

Factors that Affects Office Environment Satisfaction in Taiwan

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Abstract

The objective of the presents study was to examine the office environment (OE) satisfaction in Taiwan. A literature review, interview, and questionnaire survey approach was adopted to collect relevant data. Factors with low office worker satisfaction were identified from the questionnaire data of 454 respondents. These factors were then processed using a factor analysis approach, reducing them to three primary factors, namely, “space planning,” “psychological perception,” and “physiological perception.” Finally, the factors and their attributes were cross-referenced with the respondents’ “gender” and “(job) position” demographics. The findings of the present study can serve as a valuable reference to office furniture vendors and interior designers when formulating OEDs

Keywords: Office Environment, Workspace, Satisfaction, Factor analysis

1. Introduction

The rapid development of the economy, information technology, and wireless communication networking has created a sudden change in life and work patterns, making intelligent office environments (OE) an inevitable trend of the future. Subsequently, identifying the influential factors of OE is vital for creating a people-centric (i.e., personalized, smart, and efficient) office environment design (OED) model.

Taiwan exhibited little economic development following WWII. This stagnation persisted until the export expansion in the 1970s. Economic growth accelerated in the 1980s with the boom of the information technology industry but gradually slowed down with the outflow of investments into China following 2000.

Nonetheless, the Taiwanese office furniture industry exhibited rapid growth regardless of economic development and people attached greater value to OEs.

OED is a specialization that combines numerous aspects such as environment, hardware, aesthetics, technology, and user psychology. Thus, effectively analyzing the factors of influence of OE is a major concern in OED. Problems such as office workers' (OW) OE satisfaction, their opinions on various OED factors, and further OED developments in Taiwan must be resolved to create OEs that are comfortable, healthy, safe, effective, and worker-friendly. The findings of the present study can serve as a reference for the future OE planning in Taiwan.

2. Literature Review

Hoppock (1935) indicated that job satisfaction is the product of physical, psychological, and environmental factors that creates a sense of pleasure during work. Therefore, job satisfaction can be defined as OWs' subjective responses to their OEs. Vroom (1964) maintained that job satisfaction and job attitude are the emotional connections OWs have toward their current role, where job satisfaction increases and decreases concurrently with positive and negative attitudes, respectively. Cribbin (1972) described job satisfaction as the OWs' feeling towards their OEs, which include the OE itself, supervisors, teams, organization, and livelihood. Locke (1976) defined job satisfaction as the pleasure or positive emotional responses generated by OWs when evaluating their job or work experiences.

According to a report published by Japan's Ministry of Economy, Trade, and Industry (METI) in 1986, the workers' top five OE dissatisfactions were insufficient recreational space, narrow space, poor file management, poor layout, and poor air conditioning. Kudo (1990) proposed numerous factors and trends for space planning, categorizing them into layout method, space ecology, equipment, recreational space, color scheme, furniture selection, office automation (OA) strategy, office culture, and file management. Fawcett (1992) indicated that the OWs' office satisfaction factors include desk space, desk by window, reception, greenery/journey to work, satisfying job, and building fits in. The researcher also mentioned that the factors pending improvement include personal storage, controllable heating, somewhere to relax, easy parking, good pay, and company image.

According to a complete office design theory proposed by Duffy (1997), previous OE plans can be categorized into four types, specifically, den, hive, cell, and club. Duffy and Willis (1998) later cross-examined work patterns, spaces, and environment systems, classifying work patterns into individual process work, group process, concentrated study, and transactional knowledge work. Brill (1986), who was the CEO of BOSTI at the time, indicated that the four primary OED factors influencing work efficiency were space planning, environment conditions (room temperature, air conditioning, lighting, and noise), human factors (privacy, communication, openness, and personalized space), and furniture design and management.

3. Method

A data-reduction/structural factor analysis approach used in multivariate statistical analysis was adopted to analyze 21 OE factors. The factor analysis was employed to reduce the constructs of the 21 attribute variables, enabling the use of the least amount of factor constructs to express the original data structures while maintaining the integrity of the information contained in the data structure. The constructs were then used to elucidate the association between the original variables and the factor variables. Next, the data were plotted on a factor distribution diagram. factors that influenced OED were collected from a literature review, OW interviews, and the authors' personal opinions. Twenty-one design factors were identified and categorized into four dimensions of space planning, equipment, psychological perception, and work behavior, as tabulated in Table 1. These factors were then used to formulate a questionnaire, which was administered to a group of OW respondents to collect data for a statistical analysis. The questionnaire was a structured, score-based questionnaire. A Liker-type scale was adopted as the scoring system. Although the Likert scale is an ordinal scale, it is often used as an interval scale in data analysis to quantify statistical data. The questionnaire was administered to a group of respondents, who scored the 21 design factors based on their perceived importance and OE satisfaction.

Table 1. Office environment design factors

Dimension	factor	Definition
Space planning	Space planning	Layout, function, and flow
	Leisure space	Pantry, coffee station, gym
	Conference space	Meeting and discussion spaces
	Personal space	Size of individual work space
	Public space	Corridors and open spaces, reading area
	Reception	Reception counter and visitor area
Equipment	Illumination	Source, color temperature, illumination
	Air condition	Environment ventilation and temperature
	Office furniture	Work table, partition, chair, cabinet
	Office equipment	Computer, Internet, telephone, business machines
	cable management	Storage and concealment of equipment cables
Psychological perception	Decoration	Art and decorations
	Color	Space, building material, furniture color schemes
	Aesthetic	Space design, aesthetics, ambiance
	Natural light	Natural lighting, windows
	Green landscaping	Plants, greenery
	Noise	Volume and frequency
Work behavior	Safety	Data and personal safety
	filing management	Filing method, tools, and effectiveness
	privacy	Private spaces
	Communication	OE communication difficulty

3.1 Questionnaire design

The questionnaire comprises three parts.

(1) Respondent demographics questionnaire:

This part comprised gender (male/female), job position (supervisor/general staff), age (20-30/31-40/41 and over), industry (manufacturing/service/design/government/school), and number of employees in the company (100 or less/101 or more).

(2) OE factor satisfaction survey:

This part listed 21 OED factors. Respondents were instructed to score each factor using a five-point scoring system based on their satisfaction. For example, Lighting: *Unsatisfactory*, *Slightly unsatisfactory*, *No comment*, *Slightly satisfactory*, and *Satisfactory*, which was awarded a score of 1, 2, 3, 4, and 5, respectively.

(3) OE factor perceived importance survey:

This part listed 21 OED factors. Respondents were instructed to score each factor using a five-point scoring system based on their perceived importance (unimportant, slightly unimportant, no comment, slightly important, and important).

Pretest questionnaires were administered to 10 additional respondents to revise any ambiguous semantics or descriptions.

3.2 Respondents

Five hundred OWs were recruited to participate in the present study. The questionnaire was administered physically, via mail, and over the Internet. To achieve homogenized samples, 10-15 businesses were from the each of the four industries, namely, the manufacturing industry, service industry, design industry, and government sector/schools, for the questionnaire survey.

3.3 Questionnaire survey

The survey period was one month between 1 April 2016 and 30 April 2016. Two hundred and ten written questionnaires were retrieved. Among which, 11 incomplete questionnaires were discarded. Thus, 199 valid written questionnaires and 255 valid online questionnaires were retrieved, for a combined total of 454 valid questionnaires. The demographics of the respondents are tabulated in Table 2.

Table 2. Respondents' demographics N=454

Respondent Variables		No. of Samples	Percentage
Gender	Male	210	46%
	Female	244	54%
Position	Supervisor	182	40%
	General Staff	272	60%
Age	20-30	102	23%
	31-40	120	26%
	41 and over	232	51%
Industry	Manufacturing	102	22%
	Service	162	36%
	Design	71	16%
	Government/School	119	26%
Number of Employees in the Company	100 or less	307	68%
	101 or more	147	32%

4. Result and Discussion

4.1 Respondent' Satisfaction Towards the OE Attribute Factors

A Kaiser-Meyer-Olkin (KMO) test was used to determine the suitability of the 21 factors for factor analysis (Table 3). The Bartlett's sphericity test value was 5388.513 ($p=.00$). Thus, the factors were suitable for factor analysis. The KMO value was 0.951, denoting favorable sample size. The principal components analysis was adopted for factor analysis.

Table 3. KMO & Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.951
Bartlett's Test of Sphericity	Approx. Chi-Square	5388.513
	df	210
	p	.000

The common estimate in the diagonals of the correlation matrix was set at 1.0. That is, the correlation coefficient between a variable and itself was 1.0. The associations between the 21 variables are tabulated in Table 4. Next, common factors with eigenvalues greater than 1.0 were extracted using an explanatory variance threshold of 5%, as illustrated in the scree plot (Fig. 1). The 21 OE factors tabulated in Table 5 were rotated into three primary factors, specifically, "space planning," "psychological perception," and

“physiological perception.” The first factor, named “space planning,” combined attributes of office space, office furniture, office equipment, and communication. It focused on the utilization of space, and its eigenvalue accounted for roughly 47.2% of the overall variance (i.e., $9.914 / 21 = 0.472$). The second factor, named “psychological perception,” combined the attributes of decoration, aesthetic, color, green landscaping, and natural light. It focused on the psychological perceptions of the respondents. The third factor, named “physiological perception,” combined the attributes of safety, noise, air conditioning, lighting, file management, and privacy. It focused on the psychological perceptions of the respondents, and its eigenvalue accounted for 59.2% of the overall variance.

Table 4. Respondents’ correlation coefficient matrix

Variable	A0 1	A0 2	A0 3	A0 4	A0 5	A0 6	A0 7	A0 8	A0 9	A1 0	A1 1	A1 2	A1 3	A1 4	A1 5	A1 6	A1 7	A1 8	A1 9	A2 0	A21	
A01	1.00																					
A02	0.531	1.00																				
A03	0.570	0.541	1.00																			
A04	0.590	0.490	0.641	1.00																		
A05	0.570	0.600	0.630	0.601	1.00																	
A06	0.550	0.540	0.610	0.560	0.661	1.00																
A07	0.390	0.310	0.340	0.320	0.350	0.321	1.00															
A08	0.390	0.380	0.340	0.340	0.330	0.270	0.491	1.00														
A09	0.580	0.410	0.550	0.600	0.530	0.510	0.430	0.371	1.00													
A10	0.460	0.470	0.480	0.460	0.450	0.440	0.290	0.410	0.501	1.00												
A11	0.460	0.460	0.400	0.410	0.460	0.410	0.430	0.390	0.460	0.321	1.00											
A12	0.540	0.440	0.470	0.540	0.520	0.520	0.390	0.400	0.540	0.360	0.741	1.00										
A13	0.550	0.490	0.470	0.500	0.530	0.520	0.420	0.400	0.510	0.380	0.720	0.771	1.00									
A14	0.480	0.430	0.390	0.440	0.460	0.420	0.420	0.450	0.460	0.330	0.420	0.470	0.471	1.00								
A15	0.410	0.480	0.340	0.420	0.460	0.430	0.370	0.380	0.420	0.350	0.550	0.490	0.560	0.561	1.00							
A16	0.450	0.300	0.330	0.430	0.320	0.320	0.310	0.320	0.360	0.300	0.240	0.330	0.300	0.290	0.361	1.00						
A17	0.460	0.390	0.400	0.440	0.430	0.380	0.400	0.400	0.450	0.410	0.350	0.400	0.410	0.360	0.410	0.511	1.00					
A18	0.480	0.420	0.450	0.490	0.440	0.400	0.350	0.320	0.560	0.470	0.410	0.410	0.450	0.380	0.360	0.360	0.451	1.00				
A19	0.500	0.430	0.480	0.490	0.460	0.440	0.380	0.370	0.570	0.530	0.420	0.400	0.450	0.400	0.450	0.360	0.500	0.591	1.00			
A20	0.540	0.440	0.420	0.490	0.450	0.420	0.330	0.360	0.490	0.420	0.340	0.410	0.450	0.400	0.330	0.420	0.490	0.430	0.471	1.00		
																					1.0	
A21	0.620	0.420	0.470	0.500	0.480	0.470	0.400	0.360	0.470	0.480	0.370	0.440	0.430	0.380	0.320	0.390	0.480	0.430	0.440	0.440	1.00	

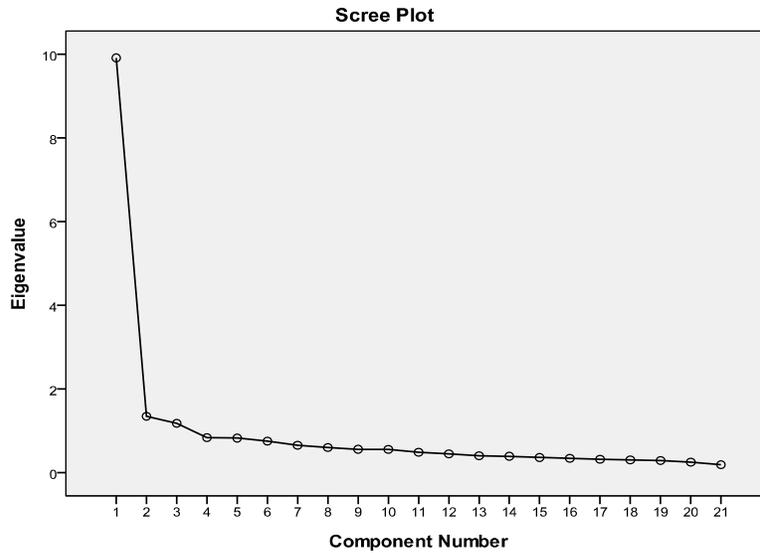


Figure 1. Respondents’ eigenvectors (factors) of the Scree Test

Table 5. Respondents’ factor composition structure

Factor Name	Attribute Code	Factor Attribute	Factor 1	Factor 2	Factor 3
Space planning	A03	Conference space	.766	.196	.215
	A06	Reception	.747	.313	.107
	A05	Public space	.734	.340	.170
	A04	Personal space	.699	.239	.314
	A01	Space planning	.611	.304	.407
	A02	Leisure space	.598	.365	.204
	A09	Office furniture	.552	.305	.425
	A10	Office equipment	.529	.100	.459
	A21	Communication	.501	.173	.487
Psychological perception	A11	Decoration	.269	.819	.132
	A13	Aesthetic	.400	.750	.173
	A12	Color	.405	.743	.148
	A15	Green landscaping	.234	.654	.286
	A14	Natural light	.261	.542	.360
Physiological perception	A17	Safety	.281	.196	.688
	A16	Noise	.227	.082	.656
	A08	Air condition	.036	.445	.592
	A07	Illumination	.037	.477	.555
	A19	Filing management	.452	.216	.546
	A20	Privacy	.435	.169	.533
	A18	Cable management	.461	.199	.486
	eigenvalue		9.914	1.348	1.178
	Percentage%		47.2	6.4	5.6
	Cumulative percentage%		47.2	53.6	59.2

The factor analysis conducted in the present study reduced the original 21 factors into three factors. However, these factors were different to the original four constructs established in the present study. Factor 1 (space planning) contained three extra attributes than Construct 1 (space planning), specifically, “office furniture,” “office equipment,” and “communication.” Factor 2 (psychological perception) contained two fewer attributes than Construct 3 (psychological perception), specifically, “safety,” and “noise.” Factor 3 (physiological perception) contained the attributes of both Construct 2 (hardware) and Construct 4 (work behavior), as tabulated in Table 6.

Table 6. A Comparison between the original four constructs and the three factors

Four Constructs	factor	Three Factors	factor
Space planning	Space planning	Space planning	Space planning
	Leisure space		Leisure space
	Conference space		Conference space
	Personal space		Personal space
	Public space		Public space
	Reception		Reception
Equipment	Illumination	Psychological perception	Office furniture
	Air condition		Office equipment
	Office furniture		Communication
	Office equipment		Decoration
	cable management		Color
Psychological perception	Decoration	Physiological perception	Aesthetic
	Color		Natural light
	Aesthetic		Green landscaping
	Natural light		Safety
	Green landscaping		Noise
	Noise		Air condition
Work behavior	Safety	Physiological perception	Illumination
	filing management		filing management
	privacy		privacy
	Communication		cable management

4.2 Respondents’ satisfaction concerning the current state of office environments

An analysis of means was adopted to analyze the satisfaction questionnaires retrieved from the respondents to place the 21 OE factors into a descending order of satisfaction. A low score denoted a low level of satisfaction. The statistical results were tabulated in Table 7. Results show that the respondents were the least satisfied with “leisure space,” “aesthetics,” “decoration,” “green landscaping,” and “privacy.” A one-sample t-test was then performed with a test value of 3 and a confidence interval of 95%. The 21 OE factors were

ordered based on the size of their negative t-values and their non-significance levels ($p>0.05$), as tabulated in Table 8. The factors with the lowest satisfaction levels in Table 8 were consistent with those in Table 7. These unsatisfactory factors reflected the respondents' psychological perception towards OE and their anticipation of space planning. Therefore, these factors can be prioritized when formulating OE improvement plans.

Table 7. Respondents' satisfaction towards the current state of office

environments (in a descending order) N=454

Order	factor	M	SD
1	Leisure space	2.80	1.154
2	Aesthetic	2.96	1.134
3	Decoration	2.97	1.042
4	Green landscaping	3.02	1.124
5	privacy	3.04	1.125
6	filing management	3.14	1.098
7	Color	3.16	1.056
8	Noise	3.18	1.071
9	Public space	3.22	1.070
10	cable management	3.23	1.089
11	Air condition	3.24	1.171
12	Reception	3.30	1.074
13	Conference space	3.36	1.068
14	Office equipment	3.37	1.098
15	Personal space	3.40	1.121
16	Space planning	3.44	1.001
17	Natural light	3.44	1.192
18	Office furniture	3.45	1.076
19	Communication	3.62	0.951
20	Safety	3.63	0.976
21	Illumination	3.76	1.017

Table 8. t-Test results for respondents' satisfaction towards the current state of office environments (in an ascending order) N=454

factor	Test Value = 3					
	t-value	df	Significance (twin-tailed)	Mean Difference	95% Confidence Interval	
					Lower limit	Upper limit
Leisure space	-3.619	453	.000	-.19604	-.3025	-.0896
Aesthetic	-.704	453	.482	-.03744	-.1420	.0671
Decoration	-.490	453	.624	-.02423	-.1214	.0729
Green landscaping	.334	453	.738	.01762	-.0860	.1212
privacy	.835	453	.404	.04405	-.0597	.1478
filing management	2.693	453	.007	.13877	.0375	.2400
Color	3.244	453	.001	.16079	.0634	.2582
Noise	3.636	453	.000	.18282	.0840	.2816
Air condition	4.063	453	.000	.22247	.1149	.3301
Public space	4.472	453	.000	.22467	.1259	.3234
cable management	4.568	453	.000	.23348	.1330	.3339
Reception	5.856	453	.000	.29515	.1961	.3942
Office equipment	6.937	453	.000	.35683	.2557	.4579
Conference space	7.248	453	.000	.36344	.2649	.4620
Personal space	7.621	453	.000	.40088	.2975	.5043
Natural light	7.950	453	.000	.44493	.3350	.5549
Office furniture	8.591	453	.000	.43172	.3330	.5305
Space planning	9.377	453	.000	.44053	.3482	.5329
Safety	13.748	453	.000	.62996	.5399	.7200
Communication	13.825	453	.000	.61674	.5291	.7044
Illumination	15.417	453	.000	.73568	.6419	.8295

Among the 21 OE factors, the top-5 factors with a highest frequency distribution of 3 or less were identified for the different genders and positions. The frequency distribution values were expressed as a percentage and placed in a descending order in Table 9, in which a higher percentage represents a lower satisfaction. Findings indicated that men had a comparatively lower OE satisfaction than women and that general staff had a comparatively lower OE satisfaction than supervisors. The order results in Table 9 were largely consistent with the mean statistics order shown in the previous tables.

Table 9. Correlation between gender/position and OE satisfaction

Factor Order	Gender			
	Male		Female	
1	Green landscaping	71%	Leisure space	71%
2	Decoration	70%	Decoration	67%
3	Leisure space	67%	privacy	62%
4	Aesthetic	67%	Aesthetic	62%
5	Color	61%	Color	58%
Factor Order	Position			
	Supervisor		General Staff	
1	Leisure space	64%	Leisure space	73%
2	Decoration	63%	Decoration	71%
3	Green landscaping	63%	privacy	69%
4	Aesthetic	61%	Aesthetic	67%
5	Color	55%	Green landscaping	64%

5. Conclusion

The objective of the present study was to investigate Taiwanese OWs' perceived satisfaction towards a number of OE factors and identify the key improvement factors in OED. The results obtained in the present study can serve as a valuable reference to business owners, OWs, office furniture vendors, and interior designers when formulating OEDs.

- (1) An evaluation confirmed that the attributes influencing OE can be categorized into three main factors, specifically, "space planning," "psychological perception," and "physiological perception."
- (2) A mean statistics analysis showed that OWs' least satisfied OE attributes were "leisure space", "aesthetics," "decoration," "green landscaping," and "privacy." These factors can be prioritized when formulating OE improvement plans.
- (3) Concerning the variable "gender," men exhibited the highest dissatisfaction with "green landscaping," "decoration," "leisure space," "aesthetics," and "color." Women exhibited the highest dissatisfaction with "leisure space," "decoration," "green landscaping," "aesthetics," and "color." Men exhibited a lower overall satisfaction than women.
- (4) Regarding variable "position," supervisors exhibited the highest dissatisfaction with "leisure space," "decoration," "green landscaping," "aesthetics," and "color." General employees exhibited the highest dissatisfaction with "leisure space," "decoration," "privacy," "aesthetics," and "green landscaping." General employees exhibited a lower overall satisfaction than supervisors.

(5) Study limitations: People's opinions concerning OE factors change over time. However, such changes are progressive. For example, factors influencing the evolution from traditional furniture to modernized system furniture included the impact of science and technology, lifestyle changes, new materials and technologies, and rapid economic growth. Therefore, OE factor surveys can be adjusted according to users' changing demands and expectations.

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