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Multifunctional Urban Spaces

a Solution to Increase the Quality of Urban Life in Dense Cities*

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Abstract | As urban population increases, cities face a dilemma on one hand, the horizontal growth causes devastating effects on the environment, and on the other hand, vertical growth leads to a decrease in the quality of life of citizens and causes a variety of mental illnesses. This dilemma has left city managers with a complex puzzle: a city that must be able to accommodate more people with minimal interference ensuring their optimum quality of life.

This research presents the idea of multifunctional urban space design as a solution to the mentioned problem. The definition of multifunctional spaces in this research has been investigated using its definition in agriculture and environmental studies. The hypothesis of this research is based on the fact that the comprehensive definition can take a new perspective on urban design, improving the functional performance of existing urban spaces and thus reducing the need to build new facilities while maintaining the quality of life in dense cities.

The research method is qualitative and based on bibliographic studies. First, the notion of functional performance and multifunctional space definition are examined in disciplines that produce a more specific interpretation of the subject, and then the definition of concepts is extended to urban design and urban space, highlighted and discussed.

Keywords | *Multifunctional Space, Urban Space, density, Shared-Use, Sustainability.*

Introduction | More than half of the world's population lives in the cities and this ratio is increasing steadily. Consequently, landscapes and forms of the cities are constantly changing, developing and expanding horizontally and vertically. In addition, urban sprawl is recognized as a harmful process, due to the increase in CO² emissions, increase of artificial soil, fragmentation of landscape in peri-urban areas and so on (Ng, 2009). Costs incurred by this spread (such as transport, infrastructure and outlying areas) are of paramount importance. As a result, the sustainable development

point of view leads to the densification of cities. A sustainable form should have these characteristics (Jabareen, 2006):

- Formal and physical aspects: 1. compactness and population density (increased structural compactness in urban development: increasing population and building density, directing the structural urban development in a compact way along the path of fast lines of public transportation, creating multiple urban centers in metropolitan area by considering the proportion of population and employment opportunities in each area, turning towards urban village models for residential neighborhoods and

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preventing sprawl by creating mixed-use area), 2. polycentric structure, varied densities (in city center, intermediate area and suburb), 3. urban form facilitating active mobility (walking, cycling, skating, etc.), 4. walkable neighborhoods, adaptive and flexible zoning and land use plan

- Social aspects: mixture of generations and generational adaptation, social diversity (a sustainable city is one with diversity which is supported by the people without social or income group separations. all individuals and groups have access to services and basic facilities and residents have equal status.)

- Environmental aspects: integrated with nature, building design adapted to climate change (materials, compact form, ventilation corridors, etc.) or nature based solutions.

The concept of sustainable urbanism faced this problem through various issues identified: social issues (mobility and equity), technical issues (infrastructure and urban form), mobility (transport, routes and infrastructure) and resources (energy, food resources and materials). It involves the objectives such as democracy, social welfare, preserving natural resources and environment, economic viability and transportation and it requires a framework that can encompass all these aspects (Farr, 2012; Favet & Gauzin-Müller, 2002; Haas, 2012, 2). These different aspects are shown in Fig. 1.

Moreover, the vertical growth and increased density degrades the quality of life of citizens, favor the diffusion of diseases or the vulnerability of population (Soule, 2006; Squires, 2002).

Now, if we consider “accommodating new citizens in the city” as our first priority, it is inevitable to move towards greater density, reduction of green space, activity centers and public places per capita. But what makes a city livable is the quality of life of its citizens (Batty, Besussi, Maat & Harts, 2003; Lim, Yuen & Low, 1999). Jan Gehl (2011) in his book, “Life between buildings” distinguishes between different types of activities that occur in an outdoor space: necessary/functional activities, optional/recreational activities and social activities in public spaces. While necessary activities take place regardless of quality of the physical environment, optional activities depend, to a significant degree, on what the place has to offer and how it makes people behave and feel about it. The better a place is, the more optional activities occur and the longer necessary activities last. Social activity is

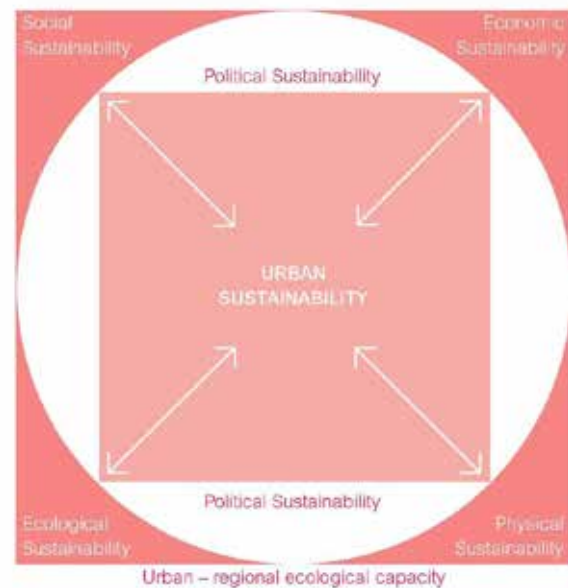


Fig. 1. The dimensions of urban sustainability. Source: Allen, 2001.

	Quality of the physical environment	
	Poor	Good
Necessary activities	●	●
Optional activities	•	●●●
"Resultant" activities (Social activities)	●	●

Fig. 2. Graphic representation of the relationship between the quality of outdoor spaces and the rate of occurrence of outdoor activities. Source: Gehl, 2011, 13.

the fruit of the quality and length of the other types of activities because it occurs spontaneously when people meet in a particular place.

He believes that the greater the possibility of performing optional activities in a city, the higher the quality of life of the citizens. In fact, he believes that the quality of urban life depends on the possibility of performing optional activities (Fig. 2).

When the city establishes its path through densification, without considering other aspects of urban sustainability (environmental and social aspects) and

providing new facilities, the quality of life of residents decreases.

Quality of life is a multifaceted concept that embraces not only the material aspects of life, such as level of living and availability of social and physical infrastructural facilities but also less tangible aspects of life such as good health and opportunities for optional activities such as recreation and play (Lim et al., 1999).

Research question

The fundamental question of this research is: How can the quality of life of citizens be maintained in densely populated cities?

Research assumption

In this study, the hypothesis focuses on the idea of multifunctional spaces as a way to increase the quality of life in high-density cities. Although this idea is employed in architecture and urban planning with an unclear and non-comprehensive definition, it could be more precise investigating its definition in the field of agriculture, which leads to increase the productivity of the farm. In fact, it is assumed that the multifunctional use of urban spaces (with the definition used in agriculture and other fields such as industry) can optimize their functional efficiency and improve the quality of life of citizens.

The idea of multifunctional urban spaces frees up more space for optional activities. It also reduces the problems that arise with urban dispersion or densification. This idea is not a new concept (especially in agriculture and landscape) but this research tries to introduce it as a response to the problem of reducing the quality of life of citizens due to the high density of future cities.

Literature review:

• Definition of “Multifunctionality”

The expression “multifunctional” has different meanings in different fields. For example, literally the meaning of multifunctionality refers to something that has or fulfills several functions (www.lexico.com/definition/multifunctional). For example, Roman Jakobson defines 6 different functions for the language (Rudy, 1990):

1. The Referential Function;
2. The Poetic Function;
3. The Emotive (alternatively called “Expressive” or “Affective”) Function;
4. The Cognitive Function;

5. The Phatic Function;

6. The Metalingual (alternatively called “Metalinguistic” or “Reflexive”) Function.

Therefore, the linguists consider the language as a multifunctional phenomenon. While the phrase in literature and linguistic could have different meanings that does not reach to mind easily, the definition of the phrase in planning and urban design could reach to a general definition of the subject from a different points of view.

Beside that the term of “ Multi-objective function optimization” could be found in engineering and economics which is an area of multiple criteria decision making, that is concerned with mathematical optimization problems involving more than one objective function to be optimized simultaneously (Caramia & Dell’Olmo, 2008). This method is used for solving the complex problems.

In agriculture, landscape and urban planning the regard has been more specialized and spatialized. “Multifunctionality” as a concept has several roots: some authors consider it as an old architectural concept in urban areas by relating it to the ancient Greek or medieval constructions (Zeidler, 1985). Others consider it with a background in agricultural studies (OECD, 2001) specifically in subjects such as agricultural intensive production or modification in production systems. It’s about the idea that agriculture has many functions in addition to producing food and fiber, e.g. environmental protection, landscape preservation, rural employment, food security, etc. (WTO, 2015).

In this study, an attempt is established to reach a comprehensive definition inspired by both domains and to investigate a multifunctional space with a general view: both as a place or an object that maintains various aspects as well as a whole active system that can be optimized. In fact, these three forms of definition collectively can define a context for achieving the goal of research.

• Multifunctional space in architecture, urban geography and urban design

The word «function» is one of the keywords in architecture and refers to the building’s purpose and the activities done by users inside the space. This word is always used in the architectural literature beside the words “form, space, stability and beauty” in the scale of a building and it is equivalent to the concept “utilitas” that Vitruvius made in the first century AD. Therefore,

“multifunctional spaces” concept has been used beside the mixed-use, multi-use and multi-purpose buildings and often without any distinction or difference. In fact, the concept of multifunctionality could be linked with the concept of multi-uses (which means the different uses of space in different times) (Zeidler, 1985) and the concept of mixed-usage (which means having a combination of at least 3 different revenue-producing uses in a specific period of time) (Thrall, 2002).

In urban design, this concept has a more precise definition. Ziedler (1985) focuses on the “space” and “function” and relates the concept of multi-use spaces to the ancient Greek or medieval constructions. He believes that the city should be a pattern of different uses and activities (in city scale not just a building). These various uses come at first from the buildings but they spread in the whole city by a comprehensive planning. He believes that the characteristic of multifunctionality should not be confined to a single space, but in logic of an integrated network, promoting functional complementarities between several public spaces in the city, always keeping the principle of proximity in mind (Pinto & Remesar, 2009, 3).

In recent years, city planners have introduced the notion of multifunctional land use as a new concept for urban land use. It can generally be defined as the combination of different socio-economic functions in the same area (Verhoef, 2004). This concept aimed at a spatial and socioeconomic synergy of different land use functions in order to save scarce space by intensifying its use, while still maintaining a high level of spatial quality (Rodenburg, Vreeker & Nijkamp, 2003).

Although a commonly accepted definition of multifunctional land use is still lacking, the notion returns to the synergy between the various functions which are combined in one area. This synergy comes into existence due to the interaction between activities. This is underlined by Brandt & Vejre (2004) who introduce three types of multifunctionality states according to the spatio-temporal characteristics of land:

1. A spatial combination of separate land units with different functions;
2. Different functions devoted to the same land unit but separated in time;
3. The integration of functions on the same unit of land at the same time.

All these types share the fact that, from a certain perspective, they choose some kind of “optimal”

arrangement and superimposition of land-uses (Potschin, Klug & Haines-Young, 2010).

A re-design of existing land use in the city with a view to a multifunctional urban planning concept has huge implications for business activities as well as the quality of life of the residents (Rodenburg, Nijkamp, De Groot & Verhoef, 2009, 1). At the same time, it can of course be viewed as a measurable spatial-economic characteristic of a given area (Rodenburg, Nijkamp, De Groot & Verhoef, 2010). Therefore, multifunctional land-use planning is an integrated approach aimed at increasing the efficiency of how land is used in different areas and at different scales (Vreeker, De Groot & Verhoef, 2004; Iveson, 1998, Lloyd & Auld, 2003; Rodenburg, et al., 2009, 2). This capacity helps the planners to control the urban sprawl and urban growth by reviving the existing mono-functional spaces with a function different than their mains’ and optimize the operating rate of multi-use spaces toward a multi-purpose project. This approach can enhance the quality of life in the city and thus create valuable spaces. Multifunctional and interconnected urban districts can be the places to live, work, shop and play (Grant, 2006). Van Schaick & Van Der Spek (2008) emphasized the relationship between human being and nature. So they believe that combining these multiple functions and uses within green spaces leads to create high-functioning, high-value open spaces.

Although in these definitions the concept is addressed in large scale and that economic aspects are much more emphasized, compared to social and environmental aspects, this approach can also be applied in local projects and small areas (for example in the scale of a neighborhood or a community). In these cases, the social aspects -improvement of urban vitality (dynamism) and enhancement of the quality of life for citizens- become more influential.

If the concept of multifunctional urban spaces would be taken as mixed zoning, some more advantages could be obtained compared to traditional zoning, such as:

1. Creating balance between residential and employment uses and facilitating of providing basic needs of urban life;
2. Making a continuous relationship between the individuals and the city enhancing the sense of belonging along with satisfaction obtained from income provision;
3. Equilibrium of commercial and residential uses in neighborhoods that leads to enhancement of social interactions;

4. Increased diversity resulted from decentralization and distribution of services across the city;
5. Increasing the possibility and easiness of accessing to leisure facilities and health services.

Since there is still no universal definition in the literature in this field, using what has been proposed in other fields such as agriculture and landscape can help us clarify the concept and facilitate its practical application in projects.

Multifunctional space in agricultural and environmental studies

The concept of multifunctionality was introduced in many international negotiations since 1992 to allow public aid to agriculture by legitimizing governments to offer farmers compensation for additional functions such as meeting other demands from society (Dufour, Mauz, Rémy, Bernard, Dobremez, Havet, Pauthenet, Pluinage & Tchakérian, 2007). Multifunctional agriculture, beside food production, considers the ecological, economical, socio-cultural, historical and aesthetical roles and values of the farm.

The effects of these additional functions could be broadly classified as benefits to society, culture, a national economy as a whole, national security, and other concerns. For example, in addition to providing food and plant-derived products for the population, agriculture may also provide jobs for rural people, contribute to the viability of the area, create a more stable food supply, and provide other desired environmental and rural outputs. The concept of multifunctionality also has been entered in other parts of economy other than agriculture such as forestry, fishing, and banking (OECD, 2001).

In this regard, multifunctionality is the ability of rural spaces to fulfill more than one function at the same time. This systematic view makes a direct relationship between multifunctionality as an activity-oriented process and sustainability as a resource-oriented process (Garzon, 2005; Grant, 2010; Mander, Wiggering & Helming, 2007).

a multifunctional approach focuses on the various roles areas can play. This extensive concept must be considered globally and comprehensively in order to embrace the complexity of such elements (Vaz, 2010; Wilson, 2007, 3).

Multifunctional agriculture, beside food production, considers the social, environmental and economic rules and values of the farm (Leeuwen, Nijkamp & de Noronha, 2010 Helming, Pérez-Soba & abbush, 2008).

This concept in the field of landscape, considered these five roles simultaneously (Hein, van Koppen, De Groot, & van Ierland, 2006; Brandt & Vejre, 2004; Helming et al., 2008, 308; Lovell, 2010, 2503; Otte, Simmering, & Wolters, 2007):

- 1- Ecological role (as an area for living);
- 2- Economical role (as an area for production);
- 3- Socio-cultural role (as an area for recreation and identification);
- 4- Historical role (as an area for settlement and identity);
- 5- Aesthetical role (as an area for experience).

A multifunctional landscape is a Landscape that provides a range of beneficial functions across production, ecological, and cultural dimensions, considering the needs and preferences of the owners and users (Lovell, 2010; Otte et al., 2007; Piorr & Müller, 2009). This shows the importance of actors' role in succeed of this concept.

As it is demonstrated in Fig. 3, according to Lovell & Taylor (2013) for the definition in agriculture, the multifunctionality of the system has been considered in a hierarchy. Although in a sustainable definition all the aspects have the same and equivalent value, cultural aspects have been considered before other aspects.

As an example for this type of landscape is the wine route in Alsace, France where there are different roles beside each other: vineyards, which provide a special land pattern, an identity for the whole area, an aesthetical experience and an attractive place for the tourists.

There are many examples of such rich landscapes all over the world. The Figs. 4, 5 & 6 illustrate different aspects a landscape might contain. The first figure (Fig. 4) focuses on the economic and identical aspect, the second one (Fig. 5) concentrates on historical and cultural roles

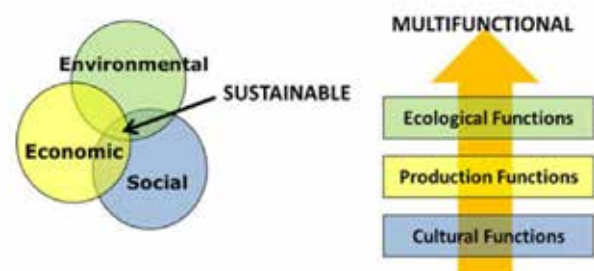


Fig. 3. Comparison of the concept of sustainability with that of multifunctionality. Source: Lovell & Taylor, 2013.



Fig. 4. Wine route in Alsace, a good example of a multifunctional landscape. Source: www.alsace-wine-route.com, 2015



Fig. 5. More than 3000 "Dovecot"¹ in the farms around Isfahan (Iran) that became to historical monuments and a part of cultural landscape. Source: www.flickr.com, 2015



Fig. 6. The rice fields in Nepal (right) and in the north of Iran (left) which have the aesthetical value and attract the tourists. Source: Right: www.isetnepal.org.np/, 2015 and left: www.isna.ir/, 2015

beside economic and ecological values and the last one (Fig. 6) represents the esthetical aspects.

Although it seems that the concept of multifunctional agriculture is formed on the basis of optimizing production systems, but in this evolution, the function has changed its initial meaning from "use" to "role", "purpose" or "target". In order to integrate all these purposes, a comprehensive transdisciplinary approach is definitely needed. The goal is to coordinate the roles in the way that the growth in one feature does not lead to weakness in the others (Mander et al., 2007; Naveh, 2001, 207; Tress, Tress, Décamps, & D'Hautesserre, 2001, 140).

Fig. 7 demonstrates different social, economic and environmental roles of a field along with the realization of purposes such as cultivation and commercialization

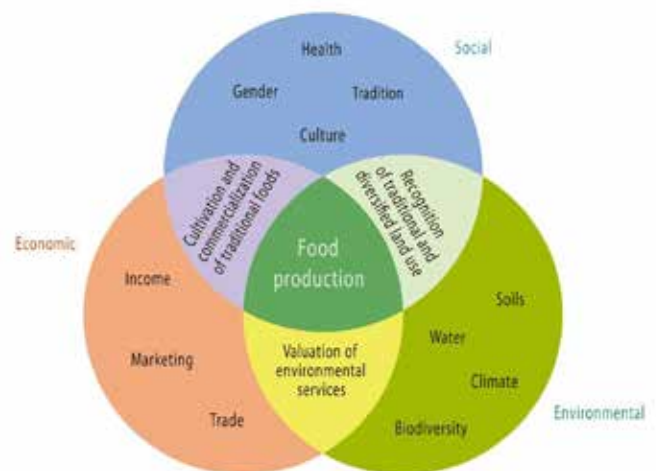


Fig. 7. The inescapable interconnectedness of agriculture's different roles and functions. Source: IAASTD 2008, 1.

of traditional food, valuation of environmental services and recognition of traditional and diversified land-use. Although the final target is still food production, this target is realized through different roles and purposes (objectives).

The most important social value of the concept of multifunctional agriculture is that it ensures the social viability of rural areas. It leads to “rural development” by proposing “alternative activities” (Karasavoglou, Ongan, Polychronidou, Todorova & Ikova, 2014). The fact that it considers the different roles and values of a place, results to a diversity of activities which attracts different social groups with different backgrounds and leads to a wide social mixity (Gehl, 2010; McGlynn, Smith, Alcock, Murrain & Bentley, 2013). Its non-commodity outputs include also nutrition safety, food production security and the welfare of production together with cultural and historical heritage which also can be considered as social effects and impacts.

From the economic point of view, a natural framework for multifunctional agriculture is a model where the emphasis is given to heterogeneity of land-use policies of agriculture and on the changes in farmers’ incentives because of changes in profitability between crops under alternative policies (Ollikainen & Lankoski, 2005). The

policies in each country might lead to different social consequences that are out of the scope of this study. In fact, the important point is that agriculture has turned into a complicated subject that includes many elements with different roles, but the target still remains food production.

Discussion

• A comparison: multifunctional urban space vs. multifunctional agricultural space

As mentioned before, the definition of multifunctional space in agriculture and environmental studies is different from architecture. The differences are summarized in Table 1.

According to what was said, it seems that the way we look at the subject of multifunctional spaces in agriculture and the landscape can be a model for researching, completing, and applying this concept in architecture and urban planning.

• Designing multifunctional urban spaces- increasing the functional efficiency of existing spaces

Since the main goal is to be capable to improve the quality of life in densely populated cities, in addition to increasing the functional efficiency of the existing spaces, we must be able to create spaces for new functions. Both of these solutions could be realized

Table 1. Comparison of the concept of multifunctional space in agriculture and architecture. Source: authors.

Architecture and urban design	Agriculture and landscape	
Classic and then post-modern	Post-modern (since 1992)	History
Mono-dimensional (performance)	Multidimensional including target, purpose and role	Definition of the notion of “Function”
Economic	Ecological, social, economic, cultural and aesthetical	Created value
Lack of consensus, there is no unified definition	Consensus of experts	Clarity
Multi-use or combined	N/A	Similar concepts
Undetermined	Determined	Relation to the concept of sustainability
N/A	Available	Legal support and compensation for applying the concept
Not investigated	High (proved)	Impact
Partial and short-term	Holistic and long-term	Point of view
Top-down	Bottom-up	Approach

by developing multifunctional spaces. This concept is explained in more details below:

Fig. 8 shows the six ways of using a space during a cycle of its activity (time).

- 1- Mono-functional space: This space has only one function and covers just one activity and one group of users. It is the most general methods for designing the space and the majority of existing spaces have been designed on this basis (example: an office or a house).
- 2- Periodic-functional space: The space which change its users or their activity; the new activity begins immediately after the previous and the space is empty just for the short period. For example, a gallery hosts the work of different artists in different art domains

over a year. There is a short interval of time between two consecutive exhibitions.

- 3- Multi-purpose space: Space designed for several activities which need similar installations and equipments. The space can be adapted to the new function and circumstances with a few changes or modifications. For example, a multi-purpose sports hall can provide the facilities for different matches but it is empty off-seasons. There is a remarkable interval of time between two consecutive activities.
- 4- Mixed-use space: The starting or ending times of the activities correspond to the same moments and there is always more than one activity going on in the space. The majority of time, an activity overlaps with at least one other activity (example: commercial-leisure centers).

5- Complex space: Activities are accomplished consecutively, but at the beginning or at the end they have a short overlap with other activities. These spaces usually have different parts and a sequence of use which permits the new group of users to enter when the previous group has not completely vacated the complex. Although total space is not still empty, some parts can be used for other groups (Example: a cinema complex)

6- Shared space: Space has a main function, but in some parts of the activity cycle, it can be replaced with another activity or have the two activities at the same time. In cases in which the main activity stops, the first function will be resumed after finishing the replacing function. As example, we can mention the weekly markets which take place in parking lots or the café terraces that occupy a part of sidewalks in some hours of the day. The mono-functional spaces which have the capacity to accommodate two or more activities at the same time can optimize their operating rate and be concerned with new functions. In our definition, these spaces could also be considered as potential spaces to be multifunctional.

To clarify this issue we may consider that “an urban space, in different scales - from a residential complex or a city block to a neighborhood or the whole city - has a defined function which is limited to specified hours of the day, days of the month or months of the year”. For instance, the parking spots of a residential complex has many free spaces during working hours; while the parking area of an office has free areas outside working hours and during public holidays. These spaces can be rekindled with other functions during their idle hours.

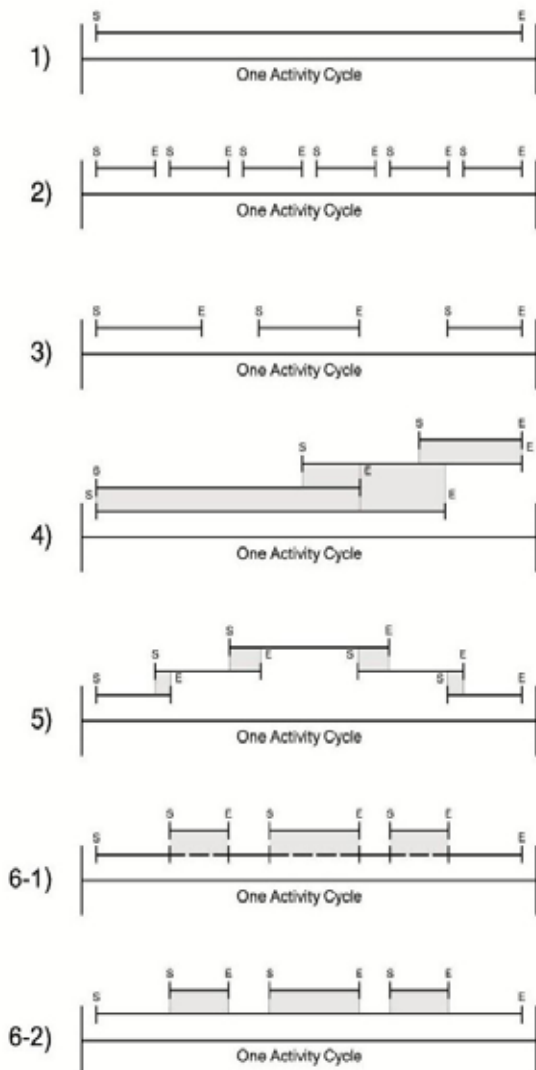


Fig. 8. The different ways of using a space (Function) during a cycle of its activity (Time). Source: authors.

Spaces with private or semi-private uses might also be allocated to a public performance. For example, the schoolyards can be opened to the public during school holidays and temporarily used as a shared communal space.

Conclusion: Multifunctional urban spaces design- Land release for developing new functions

According to what has been presented, a “multifunctional space” could be identified with these two characteristics.

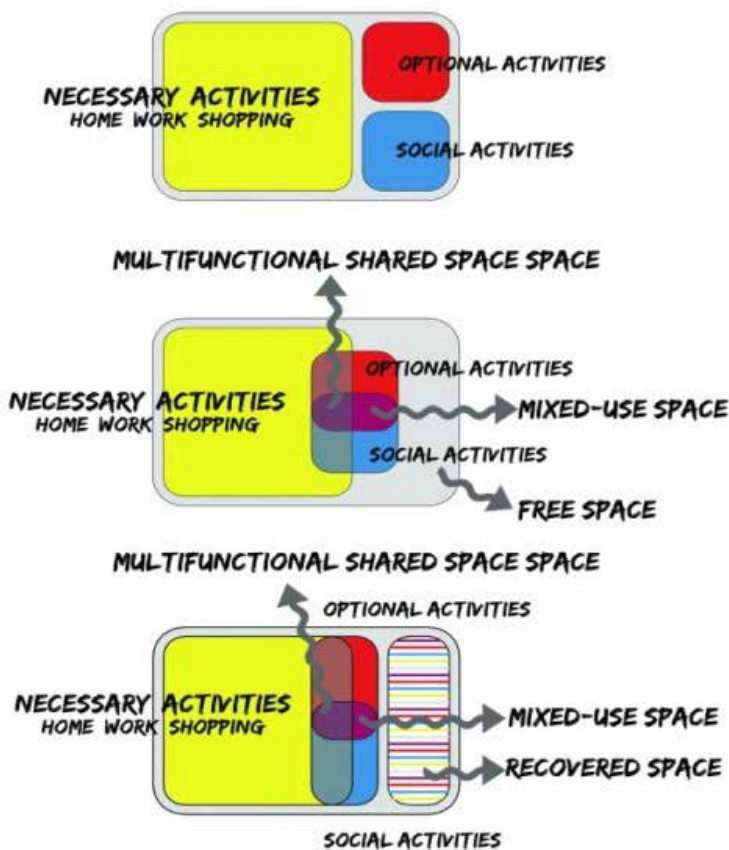
- Allow different functions, different actors and different users during different periods of time or have the capacity to accommodate two or more activities at the same time (accept more than a function simultaneously)
- Fulfill the different roles a space might have in line with the environmental, economical and social sustainability

In the event that space could be considered as a set of: space, function(s) (activity) and user(s), the mathematical interpretation of the concept of combining spaces and activities will lead to Fig. 9 The recovered space could be used for optional activities

and as levels of optional activity rise, the number of social activities usually increases substantially, both of which eventually lead to an increase in quality of life.

Fig. 10 shows the idea in the scale of a neighborhood unit. If part of the space in a residential complex could be allocated for social or recreational functions for all the residents of the neighborhood unit, the need for constructing new facilities and spaces for these activities would decrease. These small cells would enrich the diversity of activities and the choices in the whole area.

In this scale, it should be noted that when the multifunctional cells are put together, with a comprehensive vision, the benefits much more significant of the sum of the advantages of each cell would be achieved. By looking at the area as a network of spaces while creating a collection of several multifunctional spaces (in a neighborhood or a district), a substantial area of land and create a diversity of activities could be released which attract a large number of citizens and make them return to the space several times. In addition,



1- Initial Situation - monofunctional separated spaces for necessary, optional and social activities

2- Combining different spaces and functions - reviving public and semi-public spaces for functions other than their main and during their idle hours - making mixed-use and multifunctional shared spaces

3- Final Situation - using the recoverd spaces to increase the surface of the existing functions or define a new one

Fig. 9. The combination of activities and in consequence, land release for new ones lead to a high-quality space. Source: authors.

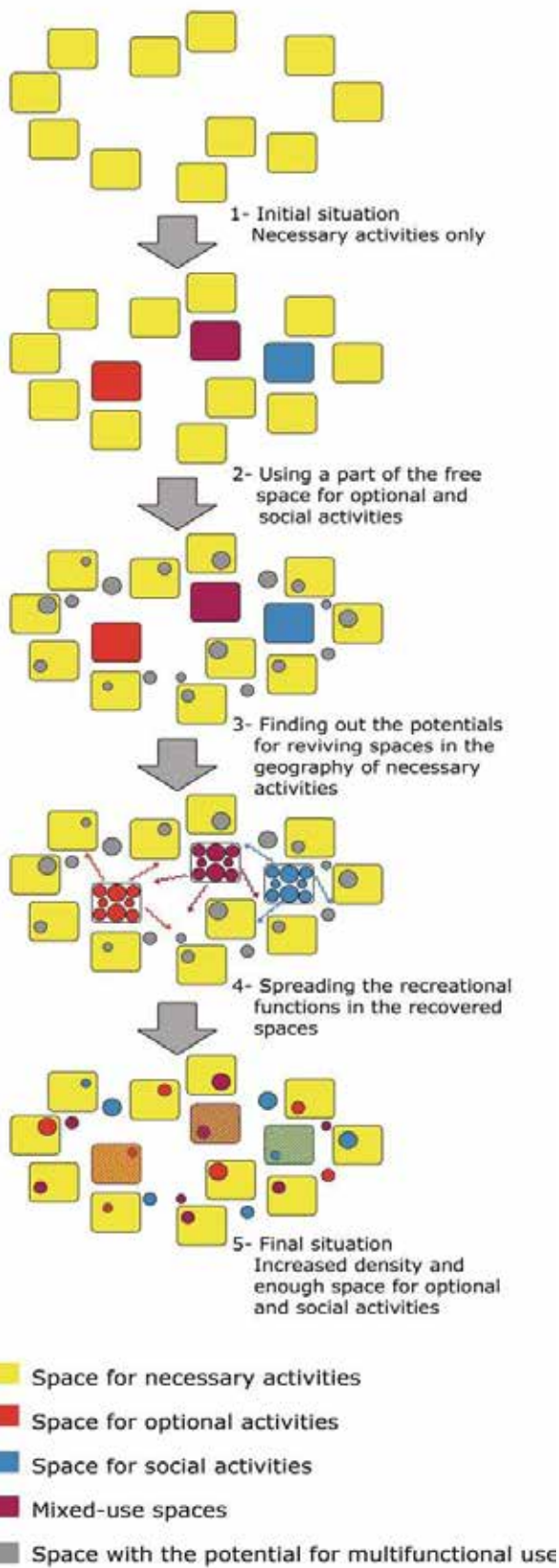


Fig. 10. Combination of activities in the scale of a neighborhood unit. Source: authors.

improve the functional performance of an area, makes it more efficient economically. These benefits are shown graphically in Figs. 10 & 11. According to what was said, it is concluded that multifunctional use of urban spaces may reduce the requirement to create new capacities in order to meet the needs arise from growing population and increasing urban density. It also enhances the quality of life of citizens ensuing increased opportunity for optional and social activities in the city (in existing spaces that have been used in a multifunctional way). This type of view has other advantages summarized in Table 2.

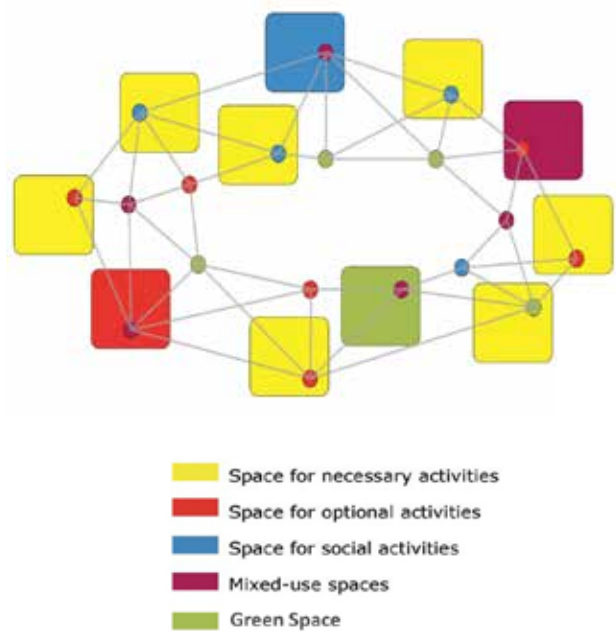


Fig. 11. Graphic representation of the idea in a local scale: a network of spaces dedicated to optional, social or multifunctional activities leads to increasing the quality of life of residents. Source: authors.

Table 2. The benefits of sharing use of urban spaces. Source: authors.

Economic Impacts	Environmental Impacts	Social Impacts
Reduce the need for new constructions; Reduce the need for urban travel; Improve the economic performance of the whole space; Save scare space by intensifying its use; Receiving a greater number of people at the same time.	Reduce the material use and pollution caused by new constructions; Reduce urban sprawl and increase density.	Save travel time and increase effective time for activity; Increase the diversity of activities in an area; Create a vital attractive area that must be re-visited; Improve the citizens' quality of life.

Endnotes

*This paper is extracted from Doctoral dissertation of “Atieh Ghafouri” entitled “Sustainable Urban Form; Multifunctionality and adaptation” conducted by Dr. Christiane Weber, in 29 June 2016, University of Strasbourg, France.

1. A “Dovecote” is a structure for gathering pigeons or doves for

agricultural use. Their droppings were prized by farmers and were thus collected for fertilizing their arid fields, in leather industry and gunpowder. The possession of a Dovecote was a symbol of status and power and was consequently regulated by law. In Iran, these Dovecotes could be found near Isphahan and Yazd.

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