

## How physical and non-physical working environment affects creativity: An empirical study

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### ABSTRACT

Creativity is one of the most important factors to increase the productivity of any organization. There are literally different factors influencing creativity such as physical and non-physical components of a system. There are different studies to confirm that both physical and non-physical issues could impact the efficiency, significantly. The study of this paper considers eleven physical and ten non-physical activities in working environment of six organizations with various business activities of educational, manufacturing and service business. The study summarizes the most and the least important physical and non-physical factors based on some statistical tests.

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## 1. Introduction

Creativity and innovations are two most important items in leading of any organization to a valued added firm. A creative firm could compete with its rivals more strongly and it could pass economical crises easier. Therefore, there is a need to setup a good environment to build better working conditions to help employees become more creative. During the past few decades, there have been tremendous efforts to determine significant factors influencing the creativity of working environments (Siegel & Kaemmerer, 1978; Schneider, 1987; Reilly, 2008). Hird (2001) examined a hypothesis on whether a change organization's structure could change the creativity. He reported that merging different drug companies could reduce the creativity. Rice (2006) performed a survey among Egyptian employees based on a questionnaire incorporating the Schwartz value and reported that self-direction is a relatively important value for creativity in the workplace. Sehat (2010) performed a study to examine the relationship between some middle-east principals' creativity and personnel's productivity in technical-vocational colleges and he found that culture and attitudes toward the organization could influence productivity, significantly. Menzel et al. (2007) described some methods to make engineers active in the area of intrapreneurship within big firms where they often are hired in

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R&D. Slater et al. (2010) determined important factors influencing marketing strategy creativity and marketing strategy implementation effectiveness. The study of this paper focuses on physical and non-physical working segments to see whether they could influence the creativity of organizations. There are various factors categorized in either physical or non-physical items and they are summarized in Table 1.

**Table 1**

Physical and non-physical items influencing creativity

Physical	Non-physical
Diversity of the number of working facilities	The feeling of freedom in working environment
The arrangement of furniture	A good background to provide feedback
The availability of a good library	A peaceful and joyful workplace
A working environment with sufficient light	Being purposeful and enjoyable job
A good phone communication	Lack of concern regarding the design of new ideas
The availability of natural flower	Dynamics and appropriate changes in the workplace
A comfortable sitting chair	The availability of discussion in the workplace
A computer with necessary software packages	No conflict in workplace
The availability of some painting and pictures hanging around	Tolerance and acceptance of new ideas regarding the organization
A good air-conditioning facilities	Opportunities for creative ideas and processing
The quality of communication	

The paper performs a questionnaire survey for both items in different organizations with various business natures. The questions are distributed among a sample of workers and the results are analyzed using a statistical analysis. The organization of this paper first explains the details of survey in section 2. Section 3 reports the details of the implementation and the conclusion remarks are given in section 4 to summarize the contribution of the paper.

## 2. The proposed methodology

The primary objective of this paper is to find out how physical or non-physical components of an organization can impact the creativity of an organization. The main questions of this research are as follows,

1. The effects of physical working environments on increasing creativity of an organization in ideal position.
2. The effects of physical working environments on increasing creativity of an organization in present position.
3. The effects of non-physical working environments on increasing creativity of an organization in ideal position.
4. The effects of non-physical working environments on increasing creativity of an organization in present position.
5. The effects of physical and non-physical working environments on increasing creativity of an organization in ideal position.
6. The effects of physical and non-physical working environments on increasing creativity of an organization in present position.

The questionnaire has two main sections where the first one is associated with the present conditions and the second one is associated with the ideal condition. The questions are also divided into two categories of physical and non-physical working parameters. We use Likert (1932) based scales for our questions from one to five where one represents for completely effective and five is considered for highly ineffective items.

### 3. The results

The statistical population of this survey consists of the municipality, Justice, universities, refineries, power plants and transportation units. We have used cluster sampling in two stages of 30 and 350 samples, respectively. The purpose of the first stage is to validate the questionnaire and in the second stage we use the results of our survey to analyze the results. The sample of the next step covers with a possibility of 95 percent covers over 80 percent of the population needed for the survey and 332 responses were gathered. The implementation of kruskal-wallis (Kruskal & Wallis, 1952) and kalmogorov-smiranov (Corder & Foreman, 2009) tests indicates that our input data are not normally distributed. Kruskal-wallis is a one-way analysis of variance by ranks and it is considered as a non-parametric method for testing equality of population medians among different groups. Let  $n_i$  be the number of observations in group  $i$ ,  $r_{ij}$  be the rank of observation  $j$  from group  $i$  and  $N$  be the total number of observations across all groups. The Kruskal-wallis (K) test is calculated as follows,

$$K = (N - 1) \frac{\sum_{i=1}^g n_i (\bar{r}_i - \bar{r})^2}{\sum_{i=1}^g \sum_{j=1}^{n_i} (r_{ij} - \bar{r})^2}, \tag{1}$$

where  $\bar{r}_i = \sum_{j=1}^{n_i} r_{ij} / n_i$  and  $\bar{r} = (N + 1) / 2$ .

The critical value of chi-square  $\chi^2_{\alpha, g-1}$  can be found with  $g - 1$  degrees of freedom and a desired significance or alpha level. The null hypothesis of equal population medians is rejected if  $K \geq \chi^2_{\alpha, g-1}$ . We can also use chi-square test for our discrete intervals and we also use kalmogovov-smiranov and man-whitney tests to compare two independent groups which are not normally distributed. Table 2 summarizes the frequency of the raw data gathered.

**Table 2**  
The input data of the survey

Title	Frequency	Percentage	Valid (%)	Cumulative
Powerhouse	51	15.4	15.4	15.4
Municipality	51	15.4	15.4	30.7
University	68	20.5	20.5	51.2
Transportation	37	11.1	11.1	62.3
Refineries	75	22.6	22.6	84.9
Justice	50	15.1	15.1	100.0

Table 3 and Table 4 demonstrate the details of the kruskal-wallis test for 10 physical working environments in idea position. As we can observe there is a meaningful difference for ideal position. The test statistics (a,b) where a represents Kruskal Wallis Test from Eq. (1) and b represents grouping of type form yields  $\chi^2 = 200.996$  with  $sig = 0.000$ . The results clearly reject the null hypothesis of equal ranking between two groups since  $\chi^2 = 200.996 > \chi^2_{0.05, 10} = 18.307$ . Table 3 also shows the results of comparison tests among different groups. Based on the results we can conclude that the computer & sufficient light as well as diversity of working items & library are in the same groups and these two groups include the most important factors that could increase creativity in an organization. The other factors of good communication service with good pictures hanging on the wall have the least influence on the creativity of people.

**Table 3**

The statistical ranking data gathered for the first question of the survey

Physical	kruskal-wallis		Subset for alpha = .05					
	Rank	N	1	2	3	4	5	6
A computer with necessary software packages	329	329	1.72					
A working environment with sufficient light	330	330	1.88	1.88				
Diversity of the number of working facilities	322	331	1.95	1.95	1.95			
The quality of communication	328	322	1.98	1.98	1.98			
A good phone communication	319	331		2.00	2.00			
A comfortable sitting chair	331	330		2.04	2.04	2.04		
A good air-conditioning facilities	330	328			2.19	2.19	2.19	
The arrangement of furniture	327	327				2.29	2.29	
The availability of a good library	331	332					2.32	
The availability of natural flower	332	319					2.39	2.39
The availability of some painting and pictures	324	324						2.63
Sum	3603	Sig.	.069	0.657	0.147	0.105	0.331	0.132

The other test is to examine the influence of eleven physical items in present environment. Table 4 summarizes the details of our results.

**Table 4**

The statistical ranking data gathered for the second question of the survey

Physical	kruskal-wallis		Subset for alpha = .05				
	Rank	N	1	2	3	4	5
A computer with necessary software packages	326	327	2.22				
A working environment with sufficient light	326	327	2.51	2.51			
Diversity of the number of working facilities	330	326		2.58	2.58		
The quality of communication	327	331		2.73	2.73	2.73	
A good phone communication	325	325		2.74	2.74	2.74	
A comfortable sitting chair	327	327		2.75	2.75	2.75	
A good air-conditioning facilities	327	329		2.79	2.79	2.79	
The arrangement of furniture	327	326			2.88	2.88	2.88
The availability of a good library	331	330				3.02	3.02
The availability of natural flower	329	327					3.17
The availability of some painting and pictures	331	331					3.18
Sum	3606	Sig.	.109	0.134	0.098	0.111	0.069

The results clearly reject the null hypothesis of equal ranking between two groups since  $\chi^2 = 162.052 > \chi^2_{0.05,10} = 18.307$ . Again, the results of kruskal-wallis test and pairwise comparisons show that the existence of sufficient light and computer equipment could significantly increase creativity under present working conditions of the organizations. Also the last group which includes the arrangement of furniture, the availability of a good library, the availability of natural flower and the availability of some painting and pictures on the wall have the least influences on creativity of the people who work for an organization.

Another test, which was performed in our study is associated with non-physical conditions in the present situations of organizations and the results are summarized in Table 5. Based on kruskal-wallis we have  $\chi^2 = 41.447 > \chi^2_{0.05,10} = 18.307$ , which means there is significant difference among all non-physical items. The first two rows of table 5 indicate that being purposeful in working environment as well as a joyful space could significantly increase the creativity of an organization while the other factors such as lack of concern regarding the design of new ideas tolerance of accepting new ideas have less effect on creativity.

**Table 5**

The statistical ranking comparison for non-physical conditions in present situations

Physical	kruskal-wallis			
	Rank	N	1	2
Being purposeful and enjoyable job	329	329	1.82	
The feeling of freedom in working environment	327	327	1.89	1.89
A good background to provide feedback	324	324	1.90	1.90
No conflict in workplace	320	320	1.93	1.93
The availability of discussion in the workplace	321	321	2.00	2.00
Dynamics and appropriate changes in the workplace	322	322	2.06	2.06
Lack of concern regarding the design of new ideas	318	318	2.06	2.06
Tolerance and acceptance of new ideas regarding the organization	321	321	2.07	2.07
A peaceful and joyful workplace	326	326		2.10
Opportunities for creative ideas and processing	325	325		2.11
Sum	3606	Sig.	.065	0.143

In order to see whether there is any difference between the ideal and the present conditions, we performed a Mann-Whitney test (Corder & Foreman, 2009) and Table 6 shows the details of the implementation of this test.

**Table 6**

The results of our Mann-Whitney test

	type	N	Mean Rank	Sum of Ranks	Mann-Whitney	Wilcoxon W	Z	Sig. (2-tailed)
Ideal	Physical	332	355.05	117878.00				
	Non-physical	330	307.80	101575.00	46960.000	101575.000	-3.180	.001
	Total	662						
Present	Physical	332	365.64	121391.50				
	Non-physical	331	298.26	98724.50	43778.500	98724.500	-4.530	.000
	Total	663						

As we can observe from Table 6, all tests imply that there are some meaningful differences between the physical and non-physical items in both present and ideal conditions.

#### 4. Conclusions

In this paper, we have presented an empirical study to determine the most effective physical and non-physical parameters affecting working environment to increase creativity. The proposed study of this paper has concluded that, among the physical environment elements, the computer & sufficient light as well as diversity of working items & library are in the same groups and these two groups include

the most important factors that could increase creativity in an organization. The other factors of good communication service with good pictures hanging on the wall have the least influence on the creativity of people. The study also concludes that, among non-physical items, being purposeful in working environment as well as a joyful space could significantly increase the creativity of an organization while the other factors such as lack of concern regarding the design of new ideas tolerance of accepting new ideas have less effect on creativity.

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