

EXPLAINING THE RATIO OF FLEXIBILITY AND SPATIAL ORGANIZATION IN HOUSING

EXPLICANDO A RELAÇÃO DE FLEXIBILIDADE E ORGANIZAÇÃO ESPACIAL NA HABITAÇÃO

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Abstract

Architectural spaces with the capability of spatial organization and internal transformations can respond to a greater number of their users' needs at different times and thus provide more desirable performance than single-functional spaces. The necessity to access this ability is one of the subcategories of flexibility in housing as a contemplative subject. The purpose of this research is to provide an analytical model in relation to developing the means-end chain model and using its indicators to identify flexible house attributes perceived by users. Users of residential complexes in Tehran city are evaluated as a research society. The research method in the present study will be of mixed type and its performance method will be based on the survey. The results show that the spatial organization in residential complexes in Tehran city is based on the flexibility of the kitchen, living, dining, catering, and bedroom spaces. Accordingly, the most flexible features take place between them, which has led to the increased flexibility of spaces in relation to various activities. However, other spaces are just a place to do a specific activity, which confirms the reduction of their flexibility.

Keywords: Flexible house, users' needs, architectural spaces.

Resumo

Espaços arquitetônicos com capacidade de organização espacial e transformações internas podem responder a um maior número de necessidades de seus usuários em momentos diferentes e, assim, fornecer um desempenho mais desejável do que espaços com uma função. A necessidade de acessar essa capacidade é uma das subcategorias da flexibilidade na habitação como sujeito contemplativo. O objetivo desta pesquisa é fornecer um modelo analítico em relação ao desenvolvimento do modelo *Means-end Chain* (Cadeia de Meios-fim) e utilizar seus indicadores para identificar os atributos da casa flexível percebidos pelos usuários. Os usuários de complexos residenciais na cidade de Teerã são avaliados como uma sociedade de pesquisa. O método de pesquisa no presente estudo é do tipo misto e seu método de execução será baseado em questionários. Os resultados mostram que a organização espacial em complexos residenciais na cidade de Teerã é baseada na flexibilidade dos espaços de cozinha, estar, jantar, sala de refeições e dormitório. Nesse sentido, as características mais flexíveis acontecem entre eles, o que tem levado ao aumento da flexibilidade dos espaços em relação às diversas atividades. No entanto, outros espaços são apenas um lugar para a realização de uma atividade específica, o que confirma a redução de flexibilidade.

Palavras-chave: Casa flexível, necessidades dos usuários, espaços arquitetônicos.

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INTRODUCTION

Nowadays, on the one hand, it can be seen that designers' connection with users has decreased over time, which reduces their knowledge of basic needs and wants. On the other hand, also living difficulties, rising prices, and the ever-changing situations of families have been cited as leading to flexibility and spatial organization in housing. But most of the projects have lacked the necessary productivity by ignoring or less attention to the living needs of the residents, and their inability to respond optimally to the needs of users is clear. Housing is one of the vital elements of human life and supplier of his or her various needs, which is called the place of rest or stop, and its role and importance as a convenient accommodation are sensitive and key. The importance of housing stems from the fact that many of each person's basic needs are met there. Considering the increase in the rate of migration, the expansion of urbanization, the technical advances in construction, the greater awareness of individual rights, and the need to meet social demands, the housing issue and the need to access it is taking on new dimensions day by day (1). Today houses in the world and in Iran have not been able to succeed in meeting the needs of users. Because the changes in them have not been derived from changes in needs, but only correspond with a particular style at a particular time that they are predictable in a short time in the economy. Therefore, the main concern is the limitation of various choices in housing species according to their type and also the inability to regulate the residence of users over time based on their wants and needs or in accordance with demographic changes (2). The great cities of the world in the new age have become the place of the density of population and the place of exchange of goods, objects, and information. The collection of these factors has led to problems such as increasing domain of inequalities, expanding degradation of criteria, and even changes in norms, values, and behaviors of individuals and has led to humans living more time in a more limited context of society whole. On the other hand, Iran has also faced a sudden population growth in recent years. The economic downturn, social problems, and the lack of specialized personnel in the fields of civil, architecture, and urbanism with a clear rationale led to hasty decisions that put housing supply solutions in an unsuitable cycle. Today, housings are being developed without the provision of complementary elements. In other words, services, facilities, and also qualities of different spaces are ignored. Meanwhile, public and private investors have begun to build by seemingly emulating the experiences of countries and importing new technologies, regardless of the conditions that this type of housing brings.

Discussion about flexibility in architectural spaces is among the topics that have received a lot of attention in recent years. Satisfying a variety of needs of different users at different times is one of the reasons for this attention. However, most researches in this field have attempted to provide general definitions and also, in some cases, introduced strategies and tools to make human living spaces flexible, especially housing. Among them, we can mention the modular approach and prefabrication in flexible housing (3), flexibility criteria for design of apartment housing in Iran (4), and such cases. Analyzing them this important can be achieved that the conceptual dimensions and the way of demonstration of such a subject in various spatial patterns have been less studied. In some ways, it can be mentioned that there is no research on housing based on this content. Although in some

researches flexibility has been used and in others means-end chain has been considered, this research affects study by using them simultaneously with each other. On the other hand, seeks to provide an analytical model in relation to developing the means-end chain model and using its indicators to identify flexible house attributes perceived by users. In order to better express the problem, this research attempts to answer the question:

How to use the indicators of the means-end chain model to identify flexible house attributes perceived by users?

BIBLIOGRAPHIC REVIEW

Background

In the field of flexibility and spatial organization in housing, various theories and experiences with different orientations have emerged, especially in recent times. This multiplicity and diversity of opinions point out the importance and urgent need for the issue. Reviewing the body of knowledge, some of the research achievements in this field have been categorized and presented based on the time of publication.

Howe (5) concludes that this mode of design will facilitate the adaptation of the house to changing household needs and dampen the demand for new housing in developing areas. Schneider and Till (6) conclude that flexible housing addresses issues of finance, participation, sustainability, technology, and their use. Geraedts (7) concludes that some predetermined goals for the experimental industrial flexible demountable projects were not achieved during implementation. Nakib (8) concludes that technological adaptability is crucial to support building sustainability by ensuring users' well-being and safety, the long-term value of the building, and functional efficiency. Rian and Sassone (9) conclude that flexibility can offer a better, adaptable, customizable, affordable, and accessible domestic setting in every aspect that brings comfort to the occupants' physical, mental, and socio-emotional health. Abbaszadeh et al. (10) conclude that a flexible and adaptable home designing on the basis of the residents' requirements changes in their different lifecycles is one of the strategies to satisfy the residents and prevent them from changing their homes. Seo and Kim (11) conclude that more precisely designed houses can guarantee the freedom of the body and thus alternatives for the flexible domestic life. Cellucci and Di Sivo (12) conclude that flexibility can be considered as the antidote to obsolescence or the characteristic of the system that guarantees slippage over time. Estaji (13) concludes that flexibility is the ability and the potential of a building to change, adapt, and reorganize itself in response to the changes. Ghafourian (14) concludes that the four types of flexibility are introduced in order of priority, including extensibility, the capability of different furniture arrangements, segregation, and multi-functionality in housing space.

Examining the mentioned items, it appears that flexibility is an issue related to spatial relations and current activities in them. But what is less considered are the conceptual dimensions and the way of demonstration of it in various spatial patterns. Accordingly, the present research tries to explain the ratio of

flexibility and spatial organization in housing with the means-end chain model.

Flexibility

Flexibility is an essential concept in the field of housing due to changes in the needs and wants of users. Flexible housing can be defined as housing that is designed to change in its lifespan. Therefore, flexible housing is suitable for users with different and changing lifestyles. Accordingly, the ability of housing to meet the needs of users from the very beginning and during its use can be considered as one of the main fields of flexibility measurement in the field of architecture (15).

Generally, flexibility is referred to as the capability to change objects and things. In architecture and environmental design and particular housing design, the term of this word refers to the spatial flexibility and the organization of human-made space and change in it to achieve new conditions, needs, and applications. Some spaces provide many activities without the need for reorganization, and some other spaces can be modified to meet different needs (16).

Priemus (17) considers the role of the capability of volumes or sub-components displacement as well as the spatial arrangement and the potential of segregation and aggregation fundamental in creating flexibility. Schroeder (18) considers the physical properties of space, such as changeability, extension, and division important for creating the flexible structure of a building. Poddubiuk (19) concludes that flexible housing is defined in three contexts of space, function, and the capability of internal change, and thus considers multi-functional space to meet needs changing. Beisi (20) concludes that housing flexibility is explained inconclusive without regard to educating residents, and to achieve such a quality considers family adaptability to home space necessary. Galfetti (21) considers the built-in facilities in a flexible space with the capability of seasonal and daily displacement or rearrangement as flexible elements. Habraken (22) considers spatial variability and flexibility achievable through active users' participation and informing them.

The artificial environment has some kinds of flexibility that require analysis. In this regard, the indicators of variability (multi-functional space), adaptability (seasonal and daily displacement), and changeability (segregation and aggregation) have been defined. Variability is the capability to provide different uses of space. This kind of flexibility deals with the two variables of space and time. Space of housing will be able to be used for several functions simultaneously and for different functions at different times. Variability can be achieved by designing a plan with a regular geometric structure, readable access to building equipment, and adjusting the size of spaces. Adaptability is the ability of a space to adapt to new conditions required. The most effective method to achieve this in architectural programming is fixing the internal components and the possibility of creating various combinations of them. In housing, it is the capability to meet the new needs by changing the interior walls and installing the components, provided that these changes do not make a change in the area of the building. Generally, adaptability includes all internal changes such as structural change, micro-elements, and spaces composition. Changeability refers to

the decrease and increase of quantity or the segregation and aggregation of spaces and the possibility of returning to the original design after the conversion or expansion of its area. In this case, flexibility means the capability to respond to population growth at different stages of life. In other words, this ability makes it possible to change the size of housing in order to make it smaller or larger. The concept of changeability is related to the study of infrastructural changes, spatial needs, and its shape (23).

Friedman (24) has studied the effect of flexible housing and design strategies on the flexibility of the home by introducing them. The varieties of methods proposed about flexibility are categorized into eight groups as the main flexible design tactics:

- Open plan that causes the minimization of the structural elements as the permanent parts and making free other elements as the changeable parts in the space,
- Extendable unit that may be considered in one defined space or it may have occurred in one free space,
- Attachment or detachment of adjacent units that is provided through a nonbearing wall between the units that can easily be removed or located,
- Prefabricated modules that create an easy, rapid, and economic process not only in initial design but also in future changes of spaces,
- Similar rooms that are composed of some similar spaces with similar distribution and access,
- Common space between adjacent units that can attach to any one of the units,
- Portable wall that provides the possibility of merging or splitting adjacent spaces,
- Retractable furniture that increases the variety of possible functions in the space (25).

Spatial organization

Spatial organization is a basic pattern for creating a composition in architecture that brings together different spaces and provides a coherent structure for design (26). In general, there are conditions for different types of spaces in a house which are:

- Spaces have special functions or require special forms,
- Spaces should be functionally flexible and freely adjustable,
- Spaces must be easily accessible and adjacent to other spaces,
- Spaces have similar functions and can be placed together as a functional set or repeated in a linear order,

- Spaces must be open to the outside to provide light, ventilation, visibility, or access to open spaces,
- Spaces should be distinct and separated from each other for being private,
- Spaces have a unique and the only function or degree of importance.

The arrangement technique of these spaces can clarify their relative importance and functional role in the organization of one building (27). There are several methods for analyzing it that each of them has its own quantitative and qualitative tools that the executive results of all of these somehow lead to a description of the function of space.

Means-end chain

The means-end chain is a model that tries to relate people's elective options to their fundamental values and goals. Its main idea is that people choose an option that has the desired consequence and minimizes the undesired consequences. Values play an important role in guiding selected patterns. Values with positive or negative evaluation relate to the consequences of people's selective options. To make the right choice among different options with different consequences, people need to learn the attributes of different options that have the desired consequences. This means that users determine which attributes of the space and its physical components are appropriate and also link them to the consequences and values that are important determinants in selection. The use of this model leads to discovering the indicators of the attribute, consequence, and value (28).

The original and simplest means-end chain model has three levels, which include product attributes, consequences, and values. Although means-end chains with more than three levels have been described in the literature (29), we restrict ourselves to Gutman's original model (30).

The attribute can be defined as a quality proper to a characteristic of a product, which is a physical or perceptible feature in one space and is preferred by users based on the people's behavioral traits. The consequence can be defined as what follows a product and arises from it, which is influenced by one given space and is felt by users based on the people's behavioral traits. The value can be defined as an enduring benefit of a product, which is a particular end state of one space and is determined, regulated, and modified by users based on the people's behavioral traits.

The model of the means-end chain analyzes the different features of samples through one component of a semi-structured laddering interview and they are appeared according to the indicators of the attribute, consequence, and value. A semi-structured laddering interview is a method in which questions are identified in advance, and all respondents are asked the same questions, but they are free to express their answers in any way that they want. This technique is used to create the right understanding of how space features are translated into meaningful communications by users (31). In fact, this method can be considered to extract the attribute, consequence, and value networks that people use when making decisions about life activities.

METHOD

The work method of this research will be done in combination and with mixed nature. Initially, information is collected through the library study, and the field survey includes using available information, observation, interview, and questionnaire. On the one hand, various demonstrations of flexibility including variability, adaptability, and changeability are categorized, in which the focus is on providing the qualitative components needed to design the desired spatial organization. On the other hand, indicators of the means-end chain are identified. Then the possibility of a relationship between the components of flexibility and means-end chain is determined that this relationship is analyzed with the help of logical reasoning. In order to implement this result in real case samples, users of residential complexes in Tehran city are evaluated as a research society. The main strategy for sampling is to select the stratified random method proportional to the volume (Equation 1) that sample volume can be extracted through Cochran's formula (Equation 2). Using the hierarchical value map in the means-end chain model for the survey, the indicators of the attribute, consequence, and value are prioritized. Finally, inductive reasoning will be used to draw a conclusion about the subject.

$$n_h = (N_h/N)n \quad (\text{Equation 1})$$

$$n = z^2pq/e^2 \quad (\text{Equation 2})$$

Where n_h is the sample size for each stratum, N_h is the population size for each stratum, N is the population size, n is the sample size, z is the desired level of confidence ($z = 1.96$), e is the desired level of precision ($e = 0.05$), p is the estimated proportion of an attribute that is present in the population ($p = 0.5$), and q is the estimated proportion of an attribute that is not present in the population ($q = 0.5$) (32).

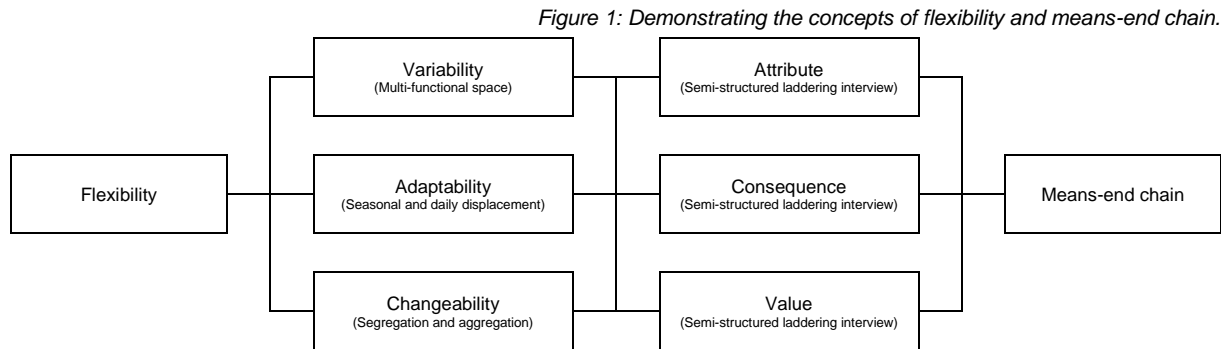
Analysis

Flexibility is a two-dimensional concept that is related on the one hand to physical structures and, on the other hand, to behavioral patterns. Accordingly, in order to develop the various fields of its formation, it is necessary to study spatial relations and current activities in them. Demonstrating the concepts of flexibility and means-end chain and investigating the case study samples are introduced below.

Demonstrating the concepts of flexibility and means-end chain

Variability is a concept related to current functions in a spatial organization and means the capability to perform different activities of users in it. Adaptability is also another demonstration of flexibility that depends on the user and the type of his or her desires more than on the space and the existing activities in it. Changeability means the capability to make a change in the spatial organization of a set in order to perform the desired activities of users in it. Therefore, it can be assumed that not only users are expected to identify which space attributes are suitable for them but also users should also be allowed to identify which physical components necessarily remain flexible. These features in the means-end chain are obtained by the

concepts of the attribute, consequence, and value, which can be evaluated using the component of a semi-structured laddering interview. Thus, the indicators of variability, adaptability, and changeability in flexibility are related to the indicators of the attribute, consequence, and value in the means-end chain model to analyze the spatial organization, and thus affect the spatial organization in housing (Figure 1).



Investigating the case study samples

Based on the available statistics, the second district of Tehran municipality was selected with the highest number of residential complexes. Then based on the collected information, matching the data, and comparing them, common factors such as the number of units, height, and shape of open space were extracted and three residential complexes of Atisaz, Mahan, and Hormozan were eligible for the most species to build were identified. Atisaz with 23 blocks, 12 to 31 floors, and 2290 units, Mahan with 5 blocks, 19 floors, and 320 units, and Hormozan with 20 blocks, 16 to 33 floors, and 1433 units are located in regions one, nine, and seven respectively (Figure 2, Figure 3, Figure 4, Figure 5, and Figure 6).

Figure 2: Location of the case study samples in Tehran city, Iran, and the world.



Figure 3: Tehran city, District two, Regions one, nine, and seven.

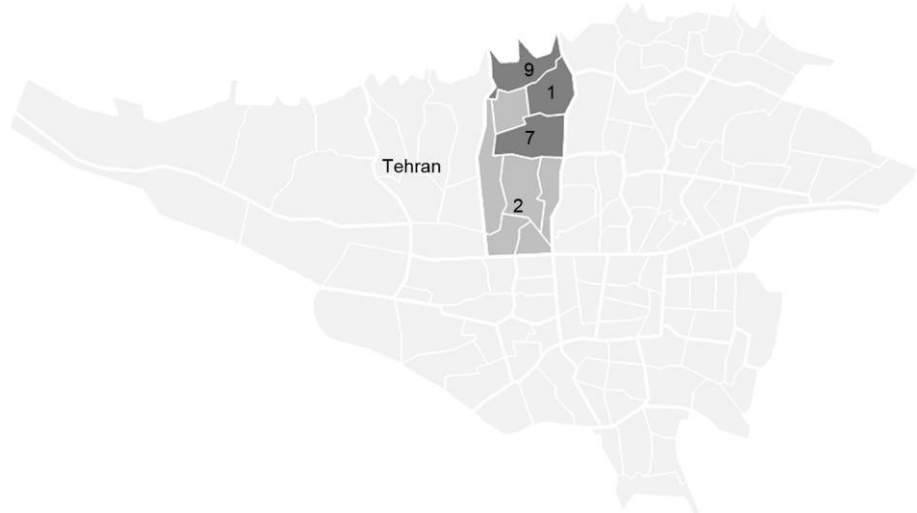


Figure 4: Atisaz residential complex site plan.

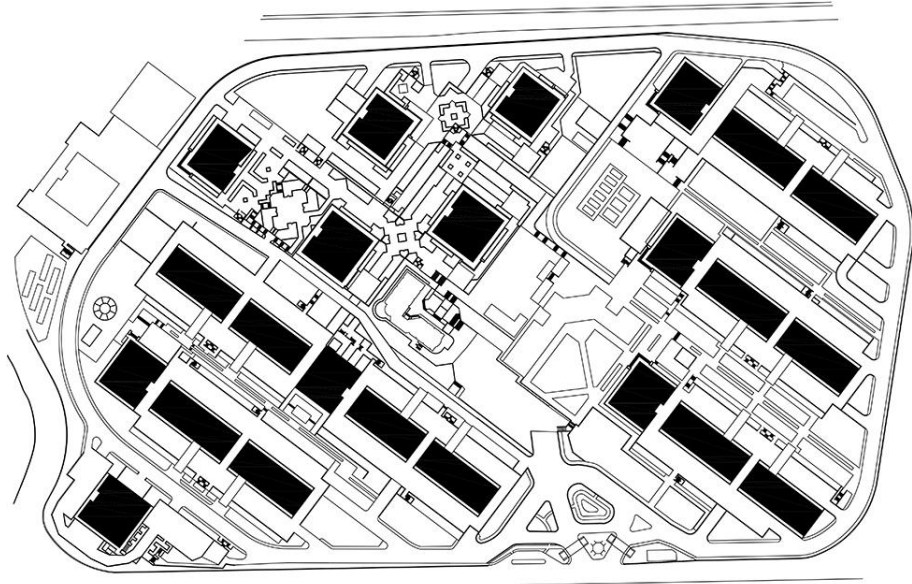


Figure 5: Mahan residential complex site plan.

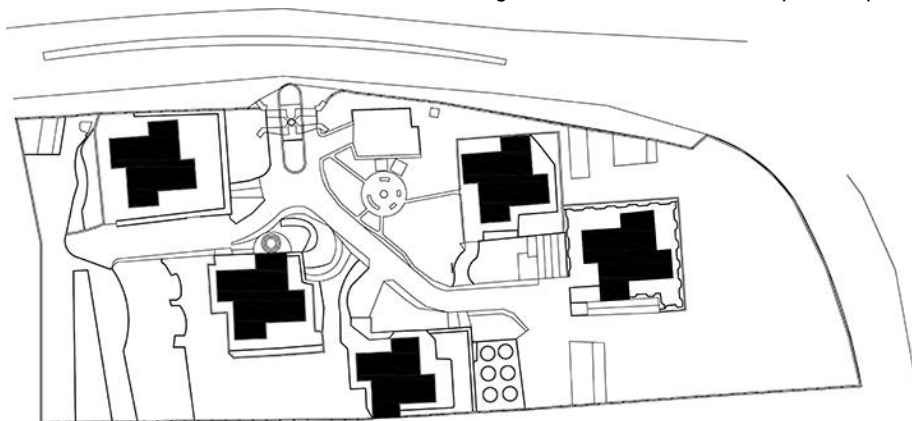


Figure 6: Hormozan residential complex site plan.

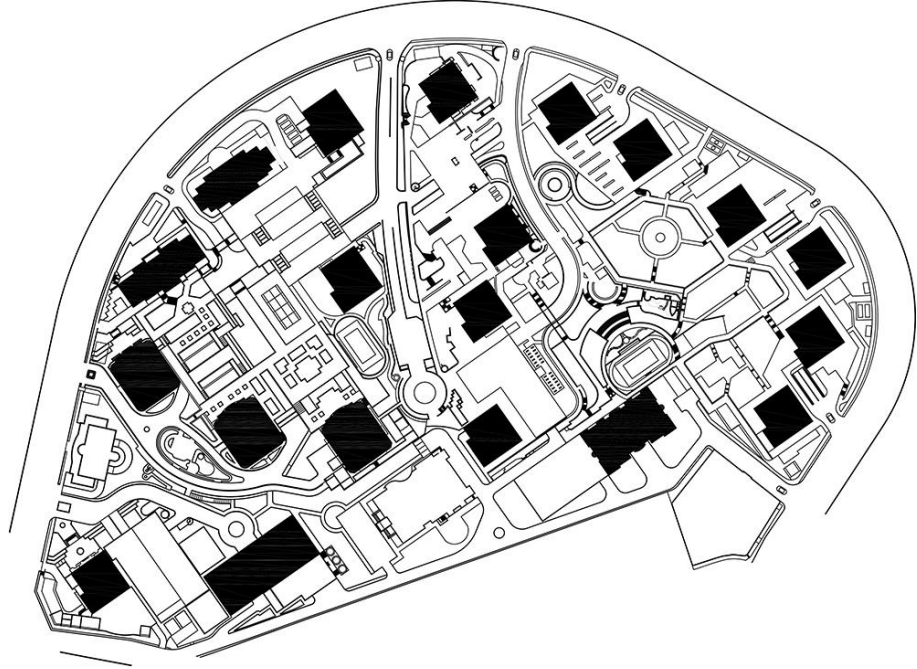


Table 1: 1, 2, and 3 bedroom plans from similar blocks in Atisaz, Mahan, and Hormozan residential complexes, 1. Entrance, 2. Hall, 3. Toilet service, 4. Kitchen, 5. Living, 6. Dining, 7. Catering, 8. Bedroom, 9. Bathroom service.

	1 bedroom	2 bedroom	3 bedroom
Atisaz			
Mahan			
Hormozan			

The 1, 2, and 3 bedroom plans were selected from similar blocks in each one, and their spaces were decomposed so that they could be assessed for future changes (Table 1).

Table 2: The sample size for each stratum, the population size for each stratum, and the population size of regions one, nine, and seven.

	n_h	N_h	N
Region one	180	99826	212728
Region nine	106	58447	212728
Region seven	98	54455	212728

Table 3: Questionnaire.

	Variable
Age group	<input type="checkbox"/> 20-40
	<input type="checkbox"/> 40-60
Gender	<input type="checkbox"/> Male
	<input type="checkbox"/> Female
Marital status	<input type="checkbox"/> Single
	<input type="checkbox"/> Married
What is important to you?	<input type="checkbox"/> Enlarging a room area
	<input type="checkbox"/> Adding a room with changing plan
	<input type="checkbox"/> Adding a room without changing plan
	<input type="checkbox"/> Modifiability of wall color
	<input type="checkbox"/> Modifiability of furniture action
	<input type="checkbox"/> Possibility to renovate equipment
	<input type="checkbox"/> Modifiability of floor covering
	<input type="checkbox"/> Modifiability of window size
Why is that important to you?	<input type="checkbox"/> Other:
	<input type="checkbox"/> Preferred aesthetic
	<input type="checkbox"/> Spatial improvement
	<input type="checkbox"/> Better ventilation
	<input type="checkbox"/> Visual effect
	<input type="checkbox"/> Better function
	<input type="checkbox"/> Everyday activity
Why is that important to you?	<input type="checkbox"/> Other:
	<input type="checkbox"/> Self-direction
	<input type="checkbox"/> Hedonism
	<input type="checkbox"/> Security
	<input type="checkbox"/> Benevolence
	<input type="checkbox"/> Other:

A number of 384 people of their users that do not belong to the same dwelling were selected with a stratified random method proportional to the volume and evaluated with the component of a semi-structured laddering interview in the hierarchical value map. All techniques used in the data collection were intended to ensure that all elicited data within all categories

of the attribute, consequence, and value are completely based on the perceptions of the respondents (Table 2).

The interview began by eliciting the flexible attributes and was dominated by the question of what to identify expected changes that the respondent expects to make in the future. The respondents were asked to name their preferred specific attributes of flexibility in house design, which they expect to allow modifications and renovations to be made as desired. The author had to use simple and clear terms because not all respondents are familiar with the terms used in flexible design. In the event that the respondent could not identify what they expect or how to respond, the interviewer shows a list of attributes that is prepared prior to the interview. The list was intended only as a guide to help the respondents in answering the questions. The author was careful not to make any suggestions or pose any leading questions that might persuade the respondents to choose any particular elements within the list. If the respondent chose more than eight attributes, he or she was then assigned the task of selecting the eight most important ones. This was done because otherwise, the laddering interviews would have taken too much time. The preferred level, which serves as the starting point for a laddering interview, was determined for every mentioned attribute (Table 3).

Having established a list of flexibility attributes in house design, the laddering interview was begun by repeating the question of why is that important to you. This question is used to establish links between the users' preferred attributes, consequences, and values. The interviews are based on a flexible house design and are recorded using an audio recorder. The conversations are then transcribed to perform content analysis and to construct ladders for each respondent (Table 4 and Table 5).

Table 4: Separation of users of Atisaz, Mahan, and Hormozan residential complexes.

	Variable	Atisaz	Variable	Mahan	Variable	Hormozan
Age group	20-40	154	20-40	91	20-40	84
	40-60	26	40-60	15	40-60	14
Gender	Male	88	Male	52	Male	48
	Female	92	Female	54	Female	50
Marital status	Single	100	Single	59	Single	54
	Married	80	Married	47	Married	44

Table 5: Users of Atisaz, Mahan, and Hormozan residential complexes.

	Variable	Frequency	Percentage
Age group	20-40	329	86
	40-60	55	14
Gender	Male	188	49
	Female	196	51
Marital status	Single	213	55
	Married	171	45

The process of analyzing the collected data begins by transcribing the recorded interview as text. Codes are assigned for repeated or important meanings within single words, phrases, or sentences. Each code represents a flexible attribute perceived by the respondents. Codes are also assigned for elements in the consequence and value categories and used in the summary of implications matrix and in all hierarchical value maps.

Figure 7: Summary of implications matrix.

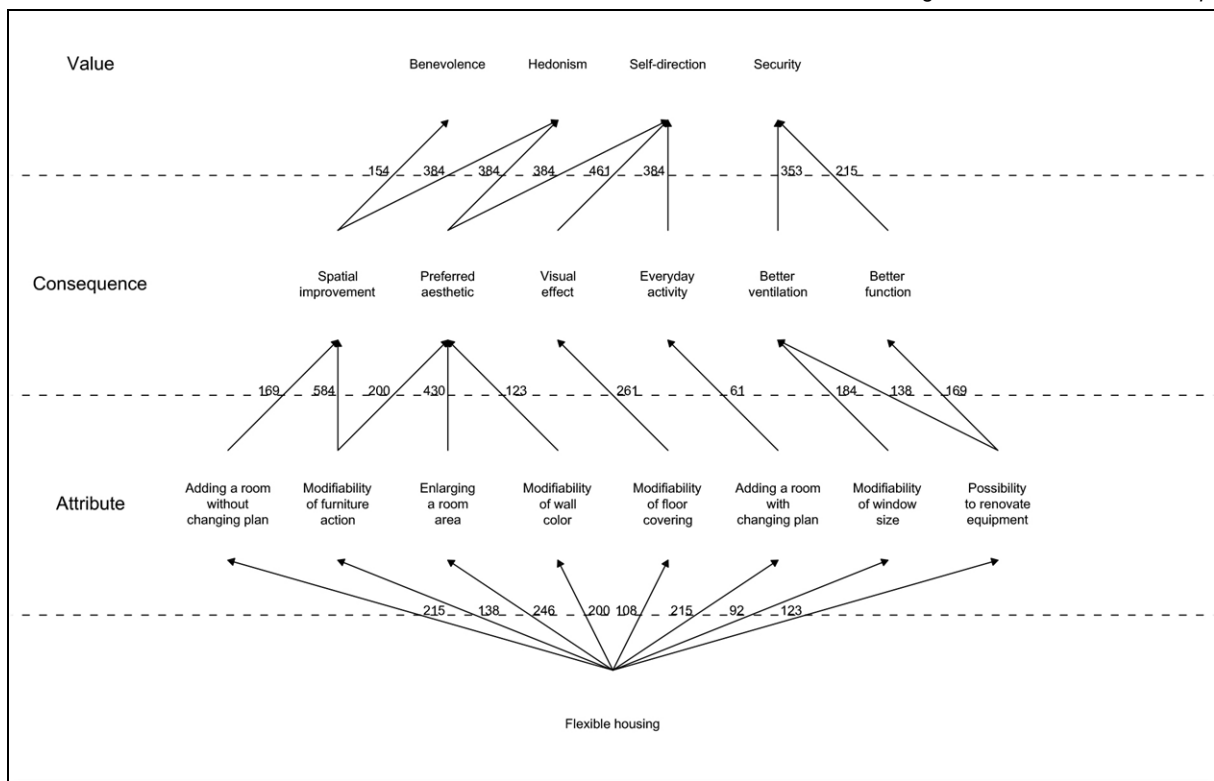
	E R A	Add - on	Add - in	M W C	M F A	P R E	M F C	M W S	P A	S I	B V	V E	B F	E A	S	H	S	B	
Enlarging a room area	430																		
Adding a room with changing plan		61																	
Adding a room without changing plan			169																
Modifiability of wall color				123															
Modifiability of furniture action					200					584									
Possibility to renovate equipment											138		169						
Modifiability of floor covering												261							
Modifiability of window size											184								
Preferred aesthetic									384						384				
Spatial improvement										384						384		154	
Better ventilation																	353		
Visual effect															461				
Better function																	215		
Everyday activity																	384		
Self-direction																		384	
Hedonism																			384
Security																			384
Benevolence																			384

All raw ladders are used to establish the summary of implications matrix, which is a table showing the number of times that each element is linked directly or indirectly to other elements. The data in the summary of implications matrix are used to construct the hierarchical value map. To construct such a tree diagram Reynolds and Gutman (33) describe a paper-and-pencil method. The use of cut-off levels from three to five to construct the hierarchical value map recommends appropriately. The author adopts

four as the cut-off level that implies that only elements that are linked to other elements four times or more in the ladders will be included in the formation of the hierarchical value map. Here, hierarchical value maps are constructed for each main space in a house as well as the house as a whole.

The constructed hierarchical value map of the entire house is used to identify important flexible attributes in a house. Because values are mainly guided by users' choice behaviors, interpretations are conducted based on the main chain of flexible attributes, consequences, and values. Each preferred flexible attribute is connected to and influenced by a specific value. All numerical values from each perceptual orientation path or chain are calculated to identify the strength of each attribute and then ranked (Figure 7).

Figure 8: Hierarchical value map.



The influence of socio-demographic variables on the respondents' evaluation of flexible house design is significant. Age group is a factor that affected the users' preferences. Respondents with the age group of 20-40 choose the option of enlarging a room area and adding a room without changing plan connected to flexibility of dining design as the most preferred. Respondents with the age group of 40-60 choose the option of adding a room without changing plan connected to flexibility of living and catering design as the most preferred. Gender is a factor that affected the users' preferences. Respondents with the gender of male choose the option of enlarging a room area, modifiability of wall color, and modifiability of floor covering connected to flexibility of bedroom design as the most preferred. Respondents with the gender of female choose the option of adding a room with changing plan, modifiability of furniture action, and modifiability of

window size connected to flexibility of whole housing design as the most preferred. Marital status is a factor that affected the users' preferences. Respondents with the marital status of single choose the option of enlarging a room area, modifiability of wall color, and modifiability of floor covering connected to flexibility of bedroom design as the most preferred. Respondents with the marital status of married choose the option of possibility to renovate equipment connected to flexibility of kitchen design as the most preferred.

Generally, the users' preferences for flexibility attributes in housing design vary. Respondents tend to have flexibility in designing the kitchen, living, dining, catering, and bedroom spaces more than other spaces. Enlarging a room area is preferred for the dining and bedroom. Adding a room with changing plan is preferred for the whole housing. Adding a room without changing plan is preferred for the living, dining, and catering. Modifiability of wall color is preferred for the bedroom. Modifiability of furniture action is preferred for the whole housing. Possibility to renovate equipment is preferred for the kitchen. Modifiability of floor covering is preferred for the bedroom. Modifiability of window size is preferred for the whole housing (Figure 8).

RESULTS AND DISCUSSIONS

Based on the above contents, an analysis of the relationship between demonstrating the concepts of flexibility and the means-end chain has been done by investigating the case study samples that have led to the ranking of the most desirable attributes of flexibility in housing design (Table 6).

Modifiability of furniture action, which falls into the category of variability, is influenced by hedonism and leads to spatial improvement. Ranking of attribute for modifiability of furniture action as 138, the consequence for spatial improvement as 584, and value for hedonism as 384 are assessed. Finally, the total amount is calculated to be 1106. Adding a room without changing plan, which falls into the category of variability, is influenced by hedonism and leads to spatial improvement. Ranking of attribute for adding a room without changing plan as 215, the consequence for spatial improvement as 169, and value for hedonism as 384 are assessed. Finally, the total amount is calculated to be 768. Modifiability of floor covering, which falls into the category of adaptability, is influenced by self-direction and leads to visual effect. Ranking of attribute for modifiability of floor covering as 108, the consequence for visual effect as 261, and value for self-direction as 461 are assessed. Finally, the total amount is calculated to be 830. Modifiability of wall color, which falls into the category of adaptability, is influenced by self-direction and leads to preferred aesthetic. Ranking of attribute for modifiability of wall color as 200, the consequence for preferred aesthetic as 123, and value for self-direction as 384 are assessed. Finally, the total amount is calculated to be 707. Modifiability of window size, which falls into the category of adaptability, is influenced by security and leads to better ventilation. Ranking of attribute for modifiability of window size as 92, the consequence for better ventilation as 184, and value for security as 353 are assessed. Finally, the total amount is calculated to be 629. Possibility to renovate equipment, which falls into the category of adaptability, is influenced by security and leads to better ventilation. Ranking of attribute for possibility to renovate equipment as 123, the consequence for better

ventilation as 138, and value for security as 353 are assessed. Finally, the total amount is calculated to be 614. Enlarging a room area, which falls into the category of changeability, is influenced by hedonism and leads to preferred aesthetic. Ranking of attribute for enlarging a room area as 246, the consequence for preferred aesthetic as 430, and value for hedonism as 384 are assessed. Finally, the total amount is calculated to be 1060. Adding a room with changing plan, which falls into the category of changeability, is influenced by self-direction and leads to everyday activity. Ranking of attribute for adding a room with changing plan as 215, the consequence for everyday activity as 61, and value for self-direction as 384 are assessed. Finally, the total amount is calculated to be 660.

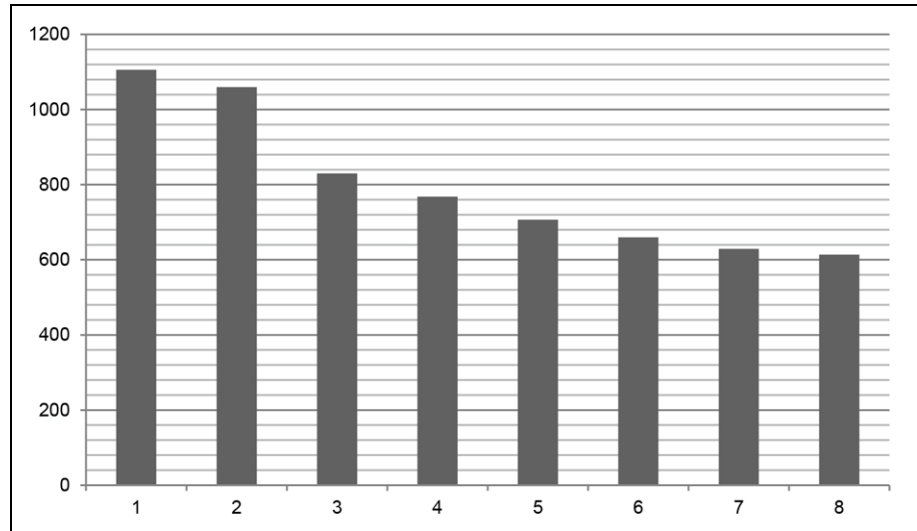
Table 6: Analysis of demonstrating the concepts of flexibility and means-end chain by investigating the case study samples.

		Means-end chain			
		Attribute	Consequence	Value	Total
Flexibility	Variability	Modifiability of furniture action	Spatial improvement	Hedonism	
		138	584	384	1106
		Adding a room without changing plan	Spatial improvement	Hedonism	
	215	169	384	768	
	Adaptability	Modifiability of floor covering	Visual effect	Self-direction	
		108	261	461	830
Modifiability of wall color		Preferred aesthetic	Self-direction		
200		123	384	707	
Modifiability of window size		Better ventilation	Security		
92		184	353	629	
Changeability	Possibility to renovate equipment	Better ventilation	Security		
	123	138	353	614	
	Enlarging a room area	Preferred aesthetic	Hedonism		
	246	430	384	1060	
	Adding a room with changing plan	Everyday activity	Self-direction		
	215	61	384	660	

Ranking of the most desirable attributes of flexibility in housing design shows that the most preferred means of flexibility appears to be the use of modifiability of furniture action in association with hedonism value. However, enlarging a room area as a preferred feature of flexibility is still apparent in the interview responses, which is also influenced by the value of hedonism. This is an interesting finding of this study and suggests that serious effort

must be undertaken by architects to ensure that future changes should not involve the modification of major structural components. Thus the spatial organization in housing becomes more flexible (Figure 9).

Figure 9: Ranking chart of the most desirable attributes of flexibility in housing design (1. MFA, 2. ERA, 3. MFC, 4. Add-in, 5. MWC, 6. Add-on, 7. MWS, 8. PRE).



The ranking chart of the most desirable attributes of flexibility in housing design indicates that modifiability of furniture action, enlarging a room area, modifiability of floor covering, adding a room without changing plan, modifiability of wall color, adding a room with changing plan, modifiability of window size, and possibility to renovate equipment are preferred respectively, and as a result, consequently, variability, adaptability, and changeability are prioritized.

CONCLUSIONS

According to the analysis that has been done on explaining the ratio of flexibility and spatial organization in housing with means-end chain model and in answering the proposed question, the results were obtained as follows:

Architectural spaces with the capability of spatial organization and internal transformations can respond to a greater number of their users' needs at different times and thus provide more desirable performance than single-functional spaces. The necessity to access this ability is one of the subcategories of flexibility in housing as a contemplative subject. The purpose of this research is to provide an analytical model in relation to developing the means-end chain model and using its indicators to identify flexible house attributes perceived by users.

The means-end chain is a model that tries to relate people's elective options to their fundamental values and goals. Its main idea is that people choose an option that has the desired consequence and minimizes the undesired consequences. Values play an important role in guiding selected patterns. Values with positive or negative evaluation relate to the consequences of people's selective options. To make the right choice among different options

with different consequences, people need to learn the attributes of different options that have the desired consequences. This means that users determine which attributes of the space and its physical components are appropriate and also link them to the consequences and values that are important determinants in selection. The use of this model leads to discovering the indicators of the attribute, consequence, and value.

The indicators of variability, adaptability, and changeability in flexibility are related to the indicators of the attribute, consequence, and value in the means-end chain model to analyze the spatial organization, and thus affect the spatial organization in housing.

Spatial organization in residential complexes in Tehran city is based on the flexibility of the kitchen, living, dining, catering, and bedroom spaces. Accordingly, the most flexible features take place between them, which has led to the increased flexibility of spaces in relation to various activities. However, other spaces are just a place to do a specific activity, which confirms the reduction of their flexibility.

Ranking of the most desirable attributes of flexibility in housing design shows that the most preferred means of flexibility appears to be the use of modifiability of furniture action in association with hedonism value. However, enlarging a room area as a preferred feature of flexibility is still apparent in the interview responses, which is also influenced by the value of hedonism. This is an interesting finding of this study and suggests that serious effort must be undertaken by architects to ensure that future changes should not involve the modification of major structural components. Thus the spatial organization in housing becomes more flexible.

Due to the lack of appropriate software in the means-end chain model for housing design and the need to use its product in flexibility, it is suggested that the possibility of creating this software be provided.

The achievements of this research could help researchers provide an analytical model in relation to developing the means-end chain model and using its indicators to identify flexible house attributes perceived by users. The conceptual model of the means-end chain can be summarized in the four propositions (34). The subjective knowledge about consumers' goods and services is organized in associative networks. The concepts in these networks that are relevant for consumer decision-making include attributes of products, consequences of product use, and consumers' values. Attributes, consequences, and values are ordered hierarchically. The structure of consumers' knowledge about goods and services influences relevant consumer behavior.

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