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Landscape Information Modeling With the Approach of Controlling Urban Metabolism

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Abstract

Paying attention to the environmental dimensions in the urban landscape has increased in recent years due to the growth of urbanization and the performance of human activities in it, which has caused human intervention in nature and disruption of the natural order. These changes, which have been applied to meet the human needs in the urban ecosystem, have emerged as effective and destructive services of the ecosystem and have caused disruption and instability in the mechanism of the natural landscape of the city and healthy human life. In order to establish sustainability in the urban landscape, which has been provided the context for human and environmental activities, it is necessary to control the destructive environmental factors by employing assessment tools.regarding the importance of environmental sustainability and the landscape as part of nature and a dynamic and complex ecosystem, urban metabolism has been used in this research to evaluate and control ecosystem services. Firstly, the background and the indicators of the urban landscape and metabolism were reviewed in the relevant, authentic books and articles. Then the factors affecting the control of metabolism in the urban landscape were explained since the metabolism had been used was used for urban planning in the previous studies, and it had been used less in the field of stability control in the landscape. Moreover, since the landscape has a multifaceted approach, there were many variables in different dimensions for landscape stability management that required multi-dimensional planning and management; therefore, the landscape information modeling (LIM) method was used in this project to master the whole discussions. Furthermore, landscape information was divided into seven dimensions with the help of the records of the architectural information modeling method. Finally, to create a conceptual model that fully would express the relationship between urban landscape metabolism and landscape information modeling, we needed to use a management strategy. In order to meet this challenge, Thompson and Martin's management strategy models were used because both aspects of landscape information modeling and urban metabolism control on sustainability path were examined simultaneously in this method. Finally, general preference was measured to achieve sustainability and establish a perfect balance at the end of the process.

***Keywords*:** Urban metabolism, Landscape Sustainability, LIM, Ecosystem services, Public preference

1. Introduction

Cities, as an artificial phenomenon, which are the result of human needs and changes in the natural context, have principles and laws, and they must be recognized to create compatibility between humans and the background. Failure to pay attention to the natural system in 1960-70 led to environmental crises due to industrial approach and human activities, which left harmful effects on citizens and nature. Then came the concept of sustainability, which means the permanence of the pattern or system of phenomena over a long period. Various conceptual models have been presented to express the subcomplexes of sustainability, most of which share environmental, economic, and social sustainability as key issues (Alberston, 2004). In addition, the environmental sciences have considered cities as the main source of environmental problems, destruction, and depreciation of natural resources in recent decades (Chen et al. 2008, 28), because the cities absorb valuable resources (such as food, fuel, water) and produce undesirable waste, including greenhouse gases, which have caused environmental instability.

On the other hand, cities have drawn attention due to the concentration of population in a relatively small area of land as a sustainable solution for the growing global population, because this method is the most cost-effective solution for transportation, drinking water supply, health services, electricity and other social services (Wu, 2013); According to Wu, creating and controlling sustainable cities are a daunting challenge because, in addition to the two-dimensionality of the city towards sustainability, it is necessary to identify and measure appropriate strategies and criteria as indicators of urban sustainability; moreover, due to the close relationship between cities and surrounding landscapes, sustainable solutions require consideration of landscape ecology broadly and beyond the political boundaries of the city and it is considered as a necessary whole (Wu, 2010). To create a desirable condition and reach new coordination between nature and the earth's inhabitants, a close inspection of social, biological, skeletal is needed to help reach an ideal condition (Kamyab Teimouri, 2015). Landscape

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designers play an important role in providing sustainable solutions by linking science and experience and, ultimately, politics (Nassauer and Opdam 2008; Swaffield 2013). A sustainable city is an environmental context for sustainable development and social welfare for the people of the society. Landscape as a bridge between nature, man, and the city and the one related to the urban environmental context can be a key element in displaying balance establishment and sustainability in the cities. Some part of the inherent factors of the landscape, as a complex, is related to the city's quality, and its other part is related to the complex ecosystem, and it is a context for performing biological and ecological activities and processes (Aminzadeh 2015, Golkar 1999). Ecosystem services are a tool formed to meet human needs in the urban landscape, and they are effective in human comfort and health (Saimon Bell, Bernard Lassus, Golkar, Masnavi). Also, the more ecosystem services are formed according to the desire of the people, the more public preference will increase, and thus the urban space will be welcomed more, leading to strengthening social sustainability. Of course, it is also important to note that uncontrolled exploitation of ecosystem services due to destructive generative services can be associated with serious environmental damage. For this reason, they should be evaluated and controlled with the help of environmental control tools, and landscape tools should be used for training and displaying in this regard.

The purpose of this research is to manage different aspects of the landscape in order to achieve balance and sustainability. In order to achieve this target, the emphasis is on controlling urban metabolism and paying attention to its consequence and proper utilization of ecosystem services which leads to environmental sustainability. Landscape can be a tool for transferring knowledge and innovations to reduce urban metabolism in urban open spaces. Moreover, to attract people's participation, the landscape should be designed and planned according to their preferences.

Urban metabolism has been used as a tool for urban planning in past researches. While emphasizing the importance of the communication and educational role of landscape in controlling urban metabolism, this research has studied the objective and subjective aspects of landscape and attention to the people's preferences and needs. This important issue is in line with accessing a managerial method in order to achieve equilibrium in sustainability. The second purpose of this research is a detailed and comprehensive examination of landscape factors and their classification, which landscape information modeling method has been used. In order to establish the relationship between modeling and metabolism, the strategic management method of Thompson and Martin has been used too, which after the integration of landscape information modeling and metabolism in the landscape because metabolism is a social, environmental process, it must be preferred by the public at the end of the process so that a comprehensive model could be achieved by the help of landscape information modeling and landscape metabolism. Since the landscape is in direct contact with individuals, the process remains unfinished if not socially accepted.

2. Theoretical Foundations

2.1. Landscape

The landscape is a complex of several disciplines, including geography, ecology, urban design, environmental design, and architecture, each of which has its characteristics and must be properly managed (Taghvaei, 2012). As a profession, landscape architecture (LA) provides site planning, design, and management advice to improve the landscape's character, quality, and experience (Deveikienė,2018). Landscape architects apply solid design processes and implementation methods, elaborated on and explained in an increasing amount of studies and publications on those topics. For example, Langley et al.2018 and Yue and Shao 2010 summarize the core knowledge domains of LA, including the evolution of analytical methods for LA planning and design. In general, it can be said that the landscape has a multi-purpose approach known as a whole and is composed of natural and man-made elements that human intervention and influences have exposed nature to changes (Breuste, 2008, Ufitavan). Multipurpose landscapes are landscapes that offer a wide range of useful functions in economic, ecological, and cultural dimensions according to the needs and preferences of owners and users (Otte et al. 2007; Lovell et al. 2010).clients and the general public are no longer only interested in the aesthetic value of landscape but also increasingly concerned about ecological functions and environment conservation (Grose,2019). As an environmental designer, Simon sees the landscape as a manifestation of changing processes in nature. Some of the processes are ecological and cultural, but all of them have been effective in changing landscapes over time. He considers geological processes, natural landscape form and its natural patterns, hydrology, wind, and other natural factors to describe the landscape effectively. He somehow refers to a connection between several ecosystems, or in other words, a larger ecosystem (Bell, 2007). Therefore, in the urban landscape, the balance of natural elements and the artificial environment is considered an important goal in the development of urban sustainability; because it increases the quality of human life and the effects of people's needs on the elements of nature and the city (Kaplan, 1995).

Moreover, another reason for the importance of the landscape in urban sustainability is related to the fact that, as a time-based approach, it can be a context for organizing the residents to act and learn since it can change, improve and self-organize in unstable conditions (Tidball and Krasny 2009; Krasny and Tidball 2012). Furthermore, the multipurpose function of the landscape can serve as a framework for changing the correlation between the social and environmental dimensions of the system in ways that benefit humans (including deprived social groups) and the environment. also Urban green spaces and landscape are vital parts of any city due to their capacity to provide a large number of urban services

to a wide range of stakeholders (Farahnaki & Barakpur 2019). The landscape of cities is composed of natural and human ecosystems, and in this respect, the city has a specific value as an ecosystem. Invading and occupying the urban landscape can affect the citizens' relationship with the natural and artificial ecosystem of the city and the extent to which they use the ecosystem services, which will be examined in detail below.

2.2. Ecosystem

The word ecosystem is a combination of two English words of ecological and system, and it is a collection of living things and their habitat. In other words, ecosystem structure emphasizes the distribution of biological and non-biological components and the complex interaction between the members of an ecosystem that transform the ecosystem structure into the performance and ultimately to services (De Groot et al. 2002. Wallace, 2007). Thus, ecosystem performances are intermediary between ecosystem processes and services and can be defined as "the capacity of the ecosystems to provide goods and services that meet human needs directly and indirectly" (De Groot, 1992). The MEA (millennium ecosystem assessment) approach is the first large-scale millennium ecosystem assessment system in which ecosystems are seen in terms of the services that they provide to the community (MEA (2005). A landscape is a nexus between nature and culture. The nexus approach focuses on the links between people and ecosystems (Fürst et al., 2017). The concept of urban ecosystems has been defined as “those in which people live at high densities, and where built structures and infrastructure cover much of the land surface (Pickett, 2001). Cities themselves are microcosms of the kinds of modifications occurring, making them informative test cases for understanding the dynamics of the socioecological system and response to change (Grimm,2008).

2.2.1.Ecosystem services

Ecosystem services are, in fact, the benefits and advantages that humans get from ecosystems (MEA, 2005). According to Wallace, ecosystem services are something that people consume or individuals experience, and the rest are part of the ecological structures and processes that bring benefit (Wallace, 2007). Also, due to ecosystem services, biodiversity of natural ecosystems and species is preserved, human life becomes possible, and the production of ecosystem goods such as seafood, natural fiber, and fodder, industrial and pharmaceutical production is guaranteed (Daily, 1997). Managed ecosystems, such as natural systems, can provide important performances reflecting "the capacity of natural processes and components to provide goods and services that meet human needs directly or indirectly" (De Groot 1992, Jenk & Jones, 2009.3).
Using ecosystem services enables human beings to meet their needs and maximize the use of ecosystem components, both biological and non-biological, which can cause instability in the cities. In order to solve this problem, it is necessary to seek the help of environmental control and evaluation tools. Environmental impact assessment is a method that aims to ensure making decisions that may have a significant impact on the environment. Assessing environmental impacts is the measurement of the various aspects of the environment regarding the way the decisions and policies are made (Tukker 2000). Utilizing more and more ecosystem services in cities to meet the needs of the people is associated with increased metabolism and weakening the sustainability of the city. Therefore, the issue of the relationship between the use of ecosystem services and metabolism in cities is an important issue that is examined below.

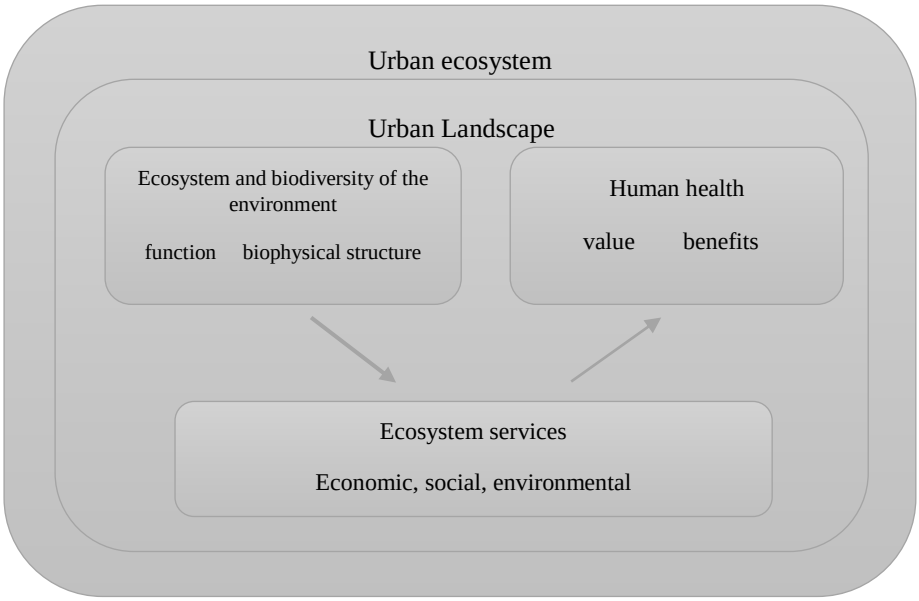

Fig.1. A framework for linking ecosystems to human welfare in the city landscape. The source:
The Author of this paper, based on Haines-Young and Potschin and the above-mentioned theoretical literature.

2.3. Urban metabolism

The concept of metabolism is adapted from biology science, in which the physiological process of living organisms such as water provides required materials. The chemical reactions in organisms entered into urban studies later (Tarr, 2002, Wachsmuth 2012).

In 1965, Wellman was one of the first people to talk about urban metabolism. A key feature of Wellman's view has been considering the urban area as a key component of metabolism, which is essential for the development and sustainability of cities. In Wellman's view, the city is a living and dynamic organ with different inputs and outputs, and in order to evaluate urban metabolism, the energy cycle, water, and wastes in a city must be considered. It also provides a broad framework for analyzing input and output sources to the urban system and its relationship to its surroundings (Kennedy, Engel, Cuddihy, 2007, Patterson and McDonald, 2007).

After Wellman, studies on urban metabolism began and received more attention in the last decade. Metabolism is first and foremost a process between man and nature (The exploitation of ecosystem services), in which man, through his actions, mediates the regulation and control of metabolism between himself and nature. In this way, he masters the external nature and changes it. He also changes his nature simultaneously (Marx, 1970: 283 and 290). Urban metabolism can be defined as "a complex of technical and socio-economic processes that take place in cities and lead to growth, energy production and disposal of waste" (Kennedy et al., 2007). In other words, urban metabolism can be considered as the process of transfer and cycle of water, energy, and materials to the city (ecosystem services) for the sustainability of biological, economic, and social activities of the city (Huang, 2003). With regards to the characteristic of urban metabolism parameters which can be criteria of sustainability, McLaren has stated that it should have scientific credentials (based on the principles of energy conservation and mass), to be representative, accountable, relevant to urban planners and residents, based on data that is comparable, understandable and unambiguous over time. (Maclaren, 1996)

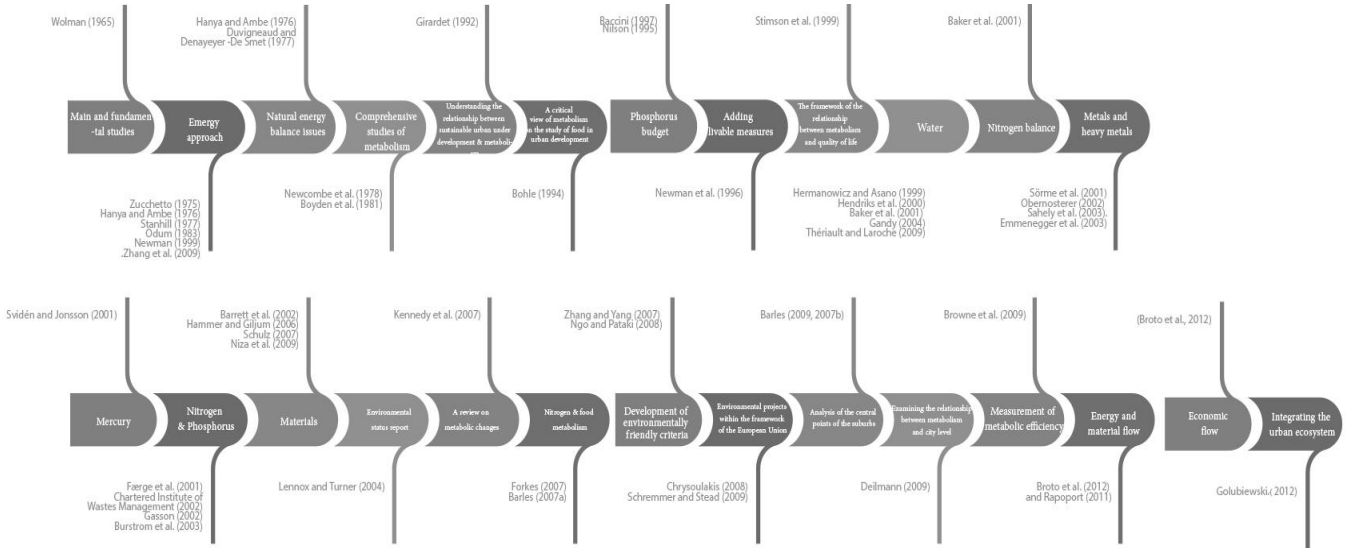

Fig. 2. Fundamental topics of urban metabolism studies since 1965. The source: The Author, based on the previous research.

2.3.1.Landscape-related factors affecting urban metabolism

The concept of metabolism is a combination of urban biochemical processes and spatial and cultural complexes, which is raised as a major challenge for multi-purpose landscape[1] design (Sheppard, 2017). In order to examine the metabolism, different categories have been made in research, in which various factors such as space function, input, and output materials or the framework have been considered. Many of these cases were not directly related to the landscape, but they can affect the quality of landscape perception. Metabolism is indirectly related to the subjective and objective aspects of the landscape because urban metabolism is related to the utilization of ecosystem services. As mentioned before, ecosystem services in the city are directly related to the quality of the ecosystem and the consequence of the quality of the urban landscape. In this article, in order to achieve a model for

1. A multi-purpose landscape, as a sustainable solution, can simultaneously meet the components of location, create a responsive environment, and prevent the expansion of spaces without urban use and the uncontrolled growth of cities. Moreover, the importance of landscape in cultural, environmental and economic dimensions, etc., has turned it into a multi-purpose space. Furthermore, landscape is a multi-layered process that involves the temporal formation of different spaces through the production of tangible product in transmission design and tangible facilitators such as background, history, processes, links, and meanings (Carmona, 2010).

the relationship between landscape design and optimization of urban metabolism and relying on various library resources, landscape and indicators related to its objective category have been examined in two general soft and hard categories as well as in the physical and activity subcategory, shown in diagram 3.

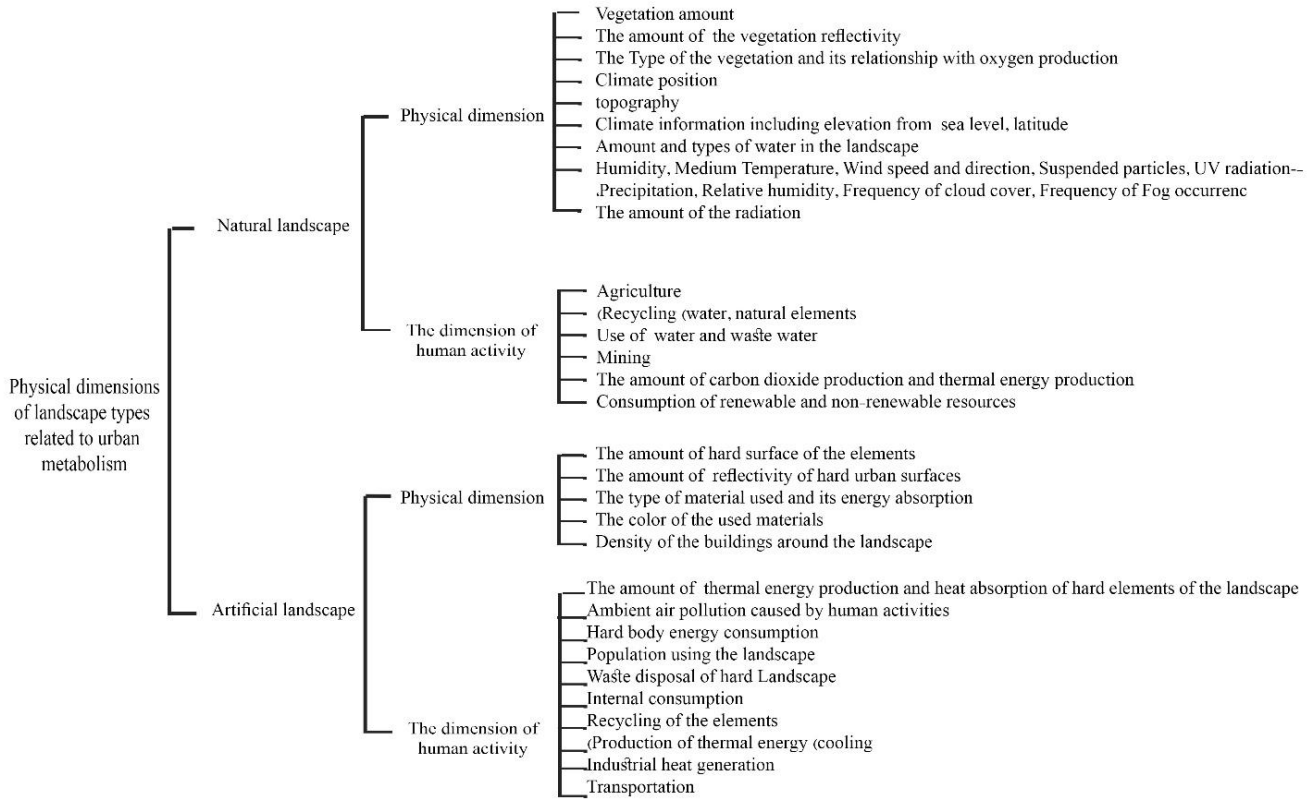

Fig.3. Metabolism factors in the landscape:
The source: The author, based on Beijing Zhang 2013, Barles Zolo, Lola Sheppard, 2017, The Workshop as well as the Sixth International Conference of Sustainable Cities System

2.3.2.People Preference

Urban metabolism and its control can help improve the objective quality of the landscape, environmental sustainability, and the healthy and clean life of the people by protecting the natural ecosystem and its values. Of course, paying attention to the urban metabolism control should not reduce the objective and subjective values of the landscape as much as possible. One of the landscape aspects that does not receive significant attention in urban studies is the perceptual dimension (Eirani-Behbahani et al.,2017).

It is also very important to consider the human dimension and people preference to create strong stability in city and urban spaces. The development and prosperity of public spaces and cities depend on social life among the people. The urban landscape is the simultaneous space of presence (Hannah Arendt, 1958). Therefore any action in urban spaces should lead to getting public attention. Therefore, if the ability to control environmental sustainability in urban spaces in various ways such as controlling metabolism and its management occurs but it does not acquire the general preference and attention, the desired result will not be achieved in the end.

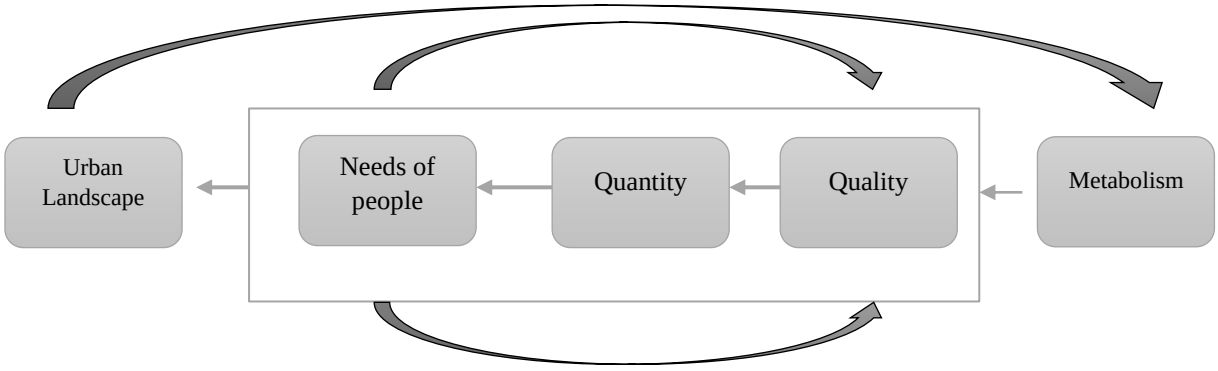

Fig.4. Relationship between landscape, human and metabolism,

From Montgomery's point of view, urban spaces are created by linking three elements of physical space, sensory experience, and activity(Montgomery, 1998: 94). Landscape of urban space, when it meets the needs of users in all dimensions, can help to improve the quality of life in various aspects and collective culture due to the acceptance and comfort of citizens the environment; moreover, the landscape can be used as a tool to educate and promote citizens' culture in dealing with the environment, getting benefit from it and reducing environmental conflicts.

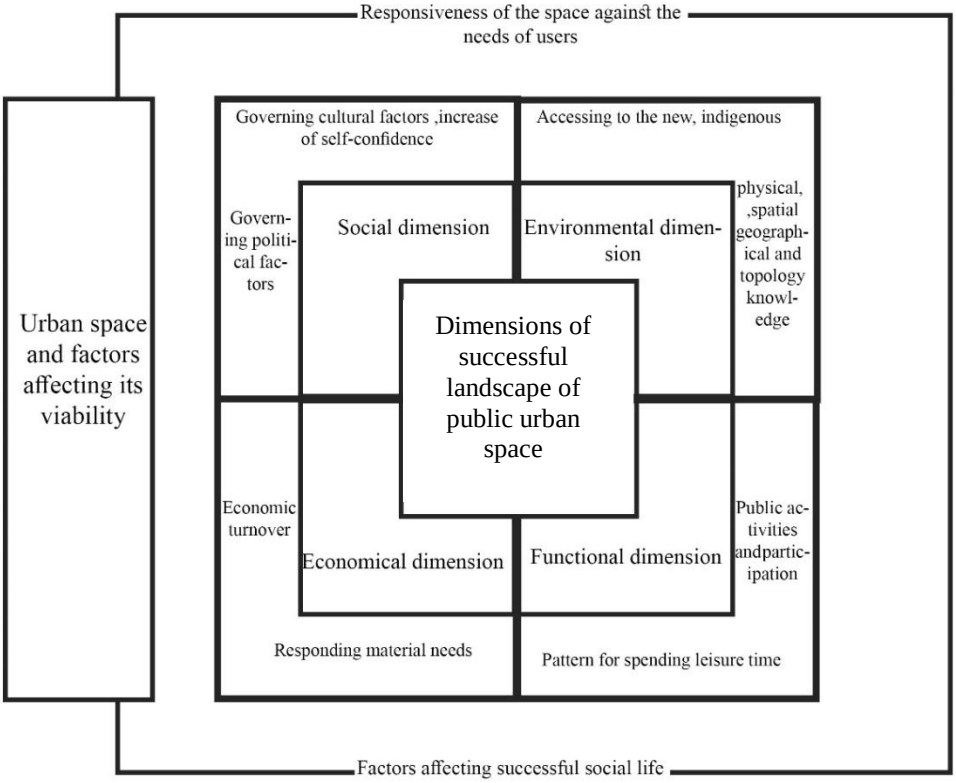

Fig. 5. Factors affecting the success of public space landscape based on the viewpoints of Kaplan & Kaplan1989, Carmona &, et al. 163: 2003, Montgomery 94: 1998, Al-Kodmany 1999؛ McCall MK, Minang 2005.The Reference: based on the authors mentioned above

As mentioned, the landscape of the urban spaces can be a tool to transfer knowledge and innovations related to reducing urban metabolism, in which the landscape of public and open urban spaces is of particular importance. Therefore, urban public spaces should be designed and planned according to their preferences to attract people's participation. The participation of the target community in the implementation and planning of the landscape of public spaces is a top-down approach that encourages people to cooperate so that the planning for solutions is not to be imposed from the top side. Participation of the society in the planning process, at the beginning of problem identification with the help of landscape design and management, can lead to more sustainable and successful interventions in the urban landscape. Therefore, being aware of the needs and preferences of the people and designing the space by considering these needs and their participation is one of the most important conditions for attracting people and the success of public space. Therefore, it will not be possible to consider only the tools of environmental control and urban metabolism and its management without public acceptance and path education.

3. Materials and Method

The multifaceted nature of the landscape causes various parameters to be involved in examining how stable it is. Also, being interdisciplinary has made the need for communication between different groups to be felt more. For this reason, it needs careful management and planning to control all factors and parameters, establish appropriate relationships with processes, and achieve a balanced system. In addition, the daily increase of changes in the landscape and the use of new protection methods need a more comprehensive and integrated information platform to help make decisions in day-to-day management. On the one hand, todays, the pressures of urban development, the uncontrolled development of tourism, and climate changes mean that landscapes are changing rapidly (Eetvelde & Antrop, 2004).

Not considering the dynamics of the city, especially the mental and psychological relationship of citizens with the issue is the weakness of the metabolism of the early models, which came to attention in the late 90s. Advanced metabolism models embodied valuable and special aspects of urban systems. According to Newman, events

more than the metabolism of resource consumption and waste generation occur in a city (Kenworthy & Newman 1999). For this reason, there is a need to review updated comprehensive information.

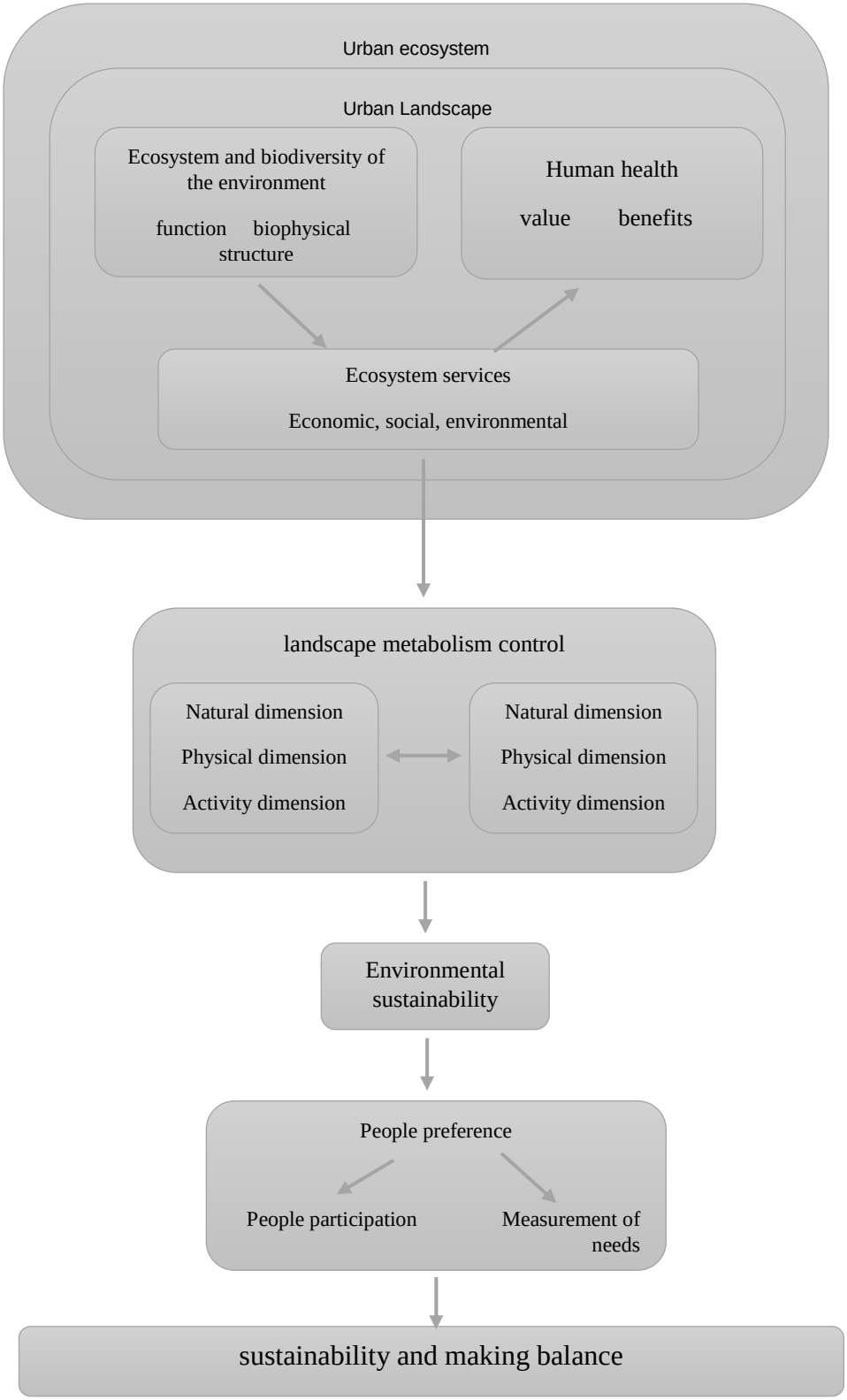

Fig. 6. Establishing sustainability in the urban ecosystem based on the theoretical literature of the research.Reference

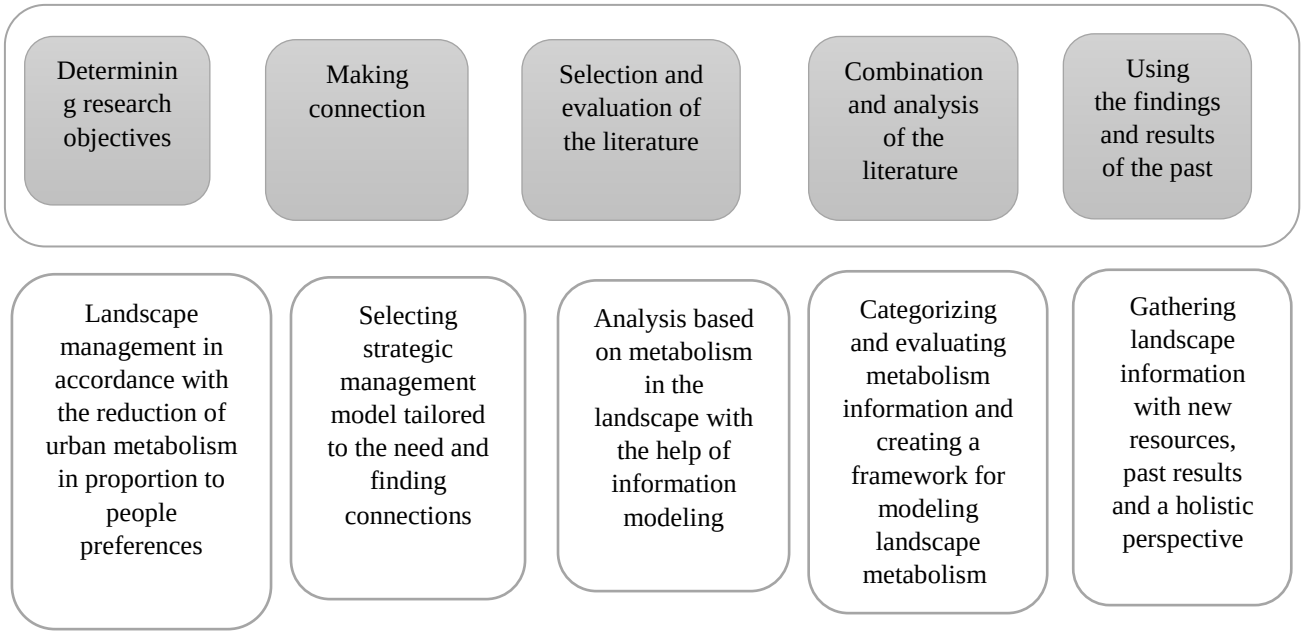

Fig. 7. Research process.

3.1.Information modeling

A landscape is simultaneously a unit and a system, depending on the role' and the scale in which we wish to examine it(Farina 2010) .The performance of a system as a whole relies not only on the parts' role but foremost on the accuracy of the rules that define the relationships among parts, as they are vital for their successful synergistic operation. In any case, its internal organization is a system comprised of specific sub-systems that perform both individual and collective processes. The balanced interaction among the composing parts is vital for the existence and maintenance of the system. Furthermore, the landscape is self-organized and self-maintained, capabilities that have a binding effect on the system's performance. Cities, as urban constructions built into the patterns of pre-existing land systems, are also landscapes, with the addition of human presence and all of the consequences it has on the dynamic balance of the receiver. The urban landscape system, apart from the internal harmonic function of its subsystems, needs an ecological balance of human, animal, and plant life, not only among themselves but also the given exterior conditions (Alexander, 1964). Therefore for addressing each landscape design problem, we have to consider, to the optimal degree, even integrate directly into the design process, these interrelations among subsystems

The concept of BIM[2] was published by Autodesk Whitepaper in 2002 and was promoted globally. BIM is used for information modeling in order to examine the physical and functional aspects, building properties, as well as providing information and drawings related to the life cycle of the building (design, construction, and operation such as location relationships, quantities, properties of components, etc.), plans and cost estimates and it is a context for exchanging work and reviewing tasks in a group project. Furthermore, change management could be mentioned as one of the main features of the architectural information modeling, in which any change to be made in any part, its programs and records could be observed in general, and the team members can use it (Bernstein, 2005; Autodesk, 2002; Bently, 2019, Ratajczak, et al. 2011).

Information modeling system (Weygant, 2011) is a process (Ohio, 2010), a design method (Bentley, 2011), and even a method of thinking (Hardin, 2009). Despite the widespread use of BIM in architecture, this software is still not used in landscape architecture (Goldman, 2011). Some researchers began to explore the use of BIM in landscape architecture (Ahmad, ALIYU, 2012; Goldman, 2011; Erwin, 2001; Gil, 2013; Zajikoko and Akhtan, 2013). Presently there is no specific and comprehensive digital tool for landscape architects. BIM software that can be used for landscape architects includes various software such as Vectors works Landmark, Land F/X, Land CAD, Site works, Archi Terra, AutoCAD Civil 3D, Autodesk's Revit, Grahisoft ArchiCAD. This software should show the physical and intrinsic characteristics of the landscape in the landscape aspect. ArchiCAD and Autodesk have been tested and have been more useful in landscape architecture among these tools (Appleton et al., 2002; Wissen-Hayek et al. 2011), but they do not meet the needs of the landscape fully, and they are not perfect.

2 . Modeling Information Building (BIM) is a process based on a three-dimensional model and a digital representation of the physical and functional characteristics of a center, which includes a shared source of knowledge for information about a center that forms a significant basis for decision-making throughout its life cycle. It also includes planning for civil engineers, architects, as well as a tool for construction specialists in planning, building management and more efficient infrastructures (Autodesk, 2019, NBIMS-US, 2016).

Table 1
Management software in different parts of the landscape.

Name of the Software	Capability in the field of landscape	Weaknesses	References
LCA	Life cycle assessment can be used to assess or compare the environmental impacts (e.g., energy and material input and output) of specific green spaces. This method can compare landscape design and management options, weighing the consequences of various activities such as tree planting or tree removal, use of fertilizer, and irrigation.	Only the control and management of planting design are dealt with in this method.	ISO 14040 Smith, et al.,2012 ؛ Ingram 2012
MLAT	This tool is intended to assist landowners and planners in making conscious decisions on land use, taking into account the multifunctional performance of the current system and possible future performances. Inputs include the area of each habitat, its functional characteristics, and the ratings of each characteristic based on user perception and specialized evaluation depending on the specific text of the site.	Only for assessing the design of farm systems	Lovell,2010
UFORE	Assessing the urban forest structure is made through aerial and ground measurements (random sampling) to determine tree cover area, the number of trees, species composition, tree biomass, and other related factors.	Only for forest planning	www.nrs.fs.fed.us/tools/ufore, Nowak2008

These tools are designed and programmed only in the early stages, mainly for one dimension of the landscape, and they cannot comprehensively cover a wide range of information, so they are not usable for landscape management. Due to the multifaceted nature of the landscape in the framework, function, meaning, and human relationship with the environment, it can be said that the landscape is beyond two or three-dimensional design. According to Azhar 2011, designing the plan, examining the codes, estimating the costs, putting the construction in order, identifying the conflicts detection and turbulence, facilities, all of these factors, must be analyzed and managed.

3.2.LIM landscape information modeling

The difference in the use of information modeling in architecture and landscape is the diversity of users and human activities that must be considered in its design and implementation. In architectural information modeling, only the physical dimensions of the space are discussed, and in fact, it emphasizes strengthening functional accountability. However, in addition to the need for physical information, strengthening landscape accountability is also related to users' preferences. According to Goldman, 2011, it is believed that BIM software is immature or simply not applicable to landscape architecture. This is the main obstacle to the adoption of BIM as a comprehensive tool landscape. By using the tools and programs of BIM, landscape analysis can be examined, developed, and documented for planning, designing and organizing, because BIM provides object information such as irrigation pipelines. It stores areas dedicated to specific plants and the list of different plants involved in each landscape project. It can also help in planning for hard and soft landscape elements, considering its many details, and it can also be used to store information for landscape architects to prepare and organize detailed information easily.

Zajíčková and Achten have proposed an approach for landscape design in the form of a landscape information model (LIM). In this view, he pointed to two goals of LIM: 1- Visualization of the physical aspects of a landscape 2- Understanding the non-physical and mental aspects of a landscape. Based on these two goals, ontology is a fundamental problem of LIM (Zajíčková, 2013 and Achten). In order to be precise in the needs, landscape components must first be categorized. Zajíčková and Achten identified two categories of landscape components:

1) Places such as land, land conditions, climate, micro-climates, and other items.

2) Landscape objects including "soft" materials such as vegetation and "hard" materials such as objects which are made. Erwin (2001) also proposed the six basic elements of the landscape as follows: landform, vegetation, water, structures (including architecture and infrastructure), animals (including people), and atmosphere (including sun, wind, etc.).

However, the components of urban landscapes are more diverse than buildings and hard landscapes. Swanwick (2002) considers landscape as the interaction between people and place and proposes a framework of landscape components for urban and cultural landscapes. The landscape includes three categories of natural, cultural, and social components and perceptual and aesthetic components (Swanwick, 2002). In many definitions of landscapes, people's perceptions and intangible components such as memories, myths, and associations have been listed as important components (Council of Europe, 2000; Anglard & Rogers, 2009; Swanwick, 2002; UNESCO, 2002, 2009), but BIM or LIM has not covered these components.

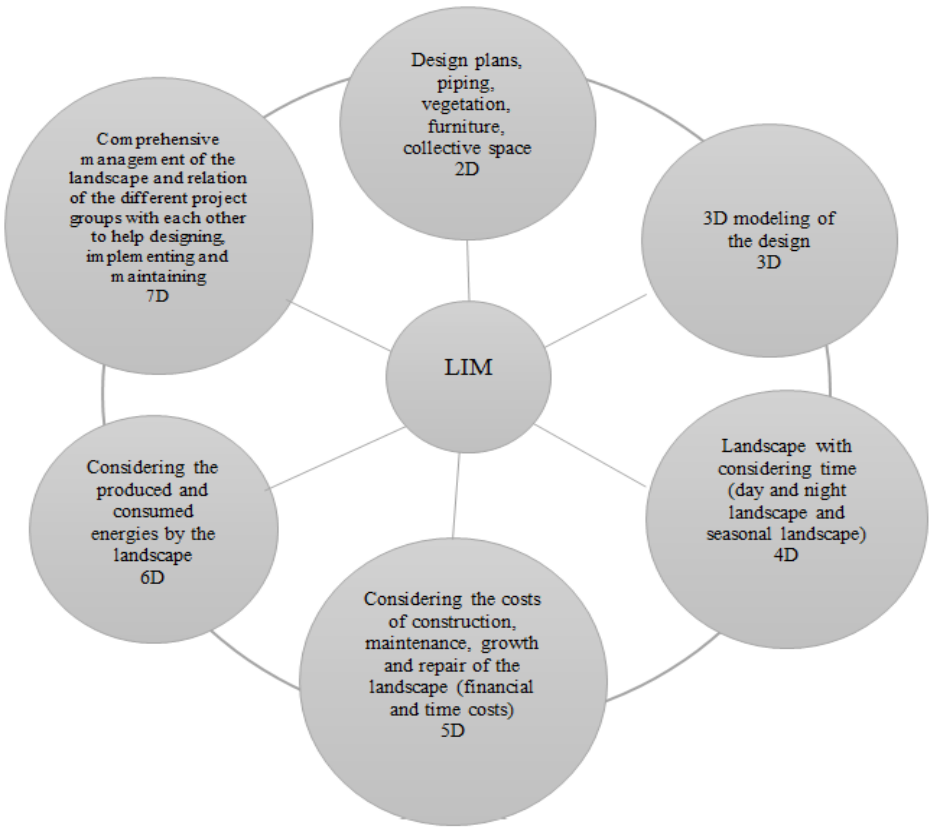

Fig. 8. Dimensions examined in landscape information modeling.
The source: The Author, based on the idea of Azhar 2011 concerning BIM

By reviewing several articles, it can be said that landscape information modeling, if it is going to be effective in managing urban metabolism, should include all the information needed in urban metabolism based on diagram 3, such as topography, site information, weather information, information related to water, soil, radiation, vegetation, materials, strengths and weaknesses, furniture and so on. In case there will be an information model for the landscape in the project, in addition to providing the possibility for controlling the input and output in order to control the metabolism, through the exchange of information models, there will be the possibility for easier integration between landscape, urban design, and architecture and a better connection will be established between these areas because landscape design exists naturally between urban structures. Parks, green spaces, public spaces, and quick visits to buildings are often the subject of landscape design. Therefore, how to achieve a comprehensive model in accordance with the multi-disciplinary feature of the landscape will be discussed in the following.

4. Analysis

In this paper, landscape designing has been employed to control urban metabolism and its consequences which causes the strengthening of environmental sustainability. In order to facilitate the control of the variables, the landscape information modeling method has also been used. In order to use the urban metabolism model and landscape information modeling simultaneously, a management method should be used for establishing a connection and balance between the two so that it can include both systems in itself. As a result, a device is needed to organize the findings in both sections of metabolism and LIM. The management model should be complex in two parts. The first part includes the integration and explanation of data, in which a meaningful classification can be done for them by selecting and accepting landscape metabolism data and modeling landscape information. The second part of this model critiques the existing structure in terms of people preference in which the data and structure can be evaluated to clarify the strengths and weaknesses between them. For this purpose, strategic management models [3] were used for conceptual modeling in this research, by benefiting from the maximum opinion

3 . According to strategic planning experts, this type of planning has major differences compared to the traditional or comprehensive planning approach, which has been proposed to address its shortcomings, and they are:
1. Strategic planning is more focused on action, results and implementation. 2. This type of planning promotes a wide variety of partnerships in the planning process. 3. This type of planning places great emphasis on understanding the external environment of local communities. 4. This approach seeks to identify the present possibilities, opportunities, and limitations of local communities through environmental studies. 5. This type of planning further emphasizes that the assessment of the strengths and weaknesses of local communities should be done in the context of its possibilities and limitations (Kaufman ,1987: 1)

of the experts (70%) and choosing among the classical (like Bureaucracy Max Weber and Henri Fayol model) and comprehensive management methods, due to including all the factors of interest in urban development, including LIM, urban metabolism, and people preference as an effective factor in decision-making to achieve sustainability

4.1.Models derived from strategic management knowledge

Heath et al. Carpenter & Saunders & Robbins & Coulter consider the strategic management process as a complete complex of commitments, decisions, and actions required to reach strategic competition and achieve above-average returns. Strategic inputs are usually derived from the internal and external environment analysis and are necessary for the formation and implementation of an effective strategy. Pierce and Robinson define strategic management as a complex of decisions and actions which are the result of the development and implementation of plans designed to achieve the goals of the company; this is while that Malehi, Farinaz, and Finley define strategic management as at least a process of setting long-term orientations for the organization.

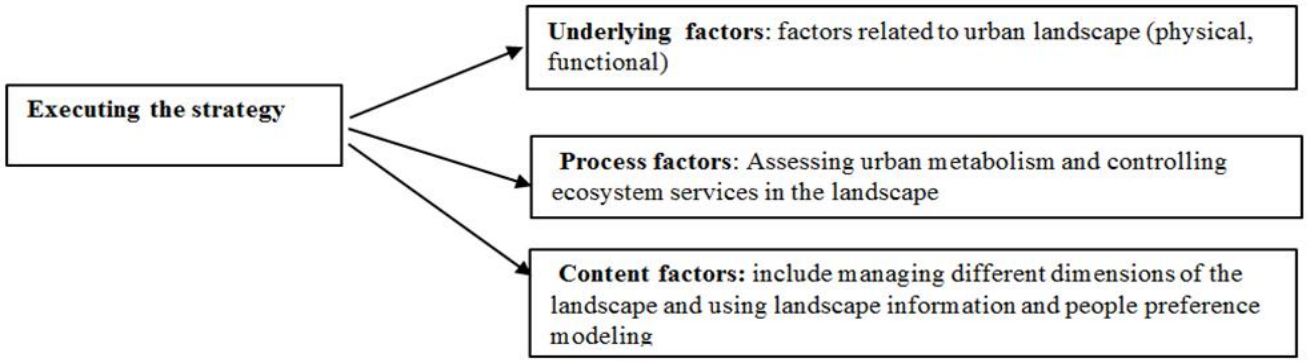

Fig. 9. Factors of strategy implementation,
The Source: The author based on the research findings taken from the model of Vandermass 2008.

4.2.Thompson and Martin Strategic Management Model

The Thompson & Martin Strategic Management Process Model, published in 2005 in "Strategic Management: Awareness and Change," introduces a new approach to strategic management models. In describing the strategic management process, they ask five key questions that executives face:"

- What are the main goals of this complex?
- What strategy should be taken to achieve these goals?
- What are the main issues of this complex?
- What are the main criteria in this complex?
- Has the company been organized in a way that supports the required goals, issues, and criteria?

In order to achieve the goals of the company, the model of Thompson and Martin examines the factors from two perspectives; so, it is suitable for this research. That is because the urban landscape metabolism can be examined as one of the parameters and criteria for landscape information modeling and as another parameter to achieve the ultimate goal of sustainability and balance.

The main goal: Achieving landscape sustainability and reducing urban metabolism

The Strategy to achieve the goal: Fit to people preference
Basic topics: Meeting human needs, Ecosystem services, City, Urban metabolism, Urban landscape

Main criterion: Metabolism in the urban landscape
The Method of supporting the goals: Select, extract, and modify data
The following figure shows the components of the strategy in the form of 12 questions from the topics of awareness and strategic change. Moving from left to right, the questions take on a logical trend. In the organizational model and part of the process, if there is a need to assess emerging opportunities and threats, the organization's strategies must be evaluated, selected, and executed before identifying the goals. So, the model can be used sequentially. Also, information confirmation implies monitoring and continuity in this context.

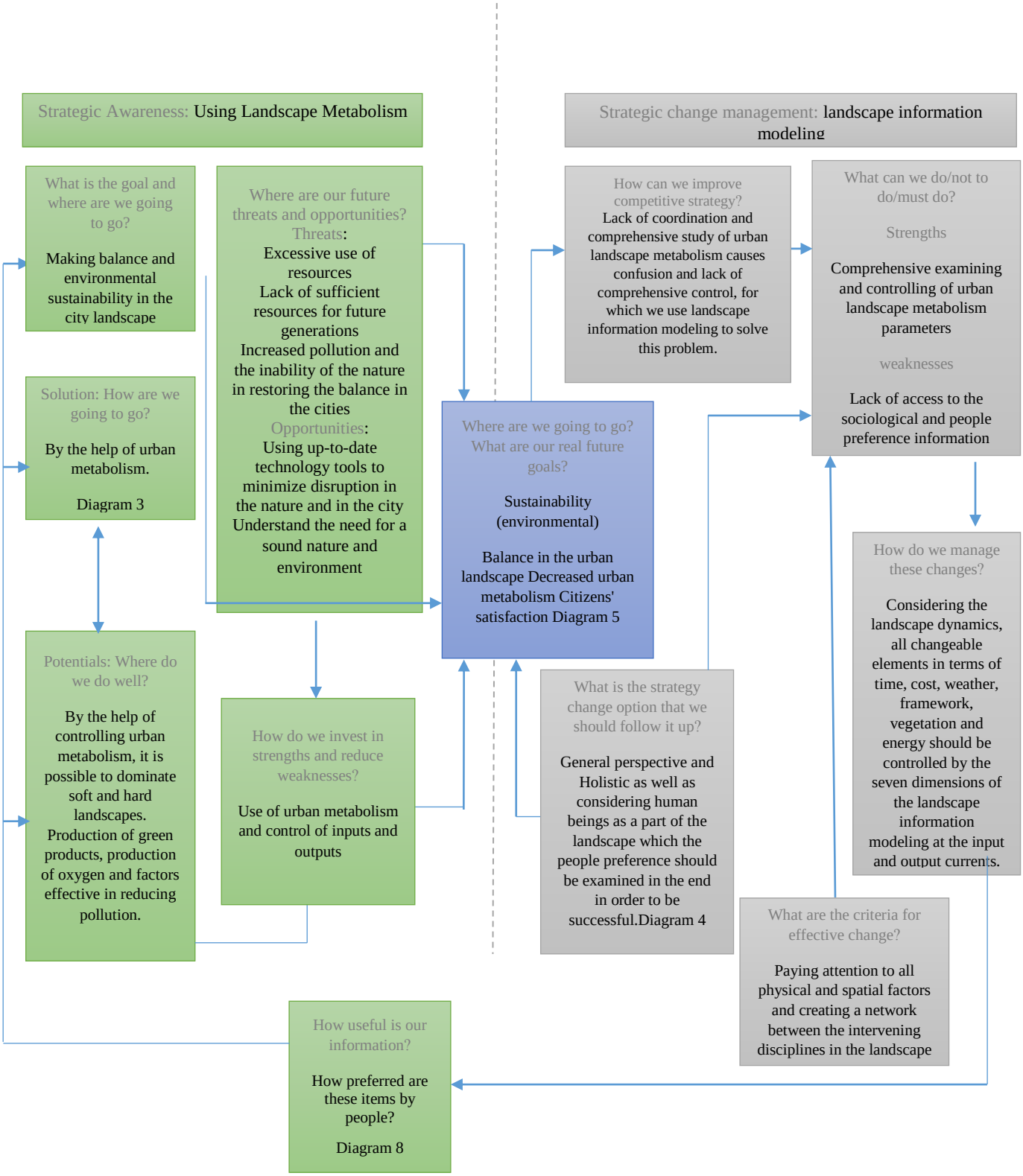

Fig. 10. Management model of reviewing urban landscape metabolism and landscape information modeling with the help of Thompson and Martin strategy.

5. Conclusion

The reviews show that the landscape can play an effective role in controlling environmental hazards and crises, which have become the main cause of concern in the sustainability of cities in recent decades. This role is because of its multifaceted approach and being a link between man and nature.

Human's ability to exploit the ecosystem to their advantage and using natural and man-made facilities, known as ecosystem services, In addition to advancing and meeting human needs in cases where it is out of

balance, has led to the destruction and waste of natural resources and instability, which is quite evident in cities as an ecosystem composed of human and natural. In this article, metabolism has been used as a control tool to achieve sustainability and balance in the urban landscape, and people preference has been used as an effective strategy. The studies conducted in this article showed the relationship between urban landscape, urban metabolism, ecosystem services, and urban sustainability, which are shown in Figures 1, 3, and 6. To achieve an effective model in landscape design, the various models presented in landscape system design were reviewed as LIM (Figure 8), which shows a detailed view of landscape system design without regard to important issues such as metabolism and people's liking to undermine achievement. It will be effective in sustainability. However, as stated in the theoretical literature, the presence of human beings in the public preference and landscape is one of the main features of a successful landscape over time and one of the main pillars of sustainability.

Moreover, the landscape can be a tool to transfer knowledge and innovations related to reducing urban metabolism in open urban spaces, which it should be designed and planned according to the preference of people to attract their participation. Due to the various dimensions of the landscape and its various components, an attempt was made to utilize the LIM with people's preference to provide more accurate planning by considering all the components and variables involved. It seems that proper planning based on people's views and preferences in urban spaces can be effective in terms of utilization of ecosystem services and strengthening the education and participation of citizens to reduce urban metabolism.

Therefore, to be more successful and achieve sustainability, it is necessary to design the landscape according to the proper use of ecosystem services and in line with its protection. Of course, paying attention to the satisfaction and preference of users in the landscape, especially in urban spaces, can greatly impact strengthening the participatory aspects. Therefore, in this article, considering the competitive advantage of strategic management over classical management and benefiting from the opinion of experts, the strategic management model of Thompson and Martin was used due to having a two-sided aspect, based on the strategy implementation process according to the diagram 8. First, the factors related to the urban landscape (physical, functional) in each sample as the underlying performance and the evaluation of urban metabolism, as well as the control of ecosystem services in the landscape as process factors and management of the various dimensions of Landscape by modeling landscape information and people, preference as content factors have been examined.

Furthermore, due to the importance of people's role in sustainability and implementation of environmental projects based on diagram 9 in the management strategy of Thompson and Martin, LIM is on one side and metabolism on the other the rate of people preference and acceptance could be placed as the last stage after the relationship between metabolism and landscape information modeling, which leads to more communication of the user with the environment as well as observing environmental factors in order to promote comprehensive social and environmental sustainability in the landscape.

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