

Determination of the Most Significant Design Criteria Affecting the Performance of Those Working on Open-Plan Offices

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Abstract: The place a person spends most of his time during the daily life cycle thereof is his work environment, namely his "office". Numerous resources report that the time spent workplace constitutes a substantial part of human life. As such, a vast number of scientific studies have been conducted with an eye to understand especially the effect of office design on efficiency and motivation in the workplace. However, a data revealing "the most important design criteria that affect the performance of working people" has not been obtained within these studies carried out a result of these literature researches. Objective of the study, in this context, was determined as the determination of the most important design criteria affecting the performance of those working in offices while the purview of the study was limited to open-plan offices with a view to reach a more detailed result. The reason why open-plan offices are the most preferred ones among other type of offices is due to the fact that they facilitate the work by increasing communication between employees. The methodology of the study in line with this objective and purview was to determine, at the first stage, the most significant factor affecting the performance of those working in open-plan offices. Subsequently, the relation of this factor with the interior design was established and the most significant design criteria affecting the performance of those working in open-plan offices were created.

Keywords: Open-plan office, noise and sound control, employee performance, office interior design, performance-based design.

INTRODUCTION

Humans, as living creatures, protect themselves from external factors by virtue of physical environment and continue their lives. Physical environment can be defined as all kinds of man-created "places" in which humans live for a short or long period of time and in which they have mutual relations and participate in various kinds of physical actions and the smallest part of it is called as "interior space". An interior space must be suitable for the activities of humans and requirements as to such activities [1]. This is simply because interior design is an important factor affecting human behavior. Güç [2] describes interior space as a strong factor in terms of forming human behavior. On the other hand, Gür [3] emphasizes the fact that it is almost impossible to think humans in a separate way from space of throughout the life process by supporting this idea.

The place a person spends most of his time during the daily life cycle thereof is his work environment, namely his "office". Danielsson [4] and Mazumdar [5] state that the time spent at a workplace constitutes a very important part of the lives of many

people. As such, a vast number of scientific studies have been conducted with an eye to understand especially the effect of office design on efficiency and motivation in the workplace. For Example, in a research made in 2006 with more than 2000 people which has astonished the senior management of Gensler, "office design and benefits provided thereby to the workplace" has been questioned. The most important outcome of the research reveals the fact that a better interior design increases the performance of employees. 90 percent of participants have brought forward this view. Moreover, according to 48 percent of the employees, a good office environment leads them to work more by staying in the workplace for a longer period of time [6]. In a similar manner, Dole and Schroeder [7] state that employees who are satisfied with the design of an office usually achieve better results in their works [8]. Roelofsen [9] indicates that, complaints and absenteeism of employees decrease and their efficiency increases as a result of the betterment of the working environment. Likewise, in Brill's [10] study it is reported that the working efficiency of the employees increase by 5 to 10% space is of through betterment of the interior space of offices. There are a vast number of scientific studies

conducted with an eye to understand especially the effect of the interior space design of office on efficiency and motivation in the workplace. However, a data revealing “the most important design criteria that affect the performance of working people” has not been obtained within these studies carried out a result of these literature researches.

PURPOSE AND METHODOLOGY

Objective of the study, in this context, was determined as the determination of the most important design criteria affecting the performance of those working in offices while the purview of the study was limited to open-plan offices with a view to reach a more detailed result. The reason why open-plan offices are the most preferred ones among other type of office plans recently is because they facilitate the work by increasing communication between employees. The methodology of the study in line with this objective and purview will be to determine, at the first stage, the most significant factor affecting the performance of those working in open-plan offices. Subsequently, the relation of this factor with the interior design will be established and the most significant design criteria affecting the performance of those working in open-plan offices will be created.

DETERMINATION OF THE MOST SIGNIFICANT FACTOR AFFECTING THE PERFORMANCE OF THOSE WORKING ON OPEN-PLAN OFFICES

It is necessary to determine primarily what the user needs in the offices in order to identify the most important factors affecting the performance of employees in open-plan offices. As such, at the first step of the study, a literature research to determine what the tools used for determining the requirements of users in the interior space design of office are has been conducted. It has been found as a result of this research that the designers have used "client questionnaires" in determining user requirements. Obtaining complete and accurate data by virtue of client questionnaire increases the success of the designer in the design process significantly [11]. Because client questionnaire translates the research objectives into specific questions that are asked of the respondents. It standardizes those questions and the response categories so every participant responds to

identical stimuli. By its wording, question flow, and appearance, it fosters cooperation and keeps respondents motivated throughout the interview. Questionnaires serve as permanent records of the research. They speed up the process of data analysis [12]. Design Build Process[13] da bu ifadeyi destekler şekilde “personal meetings are very important to design process”and “first meeting with client usually runs one-and-a-half to two hours, during which time they discuss and take detailed notes on client’s needs, wants, ideas and ideals” olduğunu söylemektedir [13]. In addition, it has been found as a result of the literature research carried out that the use of "client questionnaire" provides the following additional benefits to help to correct progress of the design process [12; 14]:

1. It translates the research objectives into specific questions that are asked of the respondents.
2. It standardizes those questions and the response categories so every participant responds to identical stimuli.
3. By its wording, question flow, and appearance, it fosters cooperation and keeps respondents motivated throughout the interview.
4. Questionnaires serve as permanent records of the research.
5. They speed up the process of data analysis.
6. They contain the information upon which reliability assessments such as test-retest or equivalent-form questions may be made, and they are used in follow-up validation of respondents' participation in the survey.

In line with all of these determinations obtained, literature and practical resources were investigated in the next phase of the study in order to determine what the client questionnaires used for the determination of user requirements in the interior space design of office. As a result of these researches a total of 288 questions were obtained from the client questionnaires in 21 different resources [15; 16; 17; 18; 19; 20; 21; 22; 23; 24; 25; 26; 27; 28; 29; 30; 31; 32; 33; 34; 35].Subsequently the cited 288 questions were examined in a comparative manner and similar ones were eliminated and the number of questions has been reduced to a total of 92 indicated in Table 1 [11].

Table 1. The questions employed for determination of the user requirements as to interior design of offices

Questions	
Are there areas for employees to socialize and rest?	What are the main business activities of your company?
Who are your rivals in the market?	What is the size/volume of your company?
How satisfied are you with the opportunities of your office?	What is the level of recognition of your company?
What is your budget?	Who are your typical customers?
Which office dynamics is the most important factor in	Are areas available in your office for working in a

performing your work?	concentrated manner?
Are you pleased with the environmental factors of your office?	What is the time allocated for the design and building process?
How satisfied are you with design and aesthetic criteria of your office?	What is the monthly rent or monetary value of the project area?
Has suspended ceiling application been made in your office?	Who is the primary decision maker during the project period?
Do you have adequate privacy in your personal work space?	What is the monetary value of neighboring areas?
Can you customize your work space?	What is the age of the building?
Can you re-arrange your office furniture when necessary?	What is the total area?
What is the scope of the project?	Is the layout of the meeting spaces in your office appropriate?
What is the number and sizes of meeting rooms in your office?	Is your workspace far from kitchen/coffee area in your office?
What is the distance between the walls or furniture and your workspace?	How effective is the office aesthetics and design on the personnel satisfaction?
What are your preferences about design styles and color?	Which qualifications are needed in the design team?
Is your workspace far from main circulation area in your office?	Are the layout of kitchen/coffee spaces appropriate in your office?
Is your workspace far from meeting rooms in your office?	What are your preferences in terms of office furniture?
Is there any rule for making structural change?	Do you want structural change?
Are there people who're working from home in your office?	What kind of spaces do you need in terms of functionality/size?
Which furniture do you share with your other workmates?	How a workspace do you need?
If you use copier/printer, where is it located?	What is the circulation density in the office?
Has your office got any automation system?	Do you want to increase transparency in the office?
Has your office got a lighting control or shading system?	Are the doors and windows enough?
Is your company publicized through visual elements at reception side?	Has any design been made intended for gaining interoffice space?
Do you have any personal preference related to the design?	What visual/audial confidentiality level should be in the office?
Is there any toilet close to the meeting or conference room?	At what interval and in what way do you use your office?
What are the sizes of closed and open office workspaces?	Which sizes and properties of storage areas do you need?
Which one has the most important effect on performing your job?	How pleased are you with the noise in the areas linked to the office?
What are the office supplies that you use most?	How long do your works remain in your workspace?
How often do you make meetings in the rooms outside the workspace?	To what extent your meetings necessitate visual and acoustic confidentiality?
How do the works to be done reach your desk?	Which area do you prefer for a joint work in the office?
Do you share files with another employee?	How often do you use reference material?
Are there large graphical materials exhibited in your workspace?	How satisfied are you with technological facilities of your office?
What should be the distance between you and other people worked together?	What are the preferences of the institution for formal meeting rooms?
Do you use pinboard, flipchart etc. for working?	What are the distracting factors in your workspace?
What is the expected start date of the project?	Which sharing reduces your productivity?
Do visual elements and accessories in your office	What are the first three choices of the institution to

reflect the style of your company?	improve the collaborative work environment in the office?
How many of the files, which you have produced or got from somewhere else, do you keep?	What are the first three choices of the institution to enhance the learning environment in the office?
Is there a sufficient number of toilets for the use of staff in your office? Are they separately for women and men?	Do you make teamwork with other employees? How long was your last teamwork?
What are the preferences of the institution for informal meeting areas?	What kind of artificial lighting is needed in the general space and private workspaces?
How easily does your office internal arrangement meet the changes that will occur in needs?	Which office opportunities have the most important effect on performing your job?
Does your flooring make noise in a manner that will affect your concentration during daily circulation in the office?	Which technological factors have the most important effect on performing your job?
Are there suitable equipments and areas in sufficient number needed for the teamwork in your office?	If you're using your workspace for meetings and interviews, what is the maximum number of people in these activities?
Do you hesitate to talk in common areas where copiers/printers are present in your office?	Which environmental condition is the most important factor in performing your work?
Is there sufficient area in your personal workspace for meetings/talks in your office?	Do the meeting spaces have necessary tools and technology in your office?
Have the material and color selection of the flooring used in your office been used effectively in separation of certain departments, private/public areas and circulation paths?	What do you think, have appropriate furniture and ambience been designed in the present arrangement for participants to communicate with each other?

92 questions in Table 1 were evaluated in terms of the nature of the replies to be given and questions for determination of the requirements of users which affect only the performance of work among all the other questions were found to be as follows:

1. Which environmental condition is the most important factor in performing your work (Natural lighting, artificial lighting, quality of air, temperature)?
2. Which office dynamics is the most important factor in performing your work (Inter-departmental access, status of the settlement between you and your workmates, meeting areas, office layout)?
3. Which office opportunities have the most important effect on performing your job (General storage area, personal storage area, seating and furniture, settlement area) ?
4. Which one has the most important effect on performing your job (One-to-one discussion

spaces, confidentiality, the noise around the office, interoffice noise, silence and reading spaces)?

5. What are the distracting factors in your workspace (noise of machines; phones ringing at a close distance to me and telephone conversations, other conversations made at a close distance to me, noise in general, background music, total silence, printers and other office equipments, personal radios)?
6. Which sharing reduces your productivity?(Computer sharing, insufficient file storage area, insufficient confidentiality, insufficient working area)

A new questionnaire has been prepared solely utilizing the questions listed hereinabove at this stage of the study. Opinions of 50 different users working in open-plan offices by using this questionnaire were received. Results of these opinions were observed to be as in Table 2.

Table 2. The results of the questionnaire carried out with 50 different users working in open-plan offices

1. Which environmental condition is the most important factor in performing your work?		
Option	Number of client	Percentage
Natural lighting	12	24%
Artificial lighting	7	14%
Quality of air	17	34%
Temperature	14	28%
2. Which office dynamics is the most important factor in performing your work?		
Option	Number of	Percentage

	client	
Inter-departmental access	14	28%
Status of the settlement between you and your workmates	18	36%
Meeting areas	1	2%
Office layout	17	34%
3. Which office opportunities have the most important effect on performing your job?		
Option	Number of client	Percentage
Settlement area	24	48%
Seating and furniture	21	42%
General storage area	3	6%
Personal storage area	2	4%
4. Which one has the most important effect on performing your job?		
Option	Number of client	Percentage
Interoffice noise	28	56%
The noise around the office	1	2%
One-to-one discussion spaces	8	16%
Confidentiality	6	12%
Silence and reading spaces	7	14%
5. What are the distracting factors in your workspace?		
Option	Number of client	Percentage
Noise of machines	10	8,19%
Phones ringing at a close distance to me and telephone conversations	33	27,04%
Other conversations made at a close distance to me	29	23,77%
Noise in general	26	21,31%
Background music	5	4,09%
Total silence	4	3,27%
Printers and other office equipments	8	6,55%
Personal radios	7	5,73%
6. Which sharing reduces your productivity?		
Option	Number of client	Percentage
None	7	8,13%
Computer sharing	16	18,60%
Unsufficient file storage area	12	13,95%
Unsufficient confidentiality	15	17,44%
Unsufficient working area	36	41,86%

When the results in Table were evaluated, it was found the factors affecting the work performance of those working in an open-plan office were defined as follows:

1. Quality of air,
2. Settlement area,
3. Status of the settlement between the person and the workmates thereof,
4. Unsufficient working area,
5. Interoffice noise,
6. Phones ringing at a close distance to me and telephone conversations

It was determined that the most important among these factors was found to be "in-office noise" by 56%. Namely, "in-office noise" is the most significant factor

affecting the performance of users working in open-plan offices.

DETERMINATION OF THE MOST SIGNIFICANT DESIGN CRITERIA TO BE TAKEN INTO CONSIDERATION IN OPEN-PLAN OFFICES

At this phase of the study, the relationship between "in-office noise" which is the factor with the most effect on the work performance of those working in open-plan offices and the design of the interior space will be established and in this way the most important design criteria to be taken into consideration in open-plan offices will be created. Hence, a second questionnaire that will allow the determination of user requirements as to "in-office noise" was prepared at this

stage of the work. 92 questions in Table 1 were utilized while creating this questionnaire and only the following questions related to "in-office noise" were selected among them:

1. What is the circulation density in the office?
2. At what interval and in what way do you use your office?
3. To what extent your meetings necessitate visual and acoustic confidentiality?
4. How often do you make meetings in the rooms outside the workspace?
5. Which area do you prefer for a joint work in the office?
6. What are the preferences of the institution for informal meeting areas?

7. What are the preferences of the institution for formal meeting rooms?
8. What visual/audial confidentiality level should be in the office?
9. What are the distracting factors in your workspace?
10. What should be the distance between you and other people worked together?
11. Do you hesitate to talk in common areas where copiers/printers are present in your office?

The data obtained subsequent to receiving the opinions of 50 different users working in open-plan offices were taken by using the questionnaire consisting of 11 questions listed hereinabove were found to be as in Table 3.

Table3. The result of the survey carried out for the determination of user requirements related to "in-office noise"

Question	Option	Number of client	Percentage
What is the circulation density in the office?	Excessively Intensive	3	6%
	Intensive	17	34%
	In normal level	23	46%
	Not busy	7	14%
At what interval and in what way do you use your office?	Writing / Printing (letters, reports, memos, etc.)	31	19,01%
	Reading (letters, reports, notes, and etc.)	24	14,72%
	Computation, data processing	28	17,17%
	Filing / Taking files	16	9,81%
	Meeting	27	16,56%
	Telephone conversations	33	20,24%
	Drawing and Design	3	1,84%
	Other: Software development	1	0,61%
To what extent your meetings necessitate visual and acoustic confidentiality?	My work does not require meetings	2	4%
	None of my meetings require visual and acoustic confidentiality	10	20%
	Some of my meetings require visual and acoustic confidentiality	25	50%
	Most of my meetings require visual and acoustic confidentiality	12	24%
	All of my meetings require visual and acoustic confidentiality	1	2%
How often do you make meetings in the rooms outside the workspace?	Once a day	13	26%
	Once a week	25	50%
	Once a month	9	18%
	Never	1	2%
	My work does not require meetings	2	4%
Which area do you prefer for a joint work in the office?	Withinopen-office plan	8	10,52%
	Inmeeting rooms	43	56,57%
	Inproject rooms	8	10,52%
	Recreation areas (e.g.: cafeterias, resting areas)	11	14,47%
	Any place in the office	6	7,89%
	I have no preference	0	0%
	Other, please specify	0	0%
What are the preferences of the institution for informal meeting areas?	Withinopen-office plan	14	18,91%
	Inmeeting rooms	20	27,02%
	Inproject rooms	7	9,45%
	Recreation areas (e.g.: cafeterias, resting areas)	18	24,32%

	Any place in the office	11	14,86%
	I have no preference	4	5,40%
	Other, please specify	0	0%
What are the preferences of the institution for formal meeting rooms?	Within open-office plan	4	6,34%
	In meeting rooms	43	68,25%
	In project rooms	8	12,69%
	Recreation areas (e.g.: cafeterias, resting areas)	3	4,76%
	Any place in the office	2	3,17%
	I have no preference	1	1,58%
	Other, please specify	2	3,17%
What visual/audial confidentiality level should be in the office?	My work environment require visual and acoustic confidentiality	2	4%
	Between 0% and 24%	8	16%
	Between 25% and 49%	15	30%
	Between 50% and 74%	14	28%
	75% or more	11	22%
What are the distracting factors in your workspace?	Noise of machines	10	8,19%
	Phones ringing at a close distance to me and telephone conversations	33	27,04%
	Other conversations made at a close distance to me	29	23,77%
	Noise in general	26	21,31%
	Background music	5	4,09%
	Total silence	4	3,27%
	Printers and other office equipments	8	6,55%
	Personal radios	7	5,73%
What should be the distance between you and other people worked together?	Very close	3	6%
	Close	15	30%
	At a normal distance	27	54%
	Far	5	10%
	Very far	0	0%
Do you hesitate to talk in common areas where copiers/printers are present in your office?	Yes	18	36%
	No	32	64%

Following were found when the results in Table 3 were evaluated:

1. The most distracting noise sources in the workplace are ringing phones and telephone conversations as well as other conversations made at a close distance and the noise in general and among them telephone conversations are the ones which occur during most of the working time,
2. Audio confidentiality level in the office is desired to be between 25% and 75%,
3. Formal and informal collaboration or meetings are held once a week in the meeting rooms in average and 50% of these meetings require acoustic confidentiality,
4. The distance between the employees at the workplace is definitely not desired to be very far from each other and they must be kept at a normal level,
5. The common usage areas at the workplaces (such as photocopy/printer and etc.) are generally places where people do not refrain from speaking loudly and therefore speaking in such areas is one of the noise sources in offices
6. Circulation in the working areas is at an intensive level.

As a result of the evaluations made hereinabove, the most important criteria that the designer should be careful in the design process relating to the control of noise inside the office or in other words, the most important design criteria affecting the working performance of users in open plan offices of can be identified under four main headings as follows:

Design Criteria I: Interior space solutions that ensure acoustic confidentiality level between 25% and 75% in the common areas office as to in particular telephone conversations and mutual conversations must be created to obtain noise control. While this is realized the distance between the employees must be arranged at a level to provide easy communication. Measurement of acoustic confidentiality must be performed by a parameter named Confidentiality Index (PI). "0" denotes

the absence of confidentiality while "1" denotes absolute confidentiality in this parameter which is between "0" and "1". In other words, solutions with 80% average of PI value must be created in order that those working in the open-plan offices can continue to perform their work without being distracted. This means that more than half of what the other people speak in another location cannot be understood and only in such a case the people working can concentrate on their works [36].

Design Criteria II: Planning solutions to make formal and informal collaborative works or meetings in individual work areas in open-plan offices are required. Closed meeting rooms providing acoustic confidentiality for all types of meetings and collaborative works should be designed. PI value to ensure acoustic confidentiality must be 95% and above. What the person speaking is completely incomprehensible in this range and is appropriate for the sharing of information with high confidentiality.

Design Criteria III: Interior space designs ensuring a level of acoustic confidentiality between 25% and 75% should be made for the common usage areas at the workplaces (such as photocopy/printer and etc.). In other words, PI value in such areas should be 80% in average.

Design Criteria IV: Materials which absorb sound, act as a sound barrier and with muffling and anti-vibration properties should be preferred while selecting ground materials to prevent noise due to the heavy circulation in the workplace.

RESULTS

The designer's performing the design process by taking into account "the most important design criteria affecting the performance of people working in open-plan offices" defined under four headings as a result of this study will enable preparation of more appropriate projects which will increase efficiency.

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