces with outstanding historical characteristics, and thus they often have monuments or relics commemorating the past of the city. Squares are also the spaces most suitable for observing the city, being ideal for both moving through and pausing; remembering and creating memories; seeing and being seen; performing celebrations and holding political gatherings, such as demonstrations and meetings; or buying and selling. The identity of a squares may be crowded, noisy, functional or symbolic; however, it should never be a non-event space [9].
2.2.1. Designing a central square

This type of square is a central space in the city, generally constructed next to public buildings. Complete elimination of car traffic in favour of pedestrians in such an area is useful, though reasonable solutions must be considered for the provision of services. Taxi areas, short-stay parking, and bus stations can all be located on the edge of such a square to facilitate this [8]. A city information office or kiosk should also be located in a place visible from all sides. As part of such a design, it is vital to consider a space with several functions, which permits different activities without fixed constructions. The square should also be connected to the inner-city pedestrian network, as only a constant flow of population can ensure movement and mobility there. The most suitable location will thus generally be the intersection of pedestrian crossings. The central square should also have favourable accommodation conditions for visitors, spectators, and those looking for a tour of the city.

Roofed teahouses are thus recommended in the open space of the square, with small diverse shops and restaurants scattered around the square. The establishment of cultural factors such as exhibitions and libraries helps complete the complex and adds to the attraction of the square. The body and the floor around the square space can be created with various elements such as roofs, windows, colonnades, and other connections, as the geometry of the shape of the field is of less importance.

3. Catalyst project

The utilisation of urban catalyst measures and projects is a new general policy in urban development and in particular in the regeneration of disorganised urban fabrics with the aim at accelerating and facilitating development processes in these contexts based on the utilisation of residents' participation and social abilities and the use of local capacities. Urban catalyst measures allow new strategies of urban redevelopment, which often include several projects resulting in established and conducted development, to be applied. In the context of social and economic functions, the development of catalyst measures promotes social and economic development, increasing participation incentives among the local community with regard to restoration and regeneration processes and creating a desire for investment in private sector [7]. Catalyst development also adds a new element to designing measures, policies, or infrastructure for events for urban areas by allowing continuous and gradual regeneration as a long-term process based on positive impact on existing elements [8], [9], [10]. Using urban catalysts in the rehabilitation of old urban fabrics is an approach that uses the elements and factors shaped by the city to encourage continuous positive development based on context. In this approach, public involvement and participation at all stages of the process are necessary, from problem detection and definition to execution and appraisal. Residents’ comprehensive cooperation and assistance and ongoing utilisation of urban spaces and areas is thus required [11]. In "The Architecture of City", published in the 1970s, Aldo Rossi described catalysts as fundamental urban factors, which were not necessarily physical or human-made; according to Rossi, these essential elements included a wide range of activities and continuous space characteristics associated with the public life of cities, including monuments, commercial centres, schools, and hospitals. These fundamental factors create stability and can facilitate and accelerate the pace of urbanisation and development [12]

3.1. Catalyst projects in urban design

In the field of urban design, the term was first introduced by Attoe and Logan in 1989. In their book "American urban architecture", they noted that the analogies supporting previous theories of urban design were inadequate. These organisational and mechanical metaphors, including the "heart of the city", "the city is a tree", or "an organism", or "a system", limited urban design decision making. Attoe and Logan instead adopted a chemistry-related metaphor, the "catalyst", which they believed to be more useful and comprehensive. According to Attoe and Logan, urban design ideas can be achieved by understanding the urban design as process of sorting catalytic reactions within cities rather than a process of assembling components in one or more urban views via the use of different tools. They also paid significant attention to formal aspects of urban catalysts, and the term was then adopted by other theorists, such as Carmona, with reference to any "facilitating and accelerating factor" [13], [14].
3.2. Types and scales of urban catalysts

Urban catalyst and urban regeneration come in various types and scales. In general, catalyst activities in renovation and restoration measures can be classified into the following four categories:

1. Promotion and development of infrastructure, pathway networks, and equipment to promote the expansion of public spaces. This includes equipping the available area appropriately for the development and modernisation of urban infrastructure, the improvement of pathways and other networks such as cycleways, and the development of public spaces at urban and neighbourhood scales.

2. Strengthening the fabric structure and infrastructure to rehabilitate and unify the target area.

3. Development and supply of urban-neighbourhood services. This refers to creating operational plans to allocate specific areas to necessary uses based on neighbourhood and regional needs, as well as the modernisation and rehabilitation of worn-out fabric to provide essential services at urban and community scales.

4. Modelling, or the creation of operational plans and programmes which take into account both the qualitative and quantitative aspects of modernisation and restoration programmes, with the aim of providing an appropriate model or sample to accelerate and facilitate the process of taking measure by people, investors, researchers, constructors, and other relevant institutions and organizations.

Rehabilitation of urban-historic spaces and collections: It refers to operational plans and programmes based on a range of public realms [15].

4. Research method

This research examines conditions before and after interventions in an urban centre (Imam Square in Hamedan) with two main focuses:

1. To identify the transformation of urban spaces before and after catalyst projects in the target area
2. To more specifically study the changes caused by preventing vehicles entering urban centres and changing the scale of public squares

The methodology used in this research was based on the mixed method, with a quantitative approach used to analyse the space syntax of Imam Square before and after catalytic interventions and a qualitative approach, using documents, data, and relevant resources, to examine the fundamental literature. As shown in figure 1, the research was based on reviewing literature about urban centres and catalyst projects then applying comparative analysis to Imam Square using both the space syntax technique and observations, interviews, and field observations. Based on this synthesis of research methods, the final results were thus developed.
4.1. Space syntax theory

Space syntax theory is based on a rejection of the metric properties of space that allows the spatial configuration to be represented by topological data. Intrinsic properties are thus shown on topological graphs, allowing the relationships between elements to become the fundamental subject of spatial analysis, as seen in figure 2. An urban grid is then used to examine the social use of space [16].

Space syntax as a technique thus allows analysis and better understanding of an area. On an urban scale, spatial structures may take on organic, uniform, or deformed shapes, yet these universal types of urban grid vary in the ways in which they interweave and connect the parts with the whole system. They emerge on different scales, and thus have varying geometric properties. The topological and geometric analysis of urban grids, facilitated by using DepthmapX software, can help develop an understanding of the configurational structure of urban spaces and the potential impact of this on social behaviour and economic activity [17], [18]. Such analysis, however, depends on both connectivity and integration factors.

![Figure 2.](image)

**Figure 2.** (from left to right) A representation of the ways people move, generally along a line; a convex space where users see each other and in which interactions take place; a visibility field (isovist), which has a different shape depending on where the observer is located [19].
4.1.1 Space syntax analysis
The research method used required an examination of the space syntax of Imam Square both before and after the catalyst interventions. The lines among all of the streets were thus drawn and DepthmapX was used to convert these to axial lines. Graph analysis was then performed to determine the connectivity and integration of Imam Square with the city as a whole in both cases.

![Figure 3. Space syntax of Imam square before intervention (extracted from DepthmapX).](image1)

![Figure 4. Space syntax of Imam square after intervention (extracted from DepthmapX).](image2)

4.2. Qualitative methods (field observations and interviews)
Before the project was implemented in the central part of the city, multiple observations and interviews were conducted in the area. Interviews with shopkeepers around the square and random pedestrians showed that the square was not a destination node, and that there was no reason for pedestrians to spend time there. Shopkeepers were also annoyed by the lack of space to provide more services and attract more customers.
After the regeneration made the square walkable, further field observations and interviews were implemented. The results illustrated that social interaction had increased, and that group activities, such as conversation, as well as individuals peoplewatching, reading, and eating meals now occurred in the space. The new Imam Square attracted a lot of attention, and shopkeepers were eager to spread their services out, cheerfully acknowledging the opportunities offered by the new situation. The details gathered from the qualitative investigation are shown in table 1. The indicators are based on four aspects of urban regeneration, as in the urban catalyst theme. Each catalyst project should thus respond to each element’s features to improve the situation.

| Case of study          | Physical                        | Economic                        | Social-cultural                  | Environmental                  |
|------------------------|---------------------------------|---------------------------------|----------------------------------|--------------------------------|
| Imam Square before intervention | -Traffic function | -Lack of urban furniture | -Lack of window shopping | -The city square has a passing role |
|                        | -Priority for pedestrians |                        | -Increased land use on square facades | -Lack of social interaction in square spaces |
|                        | -Urban furniture provision |                        | -Distribution of services | -Air and sound pollution caused by vehicles |
|                        | -Lighting for the whole square |                        | -Increases in window shopping opportunities |                        |
|                        | -Restoration of square facades |                        | -Satisfaction of shopkeepers based on improved sales | -Respect for the environment |

5. **Imam Square in Hamedan**

Hamedan’s central square is a large area known as Imam Khomeini Square. The plan of this square was prepared by the German architect Karl Frisch in 1930, though construction went on until 1956. The square thus belongs to the Pahlavi period. It is located at the intersection of Shohada Takhti Street in Hamedan, and it was registered as a national monument of Iran on July 13, 2000 (registration number 2712). The square was marked for pedestrianisation in 2016, along with Bouali and Ekbatan streets in Hamedan. This project was one of the pioneering actions in the modernisation of Iranian cities. As it is the historic core of Hamedan, utilising this square demystified the new progress in urban development policies, allowing the central square, as a symbolic space of the modern city, to be recognised as a place for cultural, social, and political events. Pictures of the carnivals and displays, as well as political events in the ensuing years, highlight the remarkable capacity of this urban space, which has become both a civic and symbolic space for the city.

Despite the period during which, along with many other city centres, the central square gradually lost its role to the needs of vehicles and transportation, it has always been a place with huge potential. It is part of the historic structure of the city, hosting the bazaar, and the Grand Mosque there has also always played a role as the arena for the most significant socio-political events in the city of Hamedan [20].

5.1. **Imam Square prior to intervention**

For a period, Imam Square mainly played a role in handling traffic, as seen in figure 5. All local transportation routes depended on it, yet few social activities took place on there; only necessary activities occurred in this area.
5.2. Imam Square after intervention (catalyst approach)
In September 2017, the car section was demolished, and the entire square became a sidewalk, as seen in figure 6. Now almost a century old, this square still maintains its connection with the streets and bazaars of Hamedan, as the design and principles of street construction and the branching of the streets have been dependent on this circular design.

6. Findings
Hamedan is one of the well-known circle cities of Iran, as shown in figure 7; this structure derives from the shape of Imam Square, while further streets act as a ring, creating layers like an onion. The six lanes that originate in Imam Square continue out to all parts of the city, connecting Shariati, Takhti, Ekbaten, Shohada, Babataher, and Bu Ali together, and facilitating the connection of other streets and their peripheral fabrics and neighbourhoods. These six streets thus have the same integration with their local districts and the whole city. Imam Square, as the central node of the city, has a high level of integration and a connectivity function, making it wasteful to allocate this space to cars and traffic functions. By making this central square more walkable, more activities, social interactions, and economic opportunities are facilitated. The field observations and interviews with users and
shopkeepers confirm the results of the space syntax analysis of this area, suggesting that that the catalyst project in the case study has been beneficial in terms of making the city more vital and prosperous.

**Figure 7.** Hamedan city and Imam Square.

7. Conclusion
In space syntax analysis, warm colours such as reds tend to imply more connected and integrated streets, while cool colours such as blue represent low connectivity and integration. The first analysis of the square during its traffic-based period sowed lower connectivity than after the intervention using the catalyst approach; these streets are now very connected and integrated with respect to the whole of the square, however. The qualitative method further illustrated the difference between the situations before and after implementing the catalyst project, particularly with regard to stakeholders’ views of the space. These perspectives confirm the space syntax findings and suggest that the changes were meaningful and coherent for these users of the urban spaces. Prohibiting personal and public vehicles from the target area brought people back to the central square, increasing the vitality of the urban space, boosting the economic situation, and decreasing the air and sound pollution. In the central circle of Imam Square, the urban space was paved, and appropriate furniture and equipment were allocated, making it once again core of the Hamedan city, being connected to all six main streets and encouraging social interaction and various activities.

The integration parameters investigated suggest that urban centres require attention to be paid to human-scale activities; it is thus better not to assign traffic roles to city centres. Interventions to rectify such focus thus have the potential to support all kinds of social and cultural actions. The comparative analysis in this research also illustrates multiple principals should be considered when shaping any city to allow greater harmony among the peoples of such cities.

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