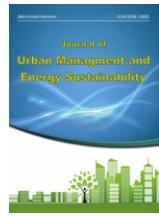


# Journal of Urban Management and Energy Sustainability (JUMES)

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## CASE STUDY RESEARCH

### The role of architectural components in increasing the efficiency of researchers in research centers (Case study: Iran's Space Town)

Seyed Mohsen Ghandi<sup>1</sup>, Mohsen Faizi<sup>2\*</sup>, Mohammad Ali Khanmohammadi<sup>3</sup>

<sup>1</sup> Ph.D. Student, Department of Architecture, Faculty of Architecture and Urban Planning, Iranian University Science and Technology, Tehran, Iran

<sup>2</sup> Professor, Department of Architecture, Faculty of Architecture and Urban Planning, Iranian University Science and Technology, Tehran, Iran

<sup>3</sup> Associated Professor, Department of Architecture, Faculty of Architecture and Urban Planning, Iranian University Science and Technology, Tehran, Iran

#### ARTICLE INFO

##### Article History:

Received 2022-07-15

Revised 2022-10-24

Accepted 2022-12-29

##### Keywords:

Architecture

Effectiveness

Organization

Researchers

Iran Science Town

DOI: [10.22034/jumes.2022.1990949.1120](https://doi.org/10.22034/jumes.2022.1990949.1120)

#### ABSTRACT

Efficiency and effectiveness are two very influential concepts and ideas in evaluating the performance of any organization to achieve aims with the least number of resources. Among the factors affecting the efficiency and effectiveness of human resources are the components and elements based on the architecture of the work environment. The research method is a combination of qualitative and quantitative methods that was done in several stages. After reviewing the comparative studies, the indicators and primary components of the model have been extracted. In the next step, the indicators and components were identified and determined through interviews with experts. Then, a quantitative questionnaire was compiled and distributed among experts to validate the research model. Then the obtained data has been subjected to statistical analysis. The statistical population of the research is the experts of advanced science and technology centers, specifically Iran Space town. The data collection tool is a semi-structured interview and a quantitative questionnaire. The reliability of the questionnaire was also checked using Cronbach's alpha test, and the results show that the alpha coefficient is higher than the standard value of 0.7, so the questionnaire has adequate reliability. Data analysis was done using SPSS20 software and structural equation method with SMARTPLS software. The results show that physical and environmental factors and components affect the efficiency of researchers. Finally, 15 components were identified as physical components affecting the efficiency of researcher, also 9 factors were identified as environmental components affecting the efficiency of researchers in Iran's space town.

Running Title: Architectural components in increasing the efficiency of researchers



#### NUMBER OF REFERENCES

19



#### NUMBER OF FIGURES

02



#### NUMBER OF TABLES

01

\*Corresponding Author:

Email: [mfaizi@iust.ac.ir](mailto:mfaizi@iust.ac.ir)

Phone: +982177240427

ORCID: <https://orcid.org/0000-0003-1022-0990>

## 1. Introduction

Human resources are the most important competitive advantage and organizational capital ([Soltani and Samadian, 2014](#)). In order to achieve excellent results using minimum manpower, it is very vital and necessary to identify the factors that cause poor performance of employees in the workplace and to take corrective measures. Researchers and experts in other fields such as industrial and organizational psychology, economics, accounting and managers in small, medium and large organizations have investigated performance management as one of the most important concepts in organizational research ([Kwon et al., 2019; Ruble et al., 2018](#)). To analyze the efficiency of an activity, the results obtained are compared with the effort invested in it. This comparison is valid in the case of human resources, because this fundamental element represents a source of costs that really matters. Currently, more companies are facing the need to increase productivity and have limited resources. The least used tool for increasing productivity is improving the quality of work, information, capital and methods of combining factors ([Saeed et al., 2019](#)). In the work performance evaluation process, individual and social performance is evaluated. The effectiveness of a group is the group's capacity to perform assigned tasks and allow its members to gain satisfaction in the pursuit of collective activities. Factors affecting group effectiveness include: group characteristics (size, composition); the task to be done; External and internal environmental factors and factors, including the state and physical conditions of the work environment (such as beauty, light, ergonomics, etc.), resources allocated to the group or detection of its presence and activity ([Saleem et al., 2022](#)). Internal or variable factors are represented by those aspects of group activity that can be directly controlled and theoretically modified in a short period of time, so as to increase performance levels or human satisfaction levels. They can be modified to increase effectiveness (e.g. management style, processes and procedures adopted by the group, including task assignments, maintaining social relationships, motivation and group development). The term "performance" refers to a specific achievement in the context

of practical activity ([Ali and Mohammad, 2022](#)). Work performance is related to a set of factors that interact at the company level: skills, personality traits, value systems, physical characteristics, interests, motivation, age, gender, education, cultural horizon, social work environment, salary and reward system, educational and control, organizational policy, work methods. Among many factors that affect performance, motivation plays a special role ([Pandey and Singh, 2022](#)).

Increasing the efficiency and productivity of the workforce can be achieved in different ways. Human resource training and promotion is one of these solutions. The process of training and improvement in the long term will improve the level of culture and knowledge of human resources, technical and professional training in accordance with work needs and increase the skills of human resources. This aspect represents investment in human resources and growth of human factor, superior use of creative potential and predictive of employee performance. Rapid understanding of issues and synchronizing with the collective force in a short period of time, as well as rapid integration into the work environment, play an important role in improving and increasing efficiency ([Dongioon et al., 2022](#)). Another factor of improving efficiency is the provision of material incentives that indicate the conditioning of income to work results. The position that the system determines the size of human resources wages correctly and determines their contribution to the total work is of particular importance. Any shortcoming in this field has an adverse effect on the incentive plan and causes neglect of the basic economic correlations, especially between increasing labor productivity and increasing salaries ([Barrera et al., 2016](#)). Labor efficiency does not depend only on the material conditions of production. The quality of labor also plays an important role. In this context, continuous improvement of employee training is a necessary condition for optimal use of human resources. Compared to unskilled labor or lower-level labor, high-quality labor is at the same time more productive. Recent research has shown that there is a very strong relationship between the level of professional education and general culture in the efficiency and productivity of the

workforce (Lozano et al., 2018).

Another important and influential component on employee efficiency is the physical work environment. The physical environment provided by organizations to carry out professional activities is one of the factors affecting the performance of employees, and on the other hand, it is the second main financial burden of the organization after human resources (Zander and Canivet, 2021). An employee's job performance is also measured by his response to activities defined for his job position, and any action to improve the ability to perform tasks can lead to improved performance. Environmental research has shown that tools and the physical environment can reduce or improve employee performance (Ghannazadeh and Sadeghzadeh, 2016). Therefore, it is necessary to pay attention to environmental assessment studies with the approach of improving the performance of employees in office spaces. A work environment is the situation in which a task or task is completed, or the work environment includes a physical geographic location as well as the environment surrounding the workplace, such as a construction site or an office building (Singh et al., 2019). All organizations have an internal and external environment. The external environment consists of general layers of environmental performance. The public environment includes non-conventional elements of the organization's environment that may affect the internal environment in a broad and general sense. The specific dimensions of the organization's environment have a greater impact on the work environment. The internal environment includes the conditions and forces in the organization. This environment includes the owner, employees, and the board of directors, each of which has an important role in the organization's internal environment (Shen and Benson, 2016). In general, the office environment is the space in which the knowledge and information activity processes required by an organization, including planning, design, monitoring, data analysis, information archiving, decision-making, and communication, take place. In buildings that have a supervisory function, such as the power plant control building, employee misconduct can have serious financial and human consequences.

(Mokhniuk and Yushchyshyna, 2018) (Narenjbar, 2015) On the other hand, due to the large initial investments for non-human resources in such buildings, in determining the physical conditions of the workplace, the functional requirements and needs of equipment and systems are prioritized over human needs and only over the provision of basic human needs in Maslow's pyramid. safety, health) are emphasized. (Singh et al., 2020) Therefore, employees must adapt to the situation. According to dissonance theory, this forced adaptation may be accompanied by irrational biological pressures and increase the possibility of human error (Silopour et al., 2014). This shows the need to pay more attention to environmental assessments in human-machine interface office buildings with supervisory functions.

According to studies, the dynamism and inefficiency of researchers in research centers leads to the lack of dynamism of the system and the lack of expected progress, which is one of the most important factors affecting researchers. The architecture of the building in the macro and the components of the environment (including light, color, design, etc.) has a significant effect on the performance of the researcher in the research centers, when the researcher is conducting research in the research center, the spaces are effective in the psyche of the researcher and directly affect the reactions and His actions have an effect. Therefore, not paying attention to the issue of the form and architectural space of the center can have negative effects on the researcher and of course lead to a decrease in efficiency. One of the most important and effective employees of any country are working in advanced science and technology research centers. These people are working at the edge of science and its results and achievements can play an essential role at the national level. Therefore, the human power in advanced science and technology centers is a valuable force and its performance is also key. In such centers, due to the importance of the product and the resulting achievement, the performance of the individual in the environment (and the relationship between the environment and the individual) plays a very important role. The characteristics of architecture in the physical environment have had different results in terms

of changing the individual's behavior according to the change of the components. Light, color, physical environment and type of layout are components that change the quality of the environment. These changes have an effect on the spatial characteristics and consequently can play a role in the efficiency of the individual in the work environment. In this regard, the current research aims to identify the physical components of advanced science and technology centers that can increase the researcher's efficiency; prepared and tried to answer this question, what are the physical components that affect the efficiency of researchers in advanced science and technology centers? Therefore, the objectives and questions of the research are:

- Identifying physical components affecting the efficiency of researchers in advanced science and technology centers as a case study of Iran's space town
- Determining the importance and influence of physical components affecting the efficiency of researchers in advanced science and technology centers
- Prioritization of physical components affecting the efficiency of researchers in advanced science and technology centers with the study sample of Iran's Space town

So, the main question is, what is the importance and influence of the physical components affecting the efficiency of researchers in advanced science and technology centers? and what is the prioritization of the physical components affecting the efficiency of researchers in Iran's space town?

## **2. Materials and Methods**

### **2.1. Research Method**

In this research, a combination of qualitative-quantitative methods has been done. Therefore, in terms of methodology, this research is a combination of exploratory type. This research is based on the purpose of an applied research. Also, based on the nature and method (how to obtain the required data), the current research is in the category of descriptive research. In terms of the type of supervision and the degree of control, this research is in the category of field research because the researcher examines the variables in

their natural state. Regarding the research method, it is necessary to state that in this research, the Delphi method was used to identify and extract the components affecting the efficiency of employees, which are based on architectural requirements. In the Delphi method, it has been done in such a way that first, the dimensions and components affecting the effectiveness of researchers in advanced science and technology centers based on architectural requirements were identified and determined based on the literature review and research background. These indicators and dimensions that were identified based on the components of the initial model and were provided to the experts in the form of a Delphi questionnaire. In this questionnaire, experts were first asked to express their opinion about the dimensions and components of the research model based on architectural requirements. Also, the experts were asked to add a component based on their opinion without prioritizing. This step was repeated several times until the results showed that it was close to collective agreement and the initial model was formed. In the following, a quantitative questionnaire was compiled based on the components identified in the qualitative phase and was provided to the experts to express their opinion regarding the effect of each factor on the efficiency of the researchers in advanced science and technology centers in Iran. The collected data were analyzed by SMARTPLS software.

## **3. Discussion and Findings**

### **3.1. Identification of components**

The Delphi method has been used to identify the factors affecting the effectiveness of researchers in advanced science and technology centers in Iran. The Delphi technique was implemented in three stages, and in each stage, a number of indicators were removed based on the average value of the Kendall coefficient and the opinion of experts in the model, and the next stage was repeated by removing weak indicators. Finally, three stages of the Delphi technique were performed, and in the third stage, the results show that we reached a collective agreement and are the final indicators. The results of the Delphi technique steps can be seen in the following

tables. The results of the Delphi method show that 15 physical-spatial components and 10 environmental components were agreed upon by experts as effective factors in improving the efficiency of researchers in advanced science and technology centers in Iran.

### 3.2. Validation of the model

Based on the results of the qualitative part of the research model consisting of two main factors affecting the researchers' efficiency, including the physical-spatial factor (with 15 components) and the environmental factor (with 10 components), the formation and analysis of the confirmatory factor for construct validity and the test of structural equations to evaluate significance

The model was done, the results of which are presented below. In order to analyze the internal structure of the questionnaire and discover the constituent factors of each construct, construct validity was performed using confirmatory factor analysis. Confirmatory factor analysis of the research structures is presented in the form of Figure 1 to examine the dimensions of the research variables. Figure 1 shows the measurement model of research model variables. According to the output of this graph, all the obtained coefficients are significant. Because the value of factor loadings for each questionnaire question is more than 0.5. As a result, it can be said that the results confirm the construct validity of the variables and dimensions of the model. In other

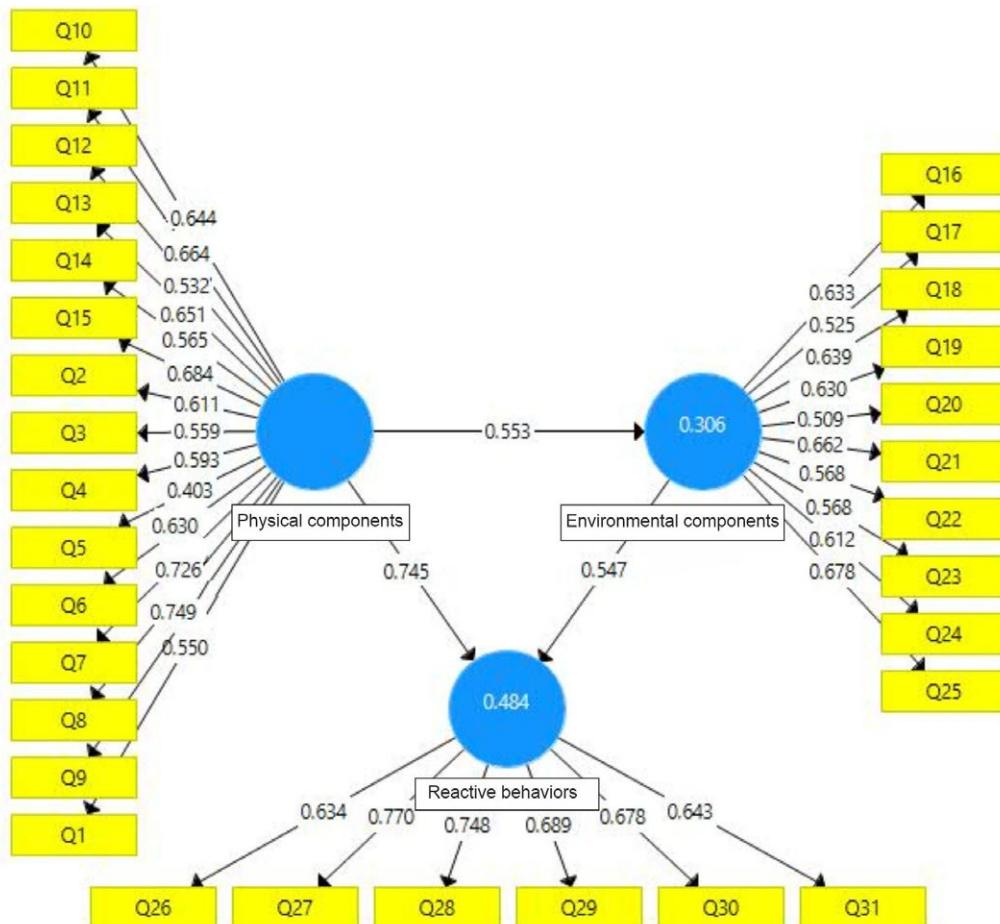


Figure 1: Confirmatory factor analysis of the research model

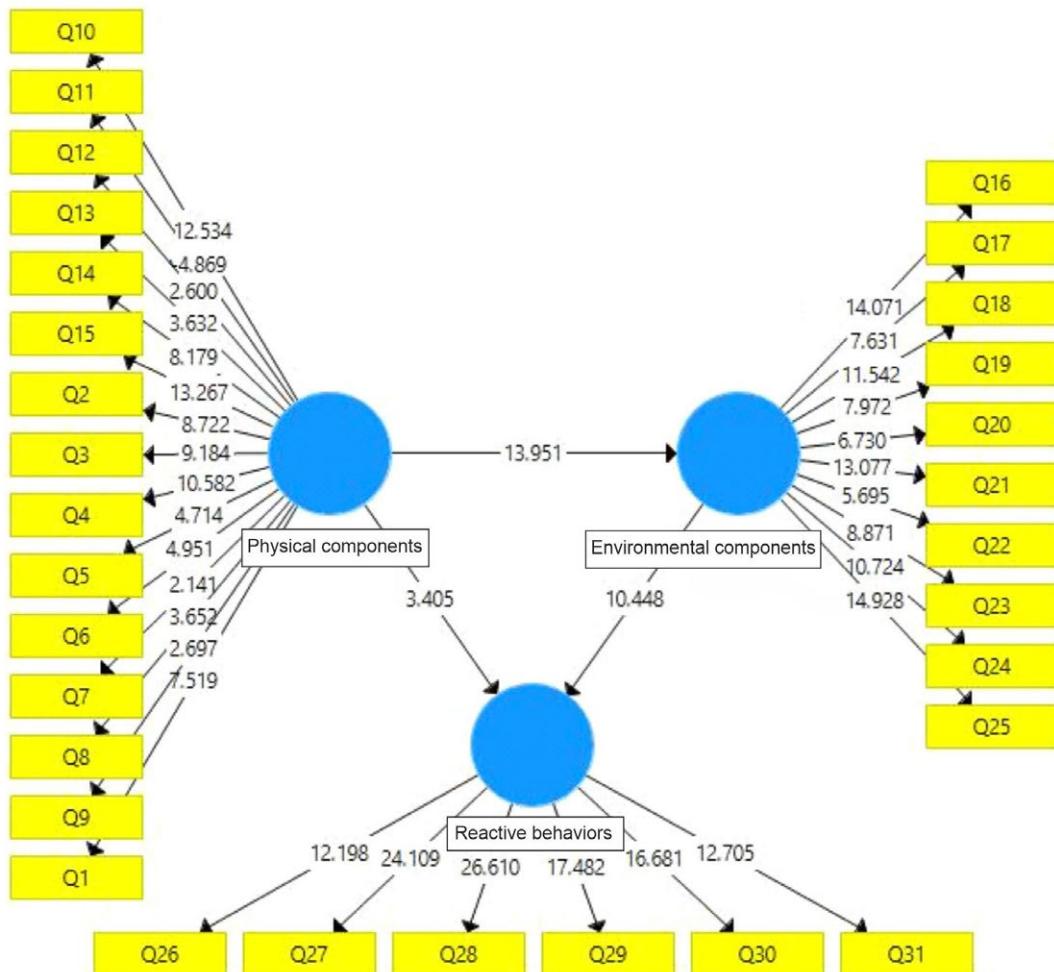


Figure 2: Structural equation model of research

words, the validity of the questionnaire structure is confirmed and it can be used to collect data. ([Figure 1](#))

In order to analyze the data, partial least squares method has been used. Partial least squares are a powerful multivariate technique from the multivariate regression family, and more precisely, an extension of the general linear model. The results of structural equation model analysis using SMART PLS software are presented in [Figure 2](#). This figure shows the output of the model analysis in the state of significance or T-Values.

This output is based on rejecting or confirming the effectiveness of the components and shows the significance of the obtained coefficients and parameters of the structural equation model. According to that, all the obtained coefficients are greater than 1.96, they are all significant.

The results of the path coefficients and t-statistics of the indicators and components of each of the main factors affecting the efficiency of researchers, which are extracted from the structural equation diagram, can be seen in [Table 1](#).

Table 1: Structural equation model of research

Factors affecting researchers' efficiency	Path coefficient	Prioritizing
The effect of the size of the space and the dimensions of the research space on the researchers' efficiency	0/530	3
The effect of building shape and form (internal height and symmetry and order or buildings with soft and curved corners) on researchers' efficiency	0/423	9
The effect of light intensity in the environment (environments with insufficient light compared to sufficient light) on researchers' efficiency	0/529	4
The effect of spatial arrangement in the environment on researchers' efficiency	0/542	2
The effect of flexibility and customization on researchers' efficiency	0/326	19
The effect of materials used in the environment on researchers' efficiency	0/352	16
The effect of using decorations, elements and native elements in the environment on researchers' efficiency	0/363	15
The effect of plants in the environment of research centers on the efficiency of researchers	0/221	25
The effect of windows and views on researchers' efficiency	0/416	11
The effect of crowding and crowding in the environment on the one hand and acoustic and visual (physical) silence on researchers' efficiency	0/375	13
The effect of desk and chair ergonomics on researchers' efficiency	0/551	1
The effect of harmony between light, color and shape on researchers' efficiency	0/346	17
The effect of the possibility of changing the height in the environment and adopting different perspectives on the researchers' efficiency	0/387	12
The effect of observing ideological issues in the physical elements of the environment on researchers' efficiency	0/316	22
The effect of allocating space and using dynamic symbols at the entrance and lobby to increase the desire for innovation (such as holograms with daily changes in concept) on researchers' efficiency	0/427	8
The effect of ventilation and air quality (in order to achieve comfort in the environment) on researchers' efficiency	0/467	6
The effect of temperature and heat on researchers' efficiency	0/324	20
The effect of increased safety on researchers' efficiency	0/278	23
The effect of using sound in the environment on researchers' efficiency	0/367	14
The effect of natural light in the environment on researchers' efficiency	0/478	5
The effect of the beauty of the environment on the efficiency of researchers	0/418	10
The effect of scent and smell in the environment on researchers' efficiency	0/321	21
The effect of having a space for mental relaxation on researchers' efficiency	0/439	7
The effect of simplicity and at the same time harmony of the environment on researchers' efficiency	0/258	24
The effect of outdoor garden park with green space based on landscape architecture on researchers' efficiency	0/342	18

#### **4. Conclusion and Results**

In this research, it was investigated and identified the effective factors on improving the efficiency of researchers in advanced science and technology research centers in Iran, where more emphasis is placed on the requirements of architecture in the space and work environment. The results of the research show that two main factors and indicators have an effect on improving the efficiency of researchers in advanced science and technology research centers in Iran, which include physical-spatial components and environmental factors. To evaluate and measure efficiency, 6 components of behavioral response have been used, which include reducing stress during sensitive work, increasing environmental comfort (satisfaction), increasing concentration in the work environment, increasing environmental interactions, increasing the sense of belonging and attachment to the space, increasing the sense of security. The results of the research in the section examining the influence of factors on the efficiency of researchers show that the factors of the size of the space and the dimensions of the research space on the efficiency of the researchers, the effect of the light intensity in the environment (environments with insufficient light compared to the sufficient light) on the efficiency of the researchers, the effect of spatial arrangement in the environment on researchers' efficiency, the effect of desk and chair ergonomics on researchers' efficiency, the effect of ventilation and air quality (in order to achieve comfort in the environment) on researchers' efficiency, and the effect of natural light in the environment on researchers' efficiency respectively have the greatest effect on researchers' efficiency. In this regard, the following suggestions are made:

- 1) It is suggested to use native decorations, elements and elements in the working environment of researchers of Iran Space Town Science Center. This element has been ranked highly in terms of its impact on researchers' efficiency.
- 2) Also, considering that the presence of plants in the environment of research centers has a high impact on the efficiency of the researchers of the Iran Space Town Science Center, therefore, it is suggested to use this element in the work

environment of the researchers based on a suitable and beautiful design.

- 3) Window, view and view is one of the elements that influence the efficiency of the researchers of Iran Space Town Science Center. Therefore, it is suggested that the working environment of the researchers has a window and a suitable view.
- 4) Desk and chair ergonomics is known as one of the important and influential components on the efficiency of the researchers of Iran Space Town Science Center. Therefore, it is suggested to use standardized and ergonomic tools in the working environment of researchers.
- 5) It is recommended to observe the harmony between light, color and shape and the possibility of changing the height in the environment.
- 6) Adopting different perspectives in the working environment of researchers can have a significant impact on the efficiency of researchers at the Iran Space Town Science Center. Therefore, it is suggested to pay more attention to this category.

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#### HOW TO CITE THIS ARTICLE

Ghandi, SM.; Faizi, M.; Khamohammadi, MA. (2022). The role of architectural components in increasing the efficiency of researchers in research centers (Case study: Iran's Space Town). *J. Urban Manage Energy Sustainability*, 3(4): 41-54.

DOI: [10.22034/jumes.2022.1990949.1120](https://doi.org/10.22034/jumes.2022.1990949.1120)

