Exploring the Link between Workplace Environment and Workers' Satisfaction: IT & Telecom Industry of Islamabad, Pakistan

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Abstract:

Work environment plays important role in employee's productivity which translates into overall increase in efficiency and productivity of organization. This research was carried out to study how productivity of employees is affected by various factors such as office layout, workplace environmental factors (light, noise and temperature etc.), thermal comfort and type of thermal control system installed in offices. Data was collected through questionnaire from various IT and telecom sector companies in Islamabad, Pakistan. Structural equation modeling (SEM) was used as an empirical tool to analyze the data. Two models were developed. Results showed that productivity of employees in IT sector companies is strongly dependent on type of control system installed and on temperature in the working environment and office layout.

Keywords: Workplace Environment, Productivity, Social Research Methods, Workers' Social Perception, Structural Equation Modelling, Pakistan

Introduction

The global IT success stories such as Microsoft, Google, Apple, etc. were difficult to materialize without the dedication and hard work of the workers of these once small startups. The hard work and dedication of employees of these firms originated from the working environment which according to some employees, has been satisfying, relaxing and innovative[1]. Therefore, work environment plays a pivotal role in employee's productivity that translates into overall increase in the efficiency and productivity of the organization.

Various studies have focused on different aspects of workplace environment and their relation to workers' efficiency and productivity. Ajala (2012) found that workplace features and good communication network at workplace affects the worker's welfare, health, efficiency, and productivity. Hameed et al. and Sehgal (Hameed et al. 2009, Sehgal 2012) have revealed a direct relationship between office design and productivity. They found that lighting at workplace is a major feature affecting workers' productivity. El-Zeiny (2012) established that interior design has considerable impact on productivity of employees. Additionally, he also highlighted that temperature of work environment has strong effect on employee's productivity followed by the furniture. Thermal environment causing thermal discomfort may affect the performance of office workers. Compelling evidence was provided that room air temperature has considerable effects on work performance (Tham & Willem 2010). Another study by Ismail et al. (2014) showed that environmental features such as luminance, humidity and temperature affect workers' productivity. However, temperature was dominant feature followed by luminance and relative humidity to affect

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the productivity of workers. Noise level at workplace is also important for workers to concentrate on their work and hence affect their productivity (Dharmendra Prajapati* 2015).

Above mentioned studies have looked into different aspects of workplace environment and their impacts on the productivity of office workers (please see Figure 1). Large number of studies featuring work environment and productivity have been undertaken in developed countries. Developing countries, particularly Pakistan lack studies that may have employed quantitative methods of analysis.

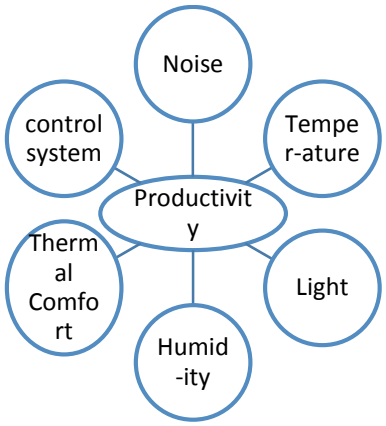


Figure 1: Relation between work environment and productivity

In addition, we could not find a research article on Pakistan that looked into the impact of office layout and ambient conditions on workers' productivity. Open-plan offices provide less privacy, reduce concentration of employees but on the other hand, provide better communication among workers. Similarly, separate offices may contribute to a comfortable and peaceful work environment that may enhance the workers' productivity. Combined effect of type of office layout and thermal control system on productivity is a rarely researched area. It is required to study the impact of office layout and type of thermal control system on employee's performance and productivity.

This paper looks into the relationship among office layouts, thermal control systems and the productivity of workers employed in the offices of IT and telecom companies located in Islamabad, Pakistan. Structural Equation Modelling provided an analytical framework to develop and analyze the relationships between variables under study.

This paper proceeds in the following manner. Section 2 presents the conceptual framework used for hypotheses development. Section 3 explains the data and method. Section 4 gives results and analysis. Section 5 discusses the results whereas Section 6 concludes the paper.

Conceptual framework and hypotheses development

Various studies have analysed the relationship between different aspects of workplace environment and employees' productivity. Building on existing literature, this paper initially suggests a couple of conceptual models leading to hypotheses that are then tested empirically using structural equation modelling.

Work effectiveness of employees might be affected by the physical features of work place such as noise, flexibility, furniture, comfort, lighting, communication, air quality and temperature (BRILL 1984). The quality of workplace environment restricts the recruitment and retention of skilled labour in a company. (Leblebici 2012) found that workplace environment affects productivity, comfort level, morale and engagement of employees. Work environment can have either positive or negative effects on all above variables. ROELOFSEN (2002) found that improved working environment resulted in the surge of productivity, reduction in absenteeism and number of complaints of the employees. Physical design of workplace is a critical aspect that affects productivity. An increase was observed in the employees' productivity with improvements in the physical layout/design of the workplace (BRILL 1984, STALLWORTH, J. O. E. KLEINER n.d.). Sensitization of layout/design might also be different among employees depending on their individual features such as age, sex, education, etc. A study showed that female workers were more concerned about interior design of their offices as they were more affected by privacy issues. On the other hand, male respondents were more affected by temperature at their workplaces (El-Zeiny 2012).

Since interior design significantly influences the performance of workers, therefore many companies incorporate new designs, layouts and techniques thereby promoting productivity and enticing employees (Hameed et al. 2009, WILLIAMS et al. 1995, UZEE 1999).The importance of interior design has further been strengthened by a study that ranked it as one of the three factors impacting job satisfaction and performance of employees (American Society of Interior Designers 1999).

Lighting is another important aspect that affects the productivity of employees at workplaces. A study conducted on the offices of the Commission for Architecture & Built Environment and the British Council, showed that attendance rate can be increased by 85%, and productivity by 25% on average by installing adequate lighting and having proper daylight. Most of the individuals in open plan offices hinted at using lighting control to enhance their level of satisfaction. Despite the fact that the controllable lights were shared, agreement among employees created an enhanced lighting environment for the majority of employees (Chraibi et al. 2016). The accessibility of individually controlled lighting resulted in a favourable office environment and a better level of workplace satisfaction (Chou et al. 2015). In addition to lighting, noise can also affect the working environment. A study showed that approximately 40% reduction in productivity and 27% increase in errors occurred due to lack of aural privacy in open-plan offices (McLaughlin 1987).

Temperature is another important aspect affecting the employee's productivity. A study was carried out in China to assess the impact of temperature on two different groups of people, one being exposed to a temperature variation while the second to a constant temperature of 26 C^{o}. A negative effect was found on the performance of employees working in a varied temperature(Cui et al., 2013). Valančius & Jurelionis (2013) found that air temperature affected the performance of

workers at offices. Rise in temperature showed a reduction in the performance by 2.5% while a fall in temperature caused an upsurge in the performance by 1.6%.During summer in Finland, productivity of employees showed a decline with temperature rise above 25 C^o (KEKÄLÄINEN et al. n.d.). Similarly, increasing air temperature in Japanese call centers showed a decline in workers' performance by 1.9% (Akimoto et al. 2010, Tanabe et al. 2015).

Thermal control systems along its types have also got attention of researchers in recent years. For employees' health and well-being it is necessary to provide them a comfortable environment. Thermal comfort, the level of satisfaction of thermal environment is the perception of the occupants of a building of the neighbouring environment (Simion et al. 2016). A main area of research has been the effects of different thermal control systems on health, well-being, efficiency and productivity of the employees at workplace. Systems such as Task Ambient Conditioning (TAC) with underfloor air distribution have shown various advantages as compared to ceiling based air distribution systems (Bauman 1999). The study revealed the advantages such as improvement in ventilation efficiency and air quality that results from delivery of fresh air to building occupants. Secondly, thermal comfort of occupants also improved as individuals were provided with some sort of personal thermal control. Thirdly, energy consumption reduced with underfloor air distribution and thermal stratification. Study concluded that satisfaction and productivity of employees improved when occupants were provided with some control to their local thermal environment.

To maintain the conditions of a comfortable workspace, central air conditioning systems are used that consume a lot of energy. On the other side, personal comfort system, an idea which refers to devices or systems that only improve individual's thermal conditions rather than that of entire room. Personal comfort system can be divided into two categories including personal heating and personal cooling. A major purpose of using personal comfort system (pcs) has been the advantage of enhanced comfort and energy saving (He et al. 2016). A study on closed office layout revealed that desk fans could meet 90% satisfactory standards (Ansi/Ashrae 2004). In addition, the provision of personal desk fans also increased thermal comfort of the office occupants. Similar results were also concluded by (Tanabe et al. 2015). On the basis of above discussed studies and variables and their effects we are able to propose our research models. Two research models are proposed based on (Preacher & Hayes 2008).

Proposed research model I

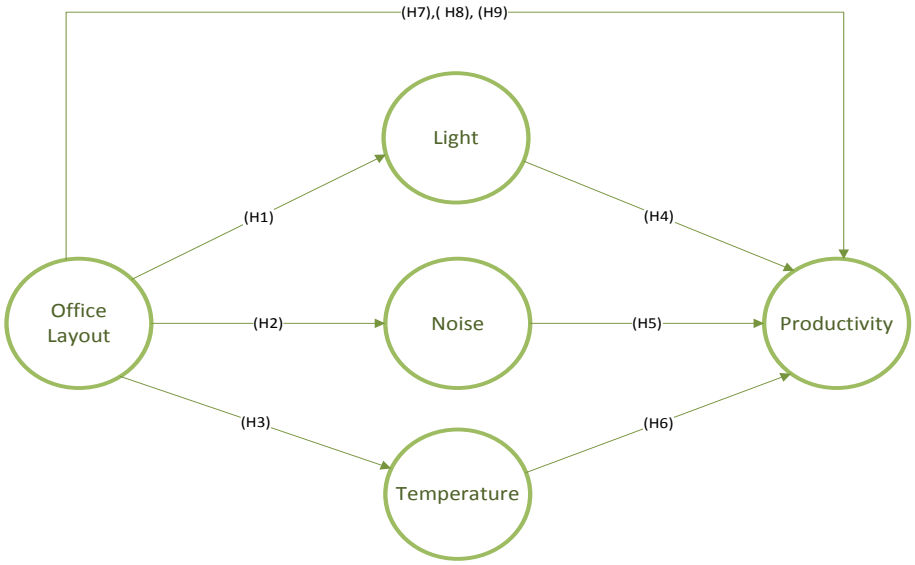


Figure 2: Proposed Research Model I

H1: office layout has positive effect on light.

H2: office layout has positive effect on noise.

H3: office layout has positive effect on temperature.

H4: Adequate light has positive effect on productivity.

H5: Too much noise has negative effect on productivity.

H6: High temperature has negative effect on productivity.

H7: Light mediates the relationship between office layout and Productivity of employees.

H8: Noise mediates the relationship between office layout and Productivity of employees.

H9: Temperature mediates the relationship between office layout and Productivity of employees.

Proposed research model II

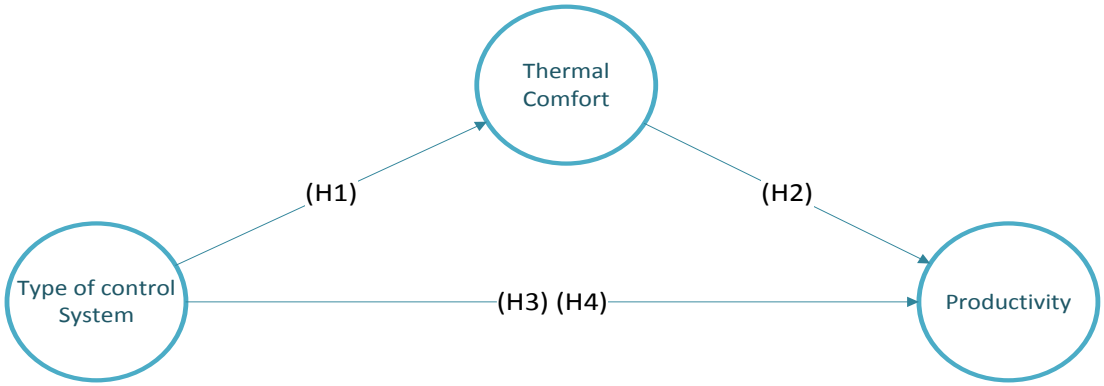


Figure 3: Proposed Research Model II

H1: Control system has positive effect on thermal comfort.

H2: Productivity of employees increase as thermal comfort increases.

H3: Control system has positive effect on productivity.

H4: Thermal comfort mediates the relationship between type of thermal control system and productivity of employees.

Data and Methodology

Information Technology (IT) and telecom firms located in the capital territory of Islamabad, Pakistan were selected for this study under two reasons. Firstly, Pakistan is contemplating a high boom in the IT and telecom sector in coming years. A positive growth in the sector relies on the innovation environment in the companies. This study may provide a good analysis of the aspects relating to work environment that help improve comfort and satisfaction of the employees thus contributing to a productive environment in the IT and telecom companies. Secondly, as a large number of companies are located in the three major cities of Pakistan including Karachi, Lahore and Islamabad; the selection of Islamabad based firms could reduce the time and financial requirement of the researchers (mainly based in Islamabad) to carry out this study.

We selected five out of 25 IT& telecom companies based in Islamabad randomly for data collection. Sample consisted of 5% of the total employees from each firm and the individuals were selected using purposive sampling technique by ensuring educational and gender diversity. 375 questionnaires were distributed in 5 companies. The questions were required to be responded on a five points Likert scale ranging from strongly disagree to strongly agree. 285 questionnaires were returned filled, of which 231 were useable with a response rate of 58% as shown in

Table ***1***.

Table 1: Population and sample space

Company	No of employees (approx.)	Sample size (5% of total no. of employees)	Data Received
Zong	1500	75	49
Nayatel	1400	70	53
Huawei	1900	95	42
Techlogix	900	45	34
Ufone	1800	90	53
Total	7500	375	231

The received data was processed and analyzed with a number of methods and software. The compilation and screening of data, descriptive statistics and reliability of the measure items was done with Statistical Package for Social Sciences (SPSS). For the mediation effect and hypothesis testing Structural Equation Modelling (SEM) technique was used in Analysis of Moment Structures (AMOS) software. The application of SEM is explained in Section 4 step by step.

Descriptive Analysis

Descriptive statistics explained the respondents' responses to different aspects of variables including layout, noise, temperature, thermal comfort, control system and productivity. Descriptive statistics show responses to each question fell above average meaning most of the respondents gave their responses in agreement.

Table 2: Descriptive Statistics Model

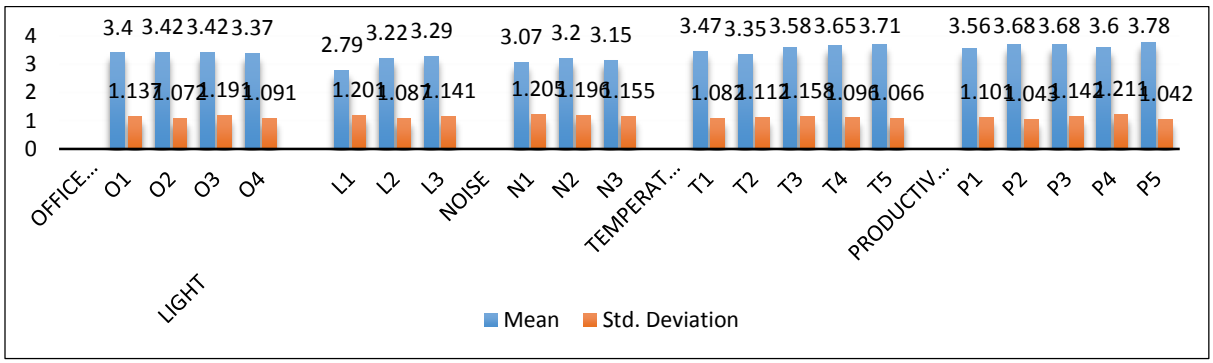
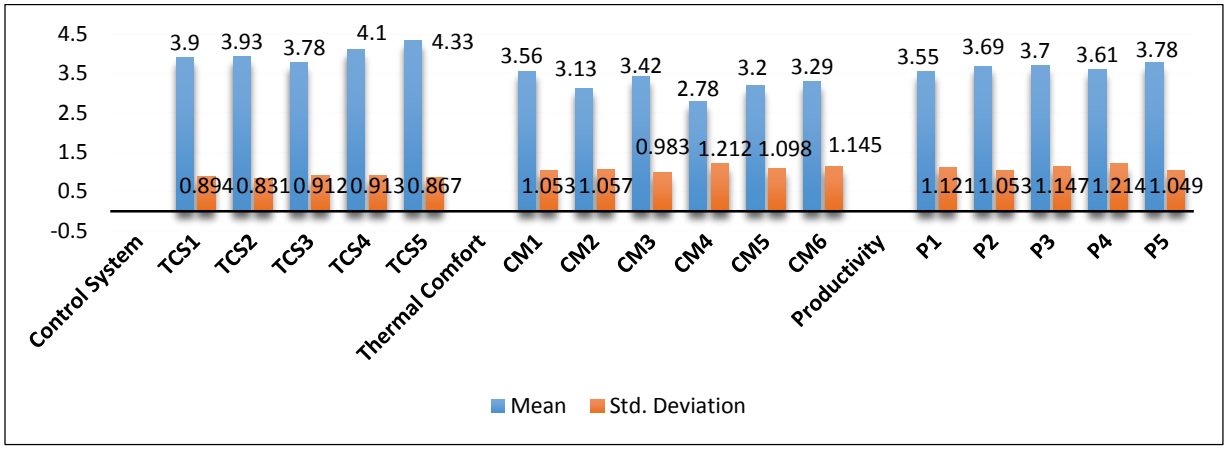


Table 3: Descriptive Statistics Model II



Results from Structural Equation Modelling (SEM)

SEM is a frequently used technique due to its flexibility and generality. The SEM comprises different steps including Specification of model, estimation of model, evaluation of model, and modification of model. These steps are mainly comprised of two parts including Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA). EFA explores the factor structure i.e. how the variables relate and group with each other based on inter-variable correlations. CFA confirm the structure of the factors that were extracted in the EFA. These steps follow the testing of assumptions to specify if SEM is applicable on the given data. After cleaning the data and checking assumptions such as multivariate normality, multicollinearity and sample size, the SEM was applied in current research in the following sequence.

Checking assumptions

Three important assumptions including multivariate normality, multicollinearity and sample size are required to check if the application of SEM is justified.

Sample size

For SEM, sample size is determined according to the number of attributes. Hair et al. (Hair et al. 2006) stated that for an average number of attributes, 100 is an acceptable sample size. This sample size can vary depending on the number of variables and attributes of a study. For current study, a sample size of 150 was suggested by statistical calculator; however, we took a sample size of 231.

Multivariate normality and multi-collinearity

In order to ensure multivariate normality, the data was screened to remove outliers and missing values in order to make data valid and reliable (Tabachnick & Fidell 2001). For checking multi-collinearity, we run regression and checked the values of Variance Inflation Factor (VIF) and Tolerance in collinearity statistic. According to Kline (Rex B. kline 2011), the values of VIF must not be greater than 10 and value of Tolerance not less than 0.1, if these conditions fulfilled then

we don't have multi-collinearity. VIF and Tolerance values for this study fell in the acceptable range which showed the lack of multi-collinearity in the data.

Model specification (Exploratory Factor Analysis)

Exploratory factor analysis (EFA) was performed using SPSS. Exploratory factor analysis was carried out in order to identify as well as for the confirmation of underlying structure of items and to reduce the total number of items. Principle Component Analysis (PCA) was used with Varimax rotation to extract the factors. Eigen values were used for determining the number of factors.

Before extraction of a manageable number of items from the items given by EFA, we checked some assumptions (please also see Table 4).The reason to check these preliminary assumptions was to test if EFA was applicable on the given data (Deng et al. 2013).

Table 4: Assumptions for selecting items through EFA

S. N	Preliminary assumption	Range	Remarks	Model I	Model II
1	Communalities (STEVENS 1992)	>0.4	Measure of perfection of questionnaire loading on the model	All values>0.4	All values>0.4
2	Individual construct reliability Cronbach Alpha (NUNNALLY & BERNSTEIN 1994)	≥0.7	Reliability of data and stability of items	All values>0.7	All Values>0.7
3	Kaiser-Meyer-Olkin (KMO) (Deng et al. 2013)	0 to 1	This test measures adequacy of sample and its value should be greater than 0.5	0.9	0.904
4	Bartlett's Test of Sphericity [30]	P < 0.05	For significant factor analysis P value should be less than 0.05	0.000	0.000
5	Cumulative variance and Eigen values [30] & Eigen value of individual factor to be extracted should be	cv>60% Eigen value>1	Cumulative variance shows reliability of data Eigen value shows the variance explained the item and its acceptability	CV=73% Eigen values of 5 factors>1	CV=67% Eigen values of 3 factors>1

Table 4 shows the assumptions fulfilled for the given data and constructs of the theoretical models. This authenticated the extraction of items with Eigen values greater than 1. For model I, Varimax rotation revealed five significant factors out of 20 with Eigen values higher than 1 and with

cumulative variance of 73% (Appendix 1). Rotated Component Matrix indicated that all the items heavily and distinctively loaded on their relevant factors (Appendix 2).This identified five constructs for model I. For model II, Varimax rotation distinguished three factors out of 16 with Eigen values greater than 1 and with cumulative variance of 67% (Appendix 3). Rotated Component Matrix indicated that all the items heavily and distinctively loaded on their relevant factors (Appendix 4). This identified three constructs for model II.

Model Identification

The first step before checking the validity and reliability of the model (with the application of confirmatory factor analysis) was to assess the uni-dimensionality of the model (Awang, 2012). Items having weak loadings (< 0.5) on the main factors were required to be removed from the models. In this study, factor loadings for both models was greater than 0.5 (Appendix 5&6).

Confirmatory Factor Analysis (CFA)

Confirmatory Factor Analysis (CFA) confirms the validity of the model. All the factor loadings should be larger than 0.5. In order to confirm the validity of the model, two validity measures are examined: convergent validity and Discriminant validity (Hair et al. 2006) (please also see Table 5).

Table 5: Confirmatory Factor Analysis CFA Assumptions

S No.	Assumptions	Name of Index	Remarks	Range	Model I	Model II
1	**Convergent[2] Validity** [27]	**AVE** Average Variance Extracted	Explanation of latent factor by its own observed variables	≥ 0.5	All AVE values >0.5	All AVE values >0.5
		CR Composite Reliability		≥ 0.7	All CR values >0.7	All CR values >0.7
2	**Discriminant Validity[3]** (Awang 2012)	**MSV** Maximum Shared Variance	Latent factor is not explained by other observed variables except its own parent's observed variables;	MSV< AVE	All MSV values < AVE	All MSV values < AVE
		ASV Average Shared Variance		ASV < AVE	All ASV values <AVE	All ASV values < AVE

[2].If the correlation between variables is not within their parent factor the issue of convergent validity occurs

[3].If the correlation of variables with variables outside their parent factor is high as compared to variables with in their parent factor then issue of discriminant validity occurs

Table 5 showed that assumptions of CFA were fulfilled for the given data and constructs of the theoretical models. For model I, all the values were in acceptable range with CR>0.7, AVE> 0.5,

MSV & ASV < AVE (Appendix 5). For model II, all the values were in acceptable range with CR >0.7, AVE> 0.5, MSV & ASV < AVE (Appendix 6). This identified that both models I & II have neither convergent validity nor discriminant validity issues.

Model assessment and model fit

Two main components of model in SEM are structural and measurement model. The relations between latent variables and their indicators are obtained from measurement model. And potential causal dependencies between dependent and independent variables are obtained from structural model. For model fit the results should be statistically significant and within acceptable range. A statistically significant level is achieved whenever the observed p-value of a test statistic is less than the significance level defined for the study. This study has confidence interval of 95% with 5% significance level (α), hence for significant results p-value must be less than 0.05 i.e. $p < 0.05$.

Assessment and fitness of Model I

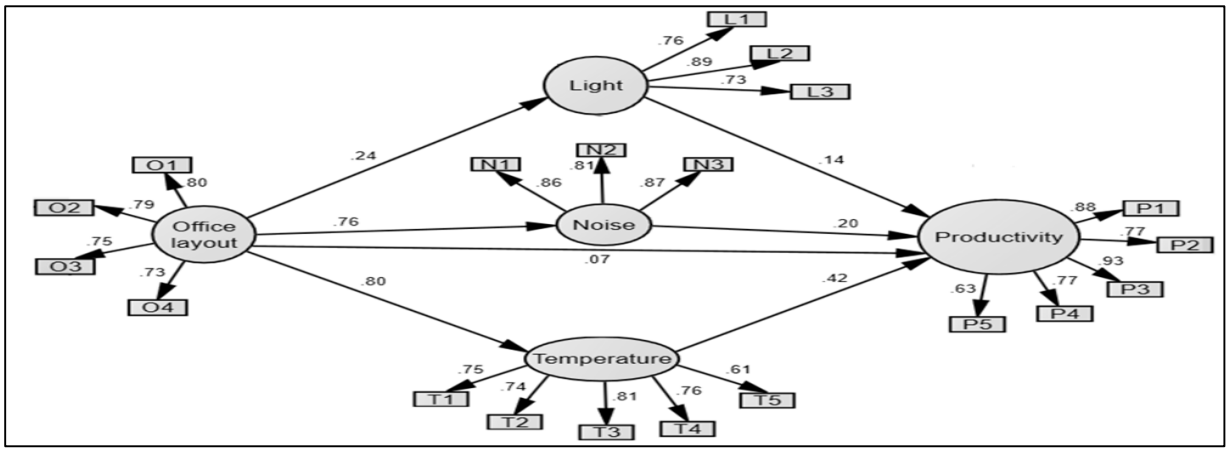


Figure 4: Structural Model 1

Direct effects

Direct effects were seen through 6 paths form Independent variable (IV) to mediator (M) and from mediator (M) to dependent variable (DV). All beta (β) co-efficient and p values showed that all the paths showing direct effects were positive and significant which implies that structural model support all hypothesis (H1, H2, H3, H4, H5 and H6) of direct path effect.

Indirect effects (mediating effect)

As discussed the research model was adopted from (Preacher & Hayes 2008). Mediation effect is examined through bootstrapping technique proposed by (Hayes 2012). The mediation effects of three constructs light, noise and temperature was examined. The path for indirect effects are as follows: Effect of office layout on productivity through light, effect of office layout on productivity through noise and effect of office layout on productivity through temperature.

Results as in the Table 6, showed that the mediation effect between office layout and productivity through light was positive and significant, H7 ($\beta = 0.033$, $p < .05$).The mediation effect between office layout and productivity through noise was positive and significant, H8 ($\beta = 0.152$, $p < .05$).

And the mediation effect between office layout and productivity through temperature was also positive and significant, H9 (β = 0.336, p < .05).

Now form the Figure 4, we can see that the direct effect from office layout to productivity was positive but insignificant (β = 0.07, p >.05). As direct path was insignificant but the indirect paths from office layout to productivity through light, noise and temperature were significant, this allowed us to conclude that relationship between office layout and productivity was fully mediated by light, noise and temperature. Therefore, H7, H8 and H9 were supported.

Table 6: Mediation effects of model I

Independent Variable (I)	Mediator (M)	Dependent Variable (D)	Path Coefficient I → M, a	Path Coefficient M → D, b	Indirect Effect a×b	Bootstrap 95% C.I	
						Upper	Lower
Office layout	Light	Productivity	0.24	0.14	0.0336	0.0009	0.0585
Office layout	Noise	Productivity	0.76	0.20	0.152	0.0515	0.2208
Office layout	Temperature	Productivity	0.8	0.42	0.336	0.1115	0.3371

Assessment and fitness of Model II

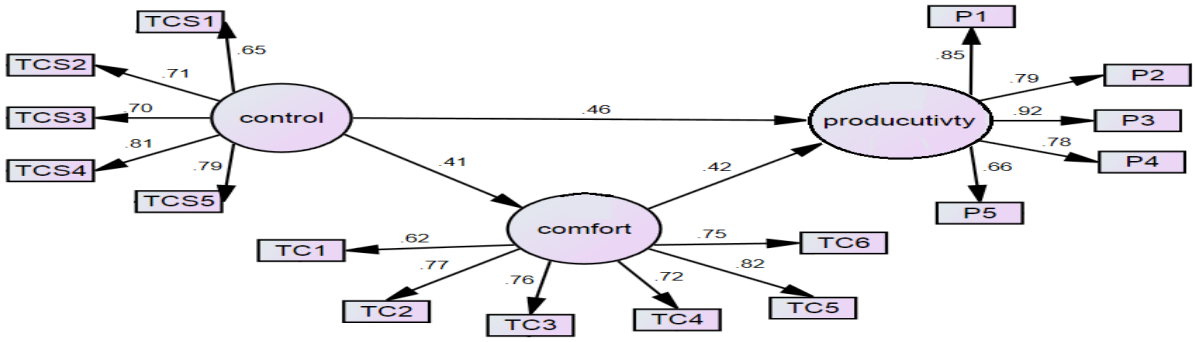


Figure 5: Structural Model 1I

As we have mediating variables in our model so we must have two type of effect in our model direct and indirect effect. Structural model path results are as follows:

Direct effects

The path from control to comfort was positive and significant, H1 (β =0.41, p < 0.05). The path from control to productivity was positive and significant, H3 (β =0.46, p < 0.05). The path from comfort to productivity was positive and significant, H2 (β =0.42, p < 0.05). The positive effect of control on productivity was strongest among all the effects. All Beta (β) co-efficient and p values showed that all the paths were positive and significant which implies that structural model support all hypothesis of direct path effect.

Indirect effects (mediating effect)

Mediation effect was examined through bootstrapping technique proposed by Hayes (Preacher & Hayes 2008).

Table 7: Mediation Effect of model II

Independent Variable(I)	Mediator (M)	Dependent Variable (D)	Path Coefficient I → M, a	Path Coefficient M → D, b	Indirect Effect a×b	Bootstrap 95% C.I	
						Upper	Lower
Control System	Thermal Comfort	Productivity	0.41	0.42	0.1722	0.0969	0.2668

Results from Table 7 showed that the mediation effect between control and productivity through comfort was positive and significant, H4 ($\beta = 0.172$, $p < .05$). This showed that comfort was mediating between control and productivity, as both the direct and indirect paths were positive and significant. It supports all the hypothesis (H1, H2, H3 and H4) and the effect of control on productivity was partially mediated by comfort.

Fit indices

There are specific parameters that were calculated to determine model fit indexes. The thresholds listed in the Table 8 were according to (BYRNE 1994, BROWNE & CUDECK 1993, STEIGER 1996). Table 8 showed that for model I and II, all the fit indices were in acceptable range.

Table 8: Fit Indices of model I& II

Fit indices	Perfect fit	Accepted fit	Measurement Model I	Structural Model I	Measurement Model II	Structural Model II
χ^2 (chi-square)			243.878	258.428	173.577	184.93
Df (Degrees of freedom)			158	160	98	99
χ^2/df (Chi square/ degrees of freedom)	$\chi^2/df < 3$	$3 < \chi^2/df < 5$	1.544	1.615	1.771	1.868
GFI (Goodness of fit)	0.95<GFI<1	0.90<GFI<0.95	0.905	0.903	0.917	0.909
NFI (Normed fit index)	0.95<NFI<1	0.90<GFI<0.95	0.919	0.914	0.922	0.917
TLI (Tucker lewis Index)	0.95<TLI<1	0.90<TLI<0.95	0.963	0.959	0.956	0.951
CFI (Comparative fit Index)	0.97<CFI<1	0.95<CFI<0.97	0.97	0.965	0.964	0.959
RMSEA (Root mean Square error of approximation)	0<RMSEA <0.05	0.05<RMSEA<0.08	0.049	0.052	0.058	0.061

Model Modification

After the models were estimated, if the result showed that fit indices of the model were not in perfect or acceptable range then in order to improve the fit indices of the model modification indices were required. In our study, all our fit indices fell in the acceptable range.

Discussion of results

The aim of this study was to assess the relationship between the workplace environment and employee productivity in the IT and Telecom sector of Islamabad, Pakistan. The relationship was studied through mediators (light, noise, temperature) and effect of the type of control system installed in offices on employees' productivity through mediator thermal comfort. For this purpose two models were developed based on (Preacher & Hayes 2008).

Results of model I showed that variables (light, noise, temperature) have positive effect on employee's productivity as all the beta values are positive and p-values are less than 0.05. These results support all the hypothesis of model I. The results also showed that strongest direct effect is between temperature and employees productivity with ($\beta = 0.42$) and strongest indirect effect of office layout on productivity is also through the temperature ($\beta = 0.336$), In the previous studies such as (Valančius & Jurelionis 2013) and (Akimoto et al. 2010), it has been shown that temperature has positive effect on the employee productivity. Results of Model I also showed that adequate lighting, less noise and perfect temperature conditions in office environment has positive effect on employee's productivity in IT and Telecom sector of Pakistan.

Results of model II showed that both direct and indirect relationship between type of control system and productivity are significant and positive as all the beta values are positive and p-values are less than 0.05. The type of control system has strongest effect on productivity ($\beta = 0.46$). The results support all the hypothesis of model II and conclude that user control over the workspace environment is very important and has strongest effect on employee's productivity.

In summary, temperature and type of control system have been found to be the main factors that affect the employee's productivity. Therefore People will be more productive and efficient in their working environment if they will able to control their workplace environment. This also shows that employees' will be more productive if their thermal comfort was improved and also if they were provided with personal control over the workspace environment as in previous studies (Miller 2007)(Lomax 2007)(Lee et al. 2005)(Greenberger et al. 2015).

Conclusion

The aim of this study was to examine the productivity and a number of different variables that contribute to increase or decrease the productivity. There have been various studies on workplace environment in developed countries. This study focusses on IT and telecom sector in Pakistan. The results show that direct paths of both models were positive and significant. The beta values of direct path show that temperature and control system has the highest effect on productivity in both models respectively. The results also showed that productivity decreases with increase in noise

and inadequate lighting. Employees will be more productive if their thermal comfort was improved and also if they were provided with personal thermal control over the workspace environment. This study signifies the place of work environment in enhancing the comfort and productivity at workplace. There is a need to design office space by keeping in mind the lighting, heating and scenic comfort in mind. This may result not only to enhance the productivity of employees but the overall organizations.

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