"Biophilic" planning, a new approach in achieving liveable cities in Iranian new towns – Hashtgerd case study

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ABSTRACT

Urbanization development in Iran has caused increasing critical problems, with the result that there is a need to review urban planning in this country. This article aims to explore the impact of biophilic planning on liveability, with special focus on the role of nature as part of society. The study was done in Hashtgerd, an Iranian new town, where an environmental analysis showed that this town can be developed on the West, North and North-West, due to the natural potential of the area.

Based on the literature review and content analysis (selective coding), components of biophilic planning and liveability of new towns have been identified and used to test the opinions of 382 residents in Hashtgerd on biophilic planning and liveability of a new town in Iran. The data from the questionnaire were collected and processed, using SPSS software. The final dependent and independent variables were identified and analysed. Correlation coefficients in the regression analysis were used to analyse the effects on each other between the identified dependent and independent variables.

According to the results and findings, urban management (a component of biophilic planning) has the biggest effect in achieving liveable cities. The outcome of the study is crucial for construction and urban planning team members, clients and environmentalists. Another reason, that is particularly relevant to developing countries, is the natural potential and related industries to create beneficial social and economic impacts.

Keywords: Biophilic planning, liveability, new town, Iran

"BIOPHILIC" BEPLANNING, 'N NUWE BENADERING IN DIE BEREIKING VAN BEWOONBARE STEDE IN NUWE DORPE VAN IRAN – HASHTGERD GEVALLESTUDIE

Die ontwikkeling van verstedeliking in Iran het groeiende kritieke probleme veroorsaak en dit het nodig geword om 'n oorsig oor stadsbeplanning in hierdie land te kry. Die doel van hierdie artikel is om die impak van "biophilic" beplanning op leefbaarheid, met spesiale fokus op die rol van die natuur as deel van die samelewing, te verken. Die studie is gedoen in Hashtgerd, 'n Iraanse nuwe dorp omdat omgewingsanalises getoon het dat hierdie dorp in die Weste, Noorde en Noordweste ontwikkel kan word as gevolg van sy natuurlike vermoëns.

Gebaseer op die literatuurstudie en inhoudsontleding (selektiewe kodering) is komponente van "biophilic" beplanning en leefbaarheid van nuwe dorpe geïdentifiseer en gebruik om die opinies van 382 inwoners in Hasthgerd oor "biophilic" beplanning en leefbaarheid van 'n nuwe dorp in Iran te toets. Nadat die data verkry uit die vraelyste versamel en verwerk is deur middel van SPSS sagteware, is die finale afhanklike en onafhanklike veranderlikes geïdentifiseer en ontleed. Korrelasiekoeffisiënte in die regressie-analise is gebruik om die uitwerking op mekaar tussen die geïdentifiseerde afhanklike en onafhanklike veranderlikes te ontleed.

Volgens die resultate en bevindinge, het stedelike bestuur (komponent van "biophilic" beplanning) die grootste effek om 'n bewoonbare stad te verwerklik. Die uitkoms van die studie is baie belangrik vir konstruksie- en stedelike beplanning spanlede, kliënte en omgewingsbewustes. Die waarde van die studie is veral van toepassing op ontwikkelende lande waar daar 'n natuurlike potensiaal en verwante bedrywighede is om 'n maatskaplike en ekonomiese impak te skep.

Sleutelwoorde: "Biophilic" beplanning, bewoonbaarheid, nuwe dorpe, Iran

MORERO WA LERATO LA BOPHELO "BIOPHILIC PLANNING" KATAMELO E NTJHA BAKENG SA HO FUMANA TOROPO YA BODULO BO BOLOKEHILENG DITOROPONG TSE NTJHA TSA IRAN - THUTO YA MAHLALE YA HASHTGERD

Ntshetsopele ya toropo ka hare ho Iran e entse hore ho be le mathata a kotsi, a eketsehileng, ka ditlamorao tsa hore ho na le tlhokeho ya ho lekodisisa tlhophiso ya toropo naheng ena. Atikele ena e ikemiseditse ho lekola kgahlamelo ya morero wa lerato la bophelo "biophilic" hodima kgonahalo ya bodulo bo bolokehileng, ka tsepamiso ya maikutlo e ikgethileng hodima seabo sa tlhaho jwaloka karolo ya setjhaba. Patlisiso/thuto ena e entswe Hashtgerd, toropo e ntjha ya Iran, moo tekolo ya tikoloho e bontshitseng hore toropo ena e ka kgona ho ntshetswapele ka Bophirima, ka Leboya, le ka Leboya-Bophirima, ka lebaka la bokgoni ba tlhaho ba sebaka seo.

Ho ya ka tekodisiso ya dingolwa le tekolo ya dintlha (khouding e qoollang), dikarolo tsa morero wa lerato la bophelo "biophilic" le kgonahalo ya ho phela ditoropong tse ntjha; di qoollotswe, mme di sebedisitswe ho lekola maikutlo a baahi ba 382 Hashtgerd mabapi le morero wa lerato la bophelo "biophilic" le kgonahalo ya ho phela toropong e ntjha ka hare ho Iran. Dintlha tse bokelletsweng ho ya ka lenane la dipotso di ile tsa bokanngwa le ho tsamaiswa ho sebediswa dinolo "software" tsa SPSS. Diphetoho tsa ho qetela tse ikemetseng le tse sa ikemelelang di ile tsa qoollwa, le ho lekolwa. Dikarolo tse bapileng tekolong ya kgutlelo morao di ile tsa sebediswa ho lekola dikgahlamelo tse ding le tse ding tse mahareng a diphetoho tse qoollotsweng tse ikemetseng le tse sa ikemelang.

Ho ya ka diphetho le diphumano, taolo ya toropo (karolo ya morero wa lerato la bophelo "biophilic") e na le kgahlamelo e kgolo ka ho fetisisa ho fumaneng ditoropo moo ho kgonwang ho phela teng. Sephetho sa thuto se bohlokwa bakeng sa kaho le ho ditho tsa sehlopha sa tlhophiso ya toropo, ho bareki le ho ba tsa thuto ya tsa tikoloho. Lebaka le leng, le amanang haholo le dinaha tse holang, ke bokgoni ba tlhaho le diindasteri tse amehang, ho etsa dikgahlamelo tsa botho le tsa moruo tse nang le molemo.

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1. INTRODUCTION

To transition from the sanitary city of the twentieth century to the sustainable city of the twenty-first, new knowledge needs to be developed and applied in order to understand the role of nature in cities (Vitousek, Mooney, Lubchenco & Mellilo, 1997: 494-499).

Because of the size and impact of cities, increasing attention has been paid to their potential to remediate some of their own environmental impacts and reduce distant resource imports, using ecosystem services such as tree canopy cover, and developing underutilized or undeveloped autochthonous resources such as water (Beatley, 2010; Platt, 1994; McPherson, Simpson, Peper, Maco & Xiao, 2005: 411-416; Pataki, Carreiro, Cherrier, Grulke, Jennings, Pincetl, Pouyat, Whitlow & Zipperer, 2011: 27-36; Pincetl, Gillespie, Pataki, Saatchi & Saphores, 2012: 475-493).

Interest in the remediating role of nature in the city has had a slow and steady history since the rise of the industrial city, including some of the early designs of Fredrick Law Olmsted, using water features in urban parks to remediate water pollution, and his advocacy of parks as 'lungs' to counter pollution. Ebenezer Howard's *Garden cities*, Le Corbusier's *Contemporary city*, and Frank Lloyd Wright's *Broad acre city plan* also reflect ideas of the importance of urban nature; urban designers and ecologists such as Ian McHarg's (1971) *Design with nature*, and Spirn (1984), as well as planners such as Rutherford Platt (1994) and open-space advocates such as Charles Little (1992) took up the refrain in the second half of the 20th century. These latter thinkers advocated that nature should be considered both in designing new urban development (watersheds and their functions, for example), and in positioning buildings in cities to enhance natural elements such as cooling winds in hot summers, or increasing the availability of sunlight in winter. In the 2000s, there was an explosion of interest in the distribution of parks and open spaces relative to the equitable provision of ecosystem services (Boone, Buckley, Grove & Sister, 2009: 767-782; Heynen, Perkins & Roy, 2006: 3-25; Wolch, Wilson & Fehrenbach, 2005: 4-35; Pincetl, 2010: 43-58).

A 'biophilic city' is a green city, a city with abundant nature and natural systems that are visible and accessible to urbanites. It is not only about physical conditions and urban design (parks, green features, urban wildlife, and walkable environments), but also about the spirit of a place, its emotional commitment and concern about nature and other forms of life, its interest in, and curiosity about nature, which can be expressed in the budget priorities of a local government as well as in the lifestyles and life patterns of its citizens. On the other hand, a 'biophilic city' is at its heart a biodiversity city, a city with abundant nature, a place where, in the normal course of work, play and life, residents feel, see, and experience rich nature (plants, trees, and animals) (Beatley, 2010: 45).

Urbanization development in Iran and in the world has caused increasing critical problems, with the result that there is a need to review urban planning in this country. Spatial distribution of cities and population and their control and management were not included in a comprehensive national plan; the problems arising from rapid urban growth have become complex. It is necessary to pay attention to urban space quality, due to the influx of people. Biophilic planning and liveability issues are important in new towns. The four new towns of Andisheh, Pardis, Parand, and Hashtgerd are located and built near the capital of Iran (Tehran). For this study, Hashtgerd was selected, due to possible future development and environmental potential. Both the Daghestan fault line and the Northern-Alborz fault line near the town are considered a natural risk, as soil movement is likely to occur when the faults become active. Natural and environmental analyses of the new towns indicate that Hashtgerd can be developed in the West, North and the North-West due to its natural potential.

This article aims to explore the impact of biophilic planning on liveability, with special focus on the role of nature as part of society. The following research questions were examined:

- Is it possible to achieve liveable cities by focusing on biophilic planning?
- What are biophilic factors?
- What factor is the most effective on liveability?

2. DEVELOPMENT OF PLANNING UP TO BIOPHILIC PLANNING

2.1 Biophilia and biophilic concepts

Biophilia, a term that originates from Greek, means 'love of life' (Callicott, n.d.: online). It was coined by the social psychologist Erich Fromm and populated in the 1980s, as Edward O. Wilson pioneered a new school of thought focused on this concept, which he defined as "the urge to affiliate with other forms of life". Wilson's Biophilia Hypothesis asserts that people need to have contact with nature and with the complex geometry of natural forms, just as they require nutrients and air for metabolism (Kellert, 2005).

In 1995, William Rees, co-author of *Our ecological footprint: Reducing human impact on the earth* (1996), and Boone & Modarres (2007: 296) as well as other authors suggested that the greatest opportunities to make the changes necessary for general sustainability can be found in cities. Planners such as Scott Campbell (1996: 296) included environmental thinking as part of sustainable thinking for cities, including bioregionalism as a guiding principle, as did Timothy Beatley and Kristy Manning (1997), among others.

That we need daily contact with nature in order to be healthy, productive individuals, and indeed we have coevolved with nature, is a critical insight of Harvard myrmecologist and conservationist E. O. Wilson. Wilson popularized the

term "biophilia" two decades ago to describe the extent to which human beings are determined to connect with nature and other forms of life. More specifically, Wilson describes it as follows: "Biophilia … is the innately emotional affiliation of human beings to other living organisms. Innate means hereditary and hence part of ultimate human nature" (Wilson, 1993: 31; Gruchow, 1995). To Wilson, biophilia is a "complex of learning rules" developed over thousands of years of evolution and human-environment interaction: "For more than 99 percent of human history people have lived in hunter-gatherer bands totally and intimately involved with other organisms."

During this period of history, and further back in history, human beings depended on an exact learned knowledge of crucial aspects of natural history. In short, the brain evolved in a bio-centric world, not a machine-regulated world. It would, therefore, be quite extraordinary to find that all learning rules related to that world have been erased in a few thousand years, even in the tiny minority of peoples who have existed for more than one or two generations in wholly urban environments (Wilson, 1993: 32).

The importance of urban green spaces and urban forests is increasing worldwide, due to the expansion of urban land fuelled by urbanization. The provision of parks and green spaces in urban areas makes a vital contribution to the quality of urban life. Nature is beneficial for human beings in various ways; people in cities do not get the opportunity to have intimate contact with nature. Realizing the importance of nature in human life, theorists and researchers associated with biophilia argue that we need to re-imagine cities as 'biophilic cities' (Beatley, 2010). "A Biophilic city is a city abundant with nature, a city that looks for opportunities to repair and restore and creatively insert nature wherever it can" (Beatley, 2010: 2).

The successful application of biophilic design necessitates consistently adhering to certain basic principles. These principles represent fundamental conditions for the effective practice of biophilic design. They include:

1. Biophilic design requires repeated and sustained engagement with nature.
2. Biophilic design focuses on human adaptations to the natural world that, over evolutionary time, have advanced people's health, fitness and wellbeing.
3. Biophilic design encourages an emotional attachment to particular settings and places.
4. Biophilic design promotes positive interactions between people and nature that encourage an expanded sense of relationship and responsibility for the human and natural communities.
5. Biophilic design encourages mutual reinforcing, interconnected, and integrated architectural solutions (Kellert, 2012).

Biophilic design further seeks to sustain the productivity, functioning and resilience of natural systems over time. Alterations of natural systems inevitably occur as a result of major building construction and development. Moreover, all biological organisms transform the natural environment in the process of inhabiting it. Based on studied related theories, Figure 1 illustrates biophilic planning features.

2.2 Liveable concept

In the *Oxford Advanced Learner Dictionary*, Hornby & Turnbull (2010) refer to liveability as being "fit for life". It can be said that, in 1981, Donald Appleyard introduced the first concept of liveability as liveable streets (Appleyard, 1981). Jacobs and Appleyard (1987: 115-116) defined liveability as a city where every individual can live relatively easily; this is the necessary goal of a proper urban environment.

Liveable city refers to an urban system that helps the psychological, social, physical and personal well-being of all residents (Cities PLUS, 2003) who have the same opportunity to participate in, and benefit from the economic and political life of the city. Liveability means that we experience ourselves as citizens in the city (Castellati, 1997: 19-33).

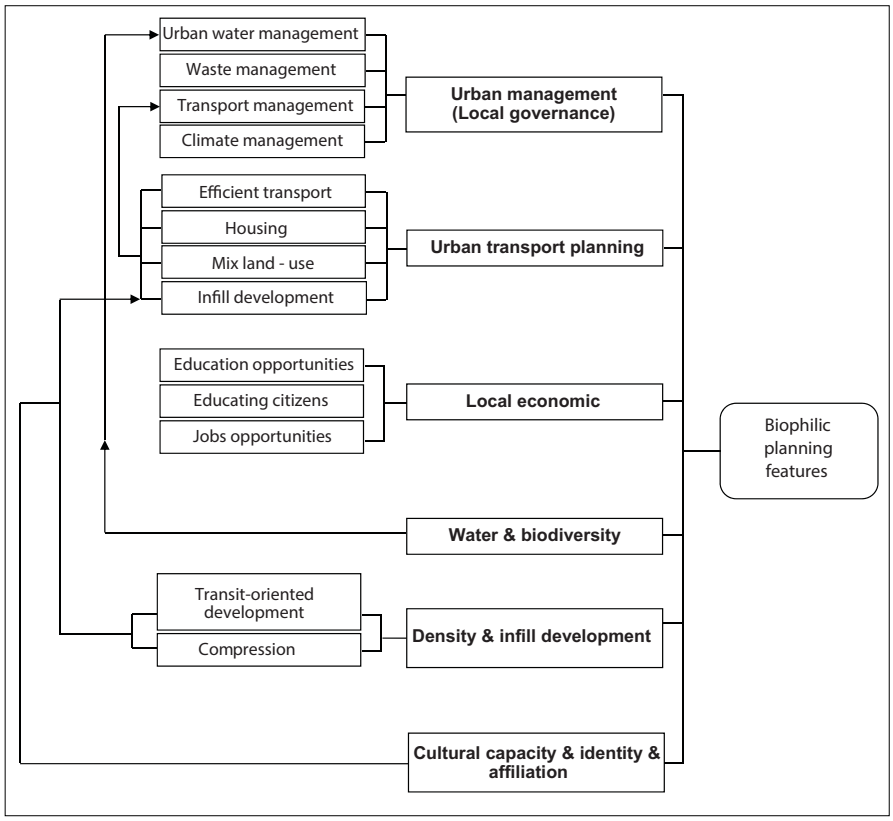

Figure 1: Biophilic features

Source: Researchers

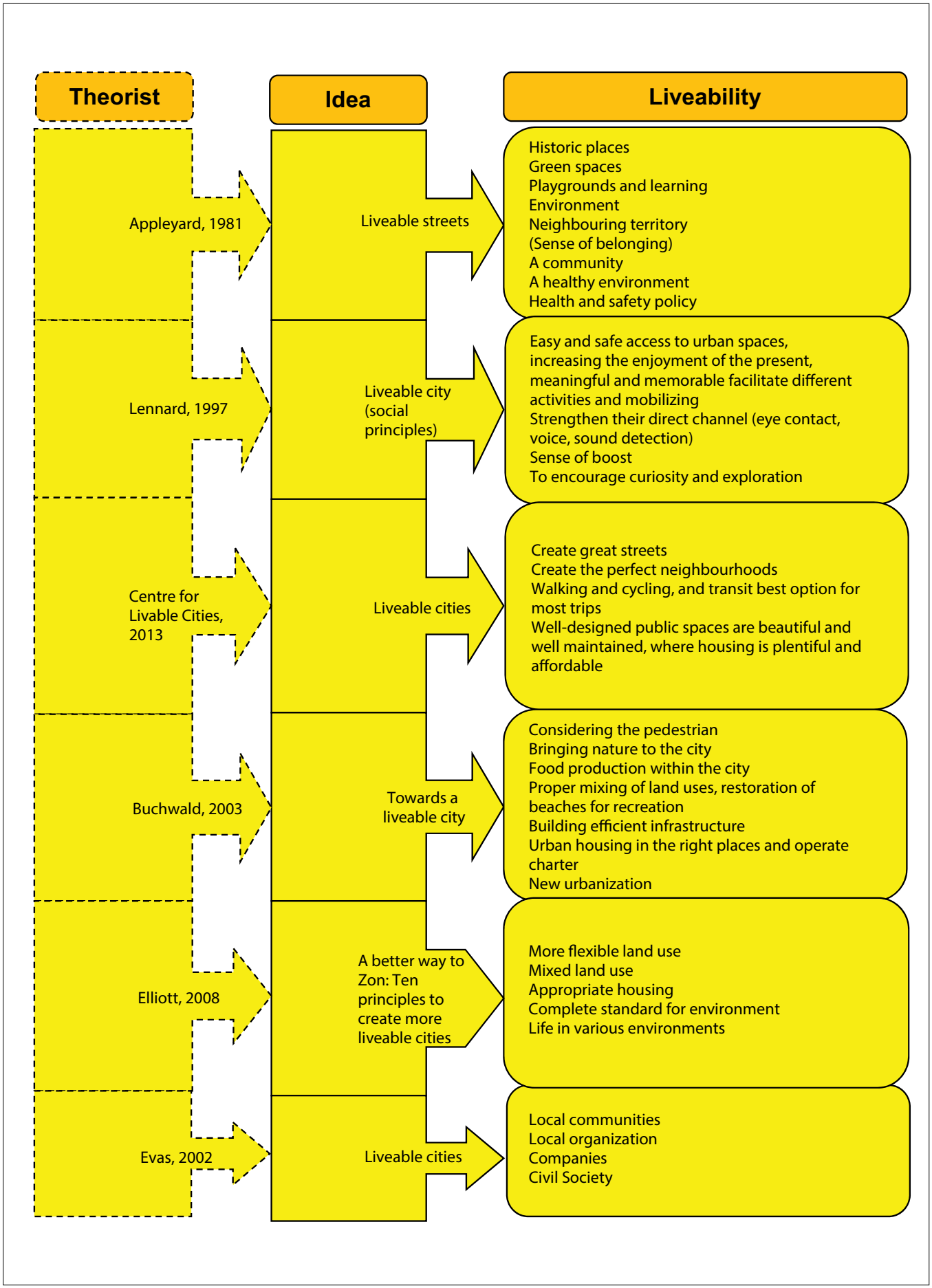

Figure 2: Different ideas about liveability

Source: Researchers

Liveable city is a city where we can live a healthy life. It is an attractive, valuable, safe city for children and seniors (Hahlweg, 1997: 13-19). These cities pay attention to creating architecture, street views and public spaces that facilitate the presence of city inhabitants in public areas. These cities are committed to reducing traffic and solving the safety problems of pollution and noise, using a range of mechanisms (Crowhurst & Lennard, 1987).

In 1997, Henry Lenard defined some factors for the bases of the city. He defined liveable city as a living organism. However, the metaphor of the city as an organism can act as a powerful conceptual framework. This framework allows us to simultaneously test different components and focus on the interdependence of these components and the natural environment (Timmer & Seymoar, 2005). Mercer Institute (2014) defined the index of living quality as political and social environment, cultural and social environment, economic environment, fun, products, habitats, clinical consideration, schools and teaching, public services, and transportation (Mercer Institute, 2014).

The Economist Intelligence Unit defined the variables of life quality as income, health, political and security stability, family life, social life, climate and geography, job security, political freedom, and sexual equality (Economist Intelligence Unit, 2013). Since 2008, the economist journal published its report about liveability index in the world's big cities. The aim of these series of reports, which are analysed by experts and city services, is to obtain the statistics of liveability quality or capability of life based on standards of great cities. Figure 2 shows various theories about liveability; Figures 3a and 3b show a summary of liveable components reviewed

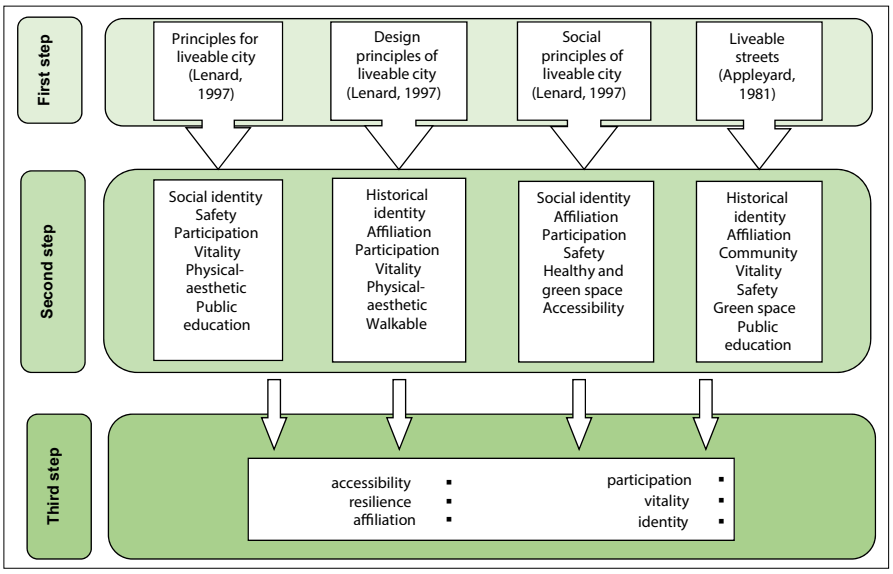

Figure 3a: Concluded liveable components

Source: Researchers

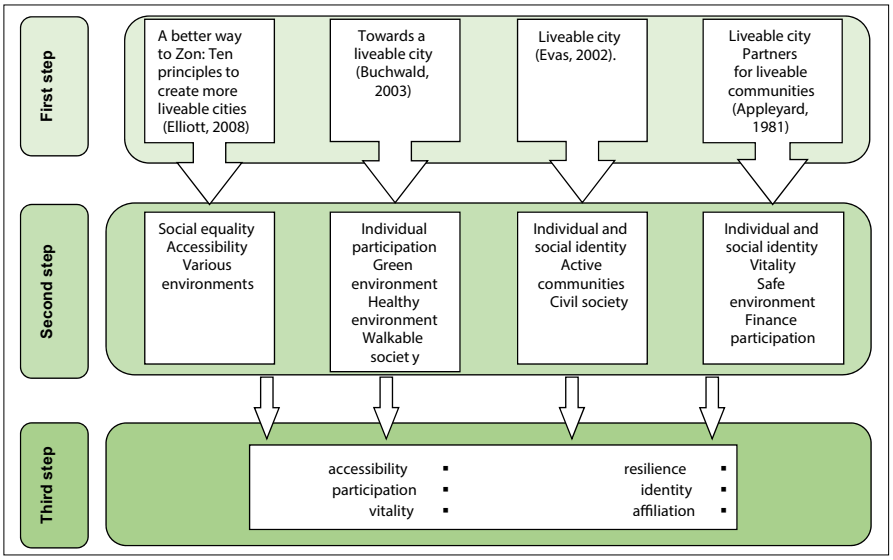

Figure 3b: Concluded liveable components

Source: Researchers

3. IRANIAN NEW TOWN SOLUTION TO POPULATION GROWTH AND URBANIZATION

Prior to 1921, Iran enjoyed a reasonable system of urbanization and urban development. It continued to be a homogenous one until 1956 when no city was superior to the other. Since the late 1950s, with rural population invading the cities and increasing urban population, the country's current problems gradually emerged. One of the most evident instances of immigration in Iran is physical and spatial instances, in the form of settlement in slums, which will eventually accelerate urbanization and the physical growth of big cities, particularly metropolises (Ajza Shokouhi & Ghrakhlou & Khazaee, 2012: 11).

The rapid growth of urban population and the patterns of urban population distribution require government plans to settle the future urban population in the existing urban areas and new towns. Therefore, since 1981, the government has started establishing new towns, with the aim of absorbing population overflow, reducing economic load of metropolises, preventing big cities to extend irregularly, local extension, optimal population distribution, and so on. In this regard, 32 cities were located and 17 towns were built. The four towns of Andisheh, Pardis, Parand, and Hashtgerd were located and built near Tehran, the largest metropolis in Iran (Ajza Shokouhi, Ghrakhlou & Khazaee, 2012: 11).

Building new towns, as a basic solution to the country's urbanization system began in 1981 and is still continuing. After more than three decades of this activity, it seems necessary to investigate the reasons why population growth is higher in some towns. Hashtgerd town was chosen for this study, as it is the most populated new town near Tehran.

4. RESEARCH METHODOLOGY

4.1 Case study of Hashtgerd

One of the main new towns in Iran is Hashtgerd. This city, located 80 kilometres west of Tehran and 25 kilometres east of Karaj, was planned as an overspill city for the fast-emerging megacities of Tehran and Karaj. It was approved by the high council of architecture and urban planning of Iran in 1993 (FMER, n.d.: 2).

Hashtgerd is the most populated of the new towns located in the Tehran metropolitan area (Zebardast & Jahan Shah Lou, 2007: 5-22; Pakzad, Hosseinzadeh Lotfi & Jahan Shah Lou, 2007: 591-600). At the end of its projected 25-year construction period, this new town was designed to accommodate a population of 500,000 (Ziari & Gharakhanlou, 2009: 143-154). According to the latest official national census (2006), Hashtgerd has a population of 45,332 (Wikipedia, 2017: online).

Hashtgerd was found to be suitable for this study, as it typifies the majority of Iranian new towns (Zebardast & Jahan Shah Lou, 2007: 5-22). In addition, compared with other new towns, Hashtgerd's areas under construction are significant and the town's inhabitants have a high rate of obesity and hypertension (Bahrami, Sadatsafavi, Pourshams, Kamangar, Nouraei, Semnani, Brennan, Boffetta & Malekzadeh, 2006). On the other hand, another reason for choosing Hashtgerd new town is its natural facilities that connect the city with the surrounding environment and healthy activities (biophilic principle). Figure 4 shows Hashtgerd's geographical situation as a new town.

Hashtgerd new town, like many other new towns in Iran and elsewhere in the world, grapples with immediate, significant, technical or economic challenges. It is a fledgling community seeking its own identity.

Figure 4: Physical-spatial characteristics of Hashtgerd new town.
Source: http://maps.google.com/maps?hl=en&tab=wl.

The local and national levels are not integrated in all respects; this often leads to suboptimal realisations, a low or inefficient use of local talents and human resources, and a lack of identification with the new environment by the inhabitants, the businesses and the representatives of civil society.

4.2 Research methods

This article explores the impact of biophilic planning on liveability, with special focus on the role of nature as part of society. An extensive literature review on biophilic planning and liveability was done to identify biophilic and liveability planning components (Mayring, 2000: online). Subsequently, a case study of a city that applies biophilic and liveability planning components was generated. The example city – Hashtgerd – was selected from the literature based on various natural and environmental elements, typifying the majority of Iranian new towns (Zebardast & Jahan Shah Lou, 2007: 5-22).

4.2.1 Data collection

The use of qualitative content analysis data reduction (selective coding) allowed the researcher to develop dominant themes and common data (Thomas, 2006: 240), in order to create a proposed model based on the literature reviewed. In the case study, semi-structured interviews with 382 Hashtgerd new town residents involved a series of forty questions that were used to obtain the opinions from residents regarding the effect of biophilic planning on liveability in Hashtgerd new town. Questions 1-3 asked biographic information. All other questions testing the components associated with liveable cities were set up based on a five-point Likert scale (where 1=very good, 2=good, 3=moderate, 4=poor, and 5=very poor). Likert-type or frequency scales use fixed choice response formats and are designed to measure attitudes or opinions (Bowling, 1997; Burns & Grove, 1997). These ordinal scales measure levels of agreement/ disagreement. The issues of validity and reliability were confirmed based on Cronbach's alpha, with an average reliability level of 0.862.

4.2.2 Sample size

In Hashtgerd new town, with a population of over 45,332 people, a sample size of 382 households was selected from the residential units. Questionnaires were completed and the required data were obtained. The Krejcie & Morgan table for sample size formulas indicates that, for a population equal to or over 40,000, a sample size of 380 is valid (Krejcie & Morgan, 1970).

4.2.3 Data analysis and interpretation of findings

Based on the literature review and content analysis (selective coding), components of biophilic planning and liveability of new towns have been identified and used to propose a concept model of biophilic planning and liveability of a new town in Iran. Having collected and processed the data from the questionnaire using SPSS software, the final dependent and independent variables were identified and analysed. Correlation coefficients in the regression analysis were used to analyse the effects on each other between the identified dependent and independent variables (Uyanik & Güler, 2013: 234). In this article, liveability components were taken as independent variables and the biophilic planning components were considered the dependent variables.

5. FINDINGS

5.1 Questionnaire results

Based on a five-point Likert scale, where 1=very good, 2=good, 3=moderate, 4=poor and 5=very poor, Table 1 shows the average mean scores from responding residents of Hashtgerd in terms of vitality, sense of place, identity, access, participation and resilience, as the six proposed components associated with liveable cities.

Questions (Q10-Q16) on access criteria were rated the highest, with an average mean score of 2.9705; the component participation was rated the lowest, with a total average of 2.3691. Vitality was rated, based on questions 4 and 5 (Q4, Q5), with an average of 2.7251.

Table 1: Mean value of the components associated with liveable cities

Variable	Average mean score (N=382)	Rank
Access	2.9705	1
Affiliation	2.9031	2
Vitality	2.7251	3
Identity	2.6257	4
Resilience	2.4372	5
Participation	2.3691	6
Average mean score for liveable cities	**2.6718**	

Table 2: Average rating of components associated with biophilic planning

Variable	Average mean score (N=382)	Rank
Environment	3.4110	1
Biophilic housing	3.2335	2
Urban management	3.1440	3
Biophilic activities	3.0694	4
Historical pattern	3.0157	5
Infill development	2.7866	6
Education	2.7382	7
Average mean score for biophilic planning	**2.6718**	

Q6 on affiliation scored an average of 2.9031 and Q7 on identity scored 2.6257. Q8 on resilience scored 2.4372 and Q9 on participation scored 2.3691.

The average liveability score of 2.6718 is slightly less than the median of three, thus indicating that the average liveability is good.

Based on a five-point Likert scale, Table 2 shows the average mean scores from residents in Hashtgerd in terms of environment, biophilic activities, education, historical pattern, urban management, infill development, and biophilic housing, as the proposed components associated with biophilic planning in new towns.

Questions 17 and 18 on "biophilic activities" show an average score of 3.0694. Other criteria such as Awareness and Education in questions 19 and 20 were investigated and show an average score of 2.7382. Standard Environment issues in questions 21-24 were reviewed and show an average score of 3.4110. Biophilic housing in questions 36-40 was investigated and was rated an average of 3.2335. Questions 26 and 27 asked standard Urban management information and score an average of 3.1440. Infill development, in questions 33 to 35, scored an average of 2.7866. According to Table 2, Environment scored the highest average with 3.4110. Education was rated the lowest, with an average score of 2.7382. Overall, the average score for biophilic planning was 3.0567, which is equal to the median of 3.

5.2 Proposed liveable city concept model and variables

Results from the questionnaire show that both the natural context (environment) and the planning context are important in the development of liveable cities. Figure 5 shows the proposed concept model with the components that are important for a liveable city, based on the physical organisation as well as the social and economical organisation of a new city.

The model outlines the value components that are deemed significant in both the natural context and the planning context that lead to liveable cities through biophilic planning. In the natural context, the model proposes resilience, vitality, affiliation, identity, accessibility and participation as components for liveable cities, which are viewed as the independent variables. In the planning context, the model proposes biophilic activities, environment, historical pattern, infill development, urban management, biophilic housing and education as components for biophilic planning, which are considered the dependent variables.

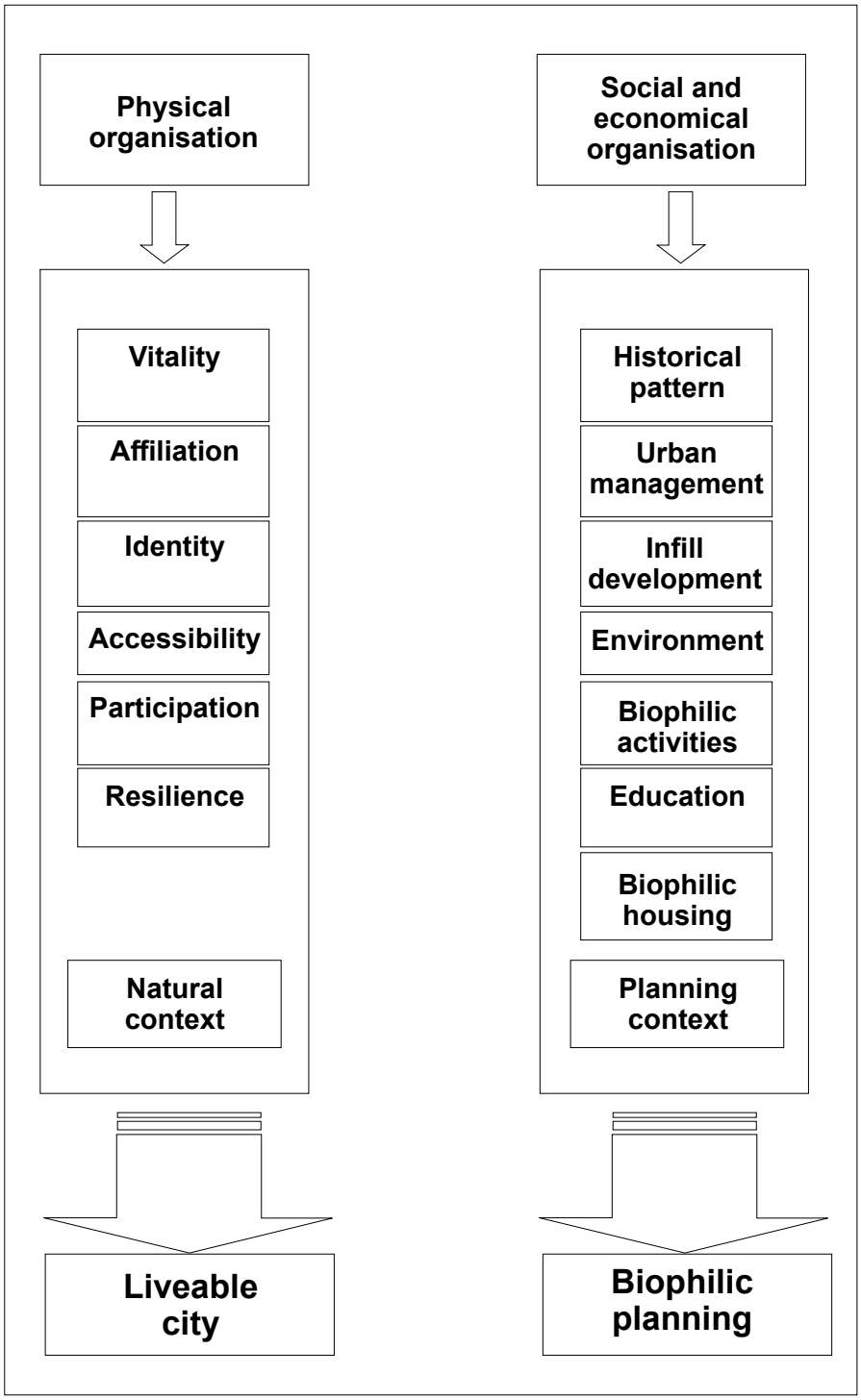

Figure 5: Liveable city concept model

Source: Researchers

Table 3: Ranking of biophilic planning variables in Vitality

Ranking	Variable	Sym in equation	B coefficient
1	Biophilic activities	B	.247
2	Education	E	.211
3	Urban management	U	.209
4	Environment	N	.147
5	Biophilic housing	H	.058
6	Historical pattern	P	-
7	Infill development	I	-

5.3 Regression analysis results

Correlation coefficients in the regression analysis were applied to measure the effects that biophilic planning variables had on the liveability variables by reporting the results of the B-Coefficients showing the amount by which the dependent variables change when changing the independent variables by one unit and keeping other independent variables constant.

5.3.1 Vitality

Equation 1 between Vitality and Biophilic planning variables was calculated as follows:

Equation 1: Y (**Vitality**) = 0.247B+0.211E+0.147N+0.209U+0.055H

Table 3 shows the effects of biophilic planning components on the vitality component of liveability. Regression equation 1 shows that biophilic activities change .247 units for every one unit in vitality. This means that, for every increase of one unit in biophilic activities, a 24.7% positive effect in the Vitality variable will occur, indicating that Biophilic activities will have the highest positive effect on Vitality.

In one-unit measurement increments, the effects of other variables are listed below:

Education (E) showed an increase and has a 21.1% effect on Vitality.

Urban management (U) showed an increase and has a 20.9% effect on Vitality.

Environment (N) showed an increase and has a 14.7% effect on Vitality.

Biophilic housing (H) showed an increase and has a 5.5% effect on Vitality.

Historical pattern and Infill development had no significant effect on Vitality. These factors were thus excluded from the regression equation.

5.3.2 Identity

Equation 2 between Identity and Biophilic planning variables was calculated as follows:

Equation 2: Y (**Identity**) = 0.296E+0.044U+0.280H+0.018P

Table 4 shows the effects of biophilic planning components on the Identity component of liveability.

Regression equation 2 shows that Education change .296 units for every unit change in Identity. This means that, for every increase of one unit in Education, a 29.6% change in the Identity variable will occur in a positive direction. Education seems to have the highest effect on Identity.

In changes of one unit, the effects of other variables are listed below:

Urban management (U) showed an increase and has a 4.4% effect on Identity.

Biophilic housing (H) showed an increase and has a 28% effect on Identity.

Historical pattern (P) showed an increase and has a 1.8% effect on Identity.

Biophilic activities, the Environment and Infill development had no significant effect on Identity. These factors were thus excluded from the regression equation.

5.3.3 Affiliation

Equation 3 between Affiliation and Biophilic planning variables was calculated as follows:

Equation 3: Y (**Affiliation**) = 0.172B+ 0.360N+0.275U+0.259I+0.310P+0. 078E

Table 5 shows the effects of biophilic planning components on the Affiliation component of liveability.

Regression equation 3 shows that Environment change .360 units for every unit change in Affiliation. This means that, for every increase of one unit in Environment, a 36% positive change in the Affiliation variable will occur. It seems that Environment has the biggest effect on Affiliation.

In unit measurements of one, the effects of other variables are listed below:

Urban management (U) showed an increase and has a 27.5% effect on Affiliation.

Infill development (I) showed an increase and has a 25.9% effect on Affiliation.

Historical pattern (P) showed an increase and has a 31% effect on Affiliation.

Biophilic activities (B) showed an increase and has a 17.2% effect on Affiliation.

Education (E) showed an increase and has a 7.8% effect on Affiliation.

Biophilic housing has no effect on Affiliation. This factor was thus excluded from the regression equation.

5.3.4 Resilience

Equation 4 between Resilience and Biophilic planning variables was calculated as follows:

Equation 4: Y (**Resilience**) = 0.222B+0.239N+0.836U+0.231I

Table 6 shows the effects of biophilic planning components on the Resilience component of liveability.

Regression equation 4 shows that Urban management change .836 units for every unit change in Resilience. This means that, for every increase of one unit in Urban management, a 83.6% positive increase in the Resilience variable will occur. It seems that Urban management has the biggest effect on Resilience.

In unit measurements of one, the effects of other variables are listed below:

Environment (N) showed an increase and has a 23.9% effect on Resilience.

Infill development (I) showed an increase and has a 23.1% effect on Resilience.

Biophilic activities (B) showed an increase and has a 22.2% effect on Resilience.

Education, Biophilic housing and Historical pattern had no effect on Resilience. These factors were thus excluded from the regression equation.

5.3.5 Partnership

Equation 5 between Partnership and biophilic planning variables was calculated as follows:

Table 4: Ranking of biophilic planning variables in Identity

Ranking	Variable	Sym in equation	B coefficient
1	Education	E	.296
2	Biophilic housing	H	.280
3	Urban management	U	.044
4	Historical pattern	P	.018
5	Biophilic activities	B	-
6	Environment	N	-
7	Infill development	I	-

Table 5: Ranking of biophilic planning variables in Affiliation

Ranking	Variable	Sym in equation	B coefficient
1	Environment	N	.360
2	Historical pattern	P	.310
3	Urban management	U	.275
4	Infill development	I	.259
5	Biophilic activities	B	.172
6	Education	E	.078
7	Biophilic housing	H	-

Table 6: Ranking of biophilic planning variables in Resilience

Ranking	Variable	Sym in equation	B coefficients
1	Urban management	U	.836
2	Environment	N	.239
3	Infill development	I	.231
4	Biophilic activities	B	.222
5	Education	E	-
6	Biophilic housing	H	-
7	Historical pattern	P	-

Equation 5: Y (**Partnership**) = 0.126E+0.373N+0.317U+0.093B

Table 7 shows the effects of biophilic planning components on the Partnership component of liveability.

Regression equation 5 shows that Environment changes .373 units for every unit change in Partnership. This means that, for every increase of one unit in Environment, a 37.3% increase in the Partnership variable will occur in a positive direction. It seems that Environment has the biggest effect on Partnership.

In unit measurements of one, the effects of other variables are listed below:

Urban management (U) showed an increase and has a 31.7% effect on Partnership.

Education (E) showed an increase and has a 12.6% effect on Partnership.

Biophilic activities (B) showed an increase and has a 9.3% effect on Partnership.

Biophilic housing, Historical pattern and Infill development had no effect on Partnership. These factors were thus excluded from the regression equation.

5.3.6 Accessibility

Equation 6 between Accessibility and biophilic planning variables was calculated as follows:

Equation 6: Y (**Accessibility**) = 0.145B+0.187N+0.228U+0.554I+0.130H

Table 8 shows the effects of biophilic planning components on the Accessibility component of liveability.

Regression equation 6 shows that Infill development changes .554 units for every unit change in Accessibility. This means that, for every increase of one unit in Infill development, a 55.4% increase in the accessibility variable will occur in a positive direction. It seems that Infill development has the greatest effect on Accessibility.

In unit measurements of one, the effects of other variables are listed below:

Urban management (U) showed an increase and has a 22.8% effect on Accessibility.

Environment (N) showed an increase and has a 18.7% effect on Accessibility.

Biophilic activities (B) showed an increase and has a 14.5% effect on Accessibility.

Biophilic housing (H) showed an increase and has a 13% effect on Accessibility.

Resilience, Education and Historical pattern had no effect on Accessibility. These factors were thus excluded from the regression equation.

5.4 Relations between liveability and biophilic planning

Figure 6 visually presents the relations between the liveability variables (independent) and the biophilic planning variables (dependent).

The final equation between Liveability variables and biophilic planning was calculated as follows:

Equation 7: (**Liveability**) = 0.179B+0.038E+0.171N+0.192U+0.016I+0.113H+0.022P

The final equation shows the relation between biophilic planning variables and liveability of Hashtgerd new town. According to these equations, for every increase of one unit of Urban management, a 19.2% increase in liveability will occur in Hashtgerd. It seems that Urban management has the most impact on the liveability of new cities.

In unit measurements of one, the effects of each biophilic component on liveability are listed below:

Urban management (U) showed an increase and has a 19.2% effect on Liveability.

Biophilic activities (B) showed an increase and has a 17.9% effect on Liveability.

Environment (N) showed an increase and has a 17% effect on Liveability.

Biophilic housing (H) showed an increase and has a 11.3% effect on Liveability.

Table 7: Ranking of biophilic planning variables in Partnership

Ranking	Variable	Sym in equation	B coefficients
1	Urban management	U	.836
2	Environment	N	.239
3	Infill development	I	.231
4	Biophilic activities	B	.222
5	Education	E	-
6	Biophilic housing	H	-
7	Historical pattern	P	-

Table 8: Ranking of biophilic planning variables in Accessibility

Ranking	Variable	Sym in equation	B Coefficients
1	Infill development	I	.554
2	Urban management	U	.228
3	Environment	N	.207
4	Biophilic activities	B	.145
5	Biophilic housing	H	.130
6	Education	E	
7	Historical pattern	P	

Table 9: Final equation: Liveability variables and biophilic planning

Ranking	Variable	Sym in equation	B coefficient
1	Urban management	U	.192
2	Biophilic activities	B	.179
3	Environment	N	.171
4	Biophilic housing	H	.113
5	Education	E	.038
6	Historical pattern	P	.022
7	Infill development	I	.016

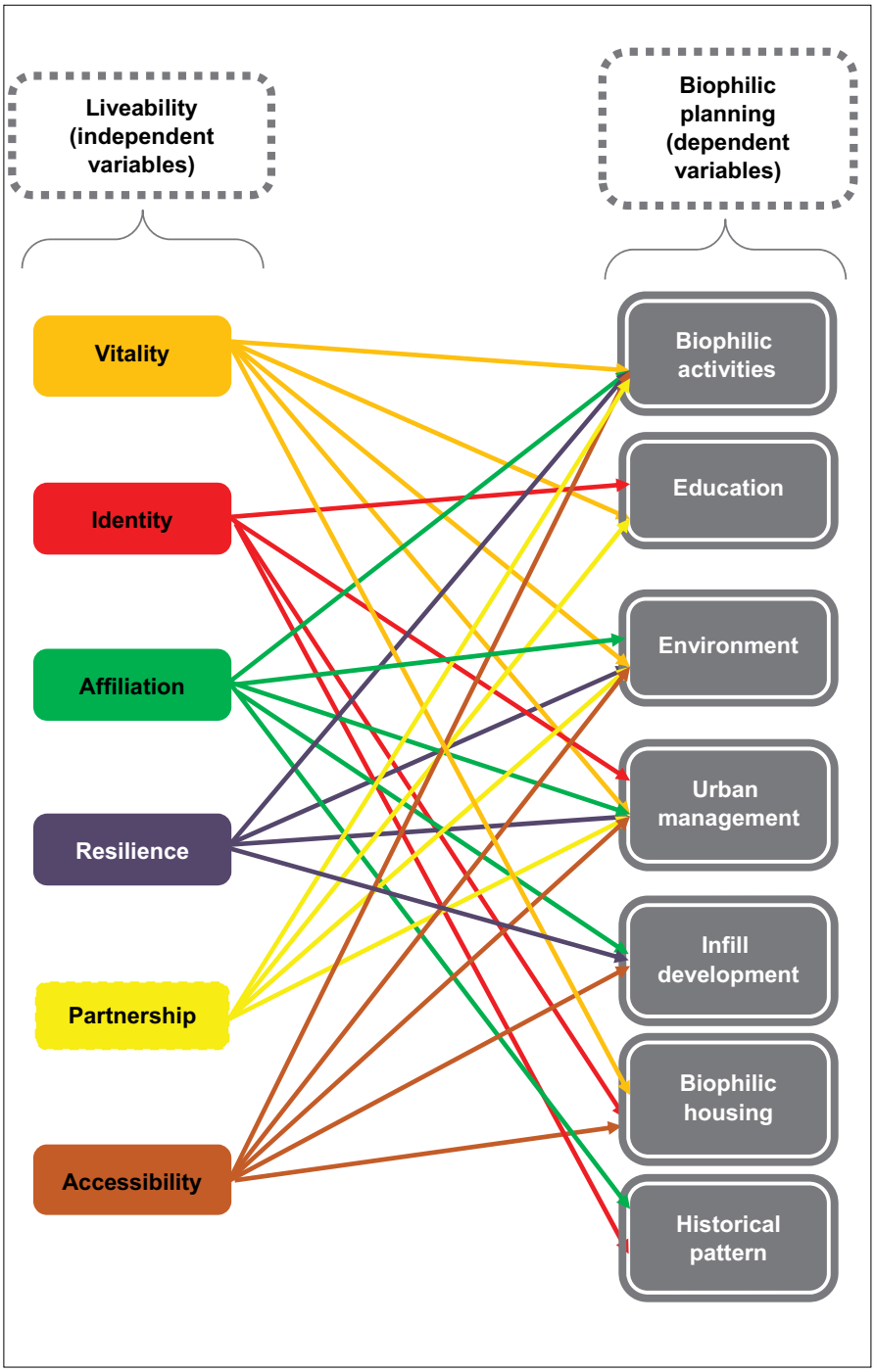

Figure 6: The relations between the variables

Source: Researchers

Education (E) showed an increase and has a 3.8% effect on Liveability.

Historical pattern (P) showed an increase and has a 2.2% effect on Liveability.

Infill development (I) showed an increase and has a 1.6% effect on Liveability.

The regression equation confirms that biophilic planning achieves liveability in Hashtgerd new town.

6. DISCUSSION

The research focused on the achievement of liveable cities through a new planning approach, namely biophilic planning. Analysis of the literature and the results from the questionnaire survey reflected factors influencing biophilic planning in Hashtgerd new town.

The average liveability score of 2.6718 was slightly less than the median of three, indicating that the respondents rated the average liveability criteria in Hashtgerd as good. Overall, the average score for biophilic planning was 3.0567, which is equal to the median of 3, indicating that respondents rated the average biophilic planning components in Hashtgerd as good.

Biophilic planning appears to have potential as a way of providing an indication of the sustainability impacts of urban environment. In particular, it is innovative, as it provides a way to connect with nature. The residents rated access to nature (as liveable component) and environment (as biophilic planning component) the highest, as this will make individuals, families and communities healthier and happier and help forge new social connections and friendships that should make such cities more resilient.

According to the regression analysis findings (B coefficients), Urban management has the most impact on the liveability of new cities. Therefore, urban planners need to propose local strategies in Hashtgerd new town.

Biophilic activities has the second highest impact on the liveability of cities and, in conjunction with Biophilic housing, adds to the liveability of cities. Design strategies such as potted plants, flowerbeds, courtyard gardens, green walls and green roofs can be included in Biophilic activities and Biophilic housing.

The research results showed an urgent need for inclusion of sustainability education in universities providing courses in built-environment professions such as architecture, quantity surveying, construction management, and urban planning. In addition, the research results showed an urgent need to educate citizens in terms of "biophilic" activities and sustainability. Local government should allow citizens to participate in urban planning issues. Participation not only makes it possible to consider the needs and expectations of inhabitants, but it also encourages their sense of belonging.

The final regression equation showed that all the biophilic planning components tested had a positive

impact on the liveability of Hashtgerd new town. The regression equation confirms that biophilic planning achieves liveability in Hashtgerd new town.

7. CONCLUSION

Biophilic planning is a new approach that focuses on healthy communities and healthy individual outcomes. It appears that biophilic design and planning led to achieving liveable cities. Liveable cities has long been a concept, but it has not yet been universally applied in practice**.** The data analysis from the research done in Hashtgerd new town in Iran show that it is possible to achieve liveable cities through biophilic planning. However, good governance structures and holistic urban planning are essential to achieve liveability. To gain a deep liveability improvement in a specific city, planners, engineers and all role players need to provide solutions to development based on all aspects of a liveable city, including components such as resilience, vitality, affiliation, identity, and accessibility. These factors necessitate more careful planning for future cities, revising old policies, and applying the successful experiences of newly established towns at regional, national, and international levels.

The main focus for the planners of new towns should include the concept of sustainability. Starting with location, incorporating the principles of sustainable development in the location finding stage of a new town has significant influence in the functionality of the towns and reduces the risk of their functional failure and unsustainability. Secondly, the social, environmental and economical aspects of sustainable urban environments require attention to issues beyond housing production. New approaches such as biophilic planning are needed to lead new cities to sustainability.

Other new towns should use these new approaches by focusing on their own local approach to liveability. New towns can use integrated thinking as a planning strategy of sustainable urban development. For a more attractive development of new towns such as Hashtgerd, the involvement of citizens in issues of urban development and planning processes is essential. Healthier, more socially connected individuals, families and communities will increase the likelihood of successful adaptation to this dynamic future, as integrated planning is the future for liveable cities.

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