

Information System Quality and Stress: A Causal Model

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ABSTRACT

This paper reports a survey of 500 information system (IS) managers exploring the causal relationships between IS quality and IS job stress. In addition, organizational characteristics and job satisfaction are included in the research model. Using the 104 usable samples, the study performed statistical analysis and path analysis. The results suggest that corporate management should focus on improving both corporate climate and IS climate. This would improve IS quality and job satisfaction, and reduce job stress. Contrary to the expectation, IS quality does not significantly affect the levels of job satisfaction and job stress. It should be treated as an outcome or effect variable instead of an intervening cause variable.

INTRODUCTION

Information system (IS) managers are in a stressful profession. According to Li and Shani [7], the source of job stress may come from role ambiguity, role conflict, work overload, and job-induced anxiety. The factors influencing the level of stress may include organization-wide climate (or corporate climate, for short), IS climate, the growth status of organization's information system (i.e., IS sophistication), and job satisfaction. Li and Shani verified that job stress is negatively affected by the organizational contextual factors and job satisfaction while organizational contextual factors and job satisfaction are positively affecting one another. Their research model is depicted in Figure 1.

Furthermore, many studies reported that job stress and job performance have significant negative relationship. To most IS managers, high job performance means high quality in information system services because nothing is more rewarding than having a high quality information system. Recently, Li and Rogers [8] reported that organizational contextual factors also have positive impacts on IS quality. However, they did not explore that relationship between IS quality and job stress, nor job satisfaction. It is logical to assume that IS quality may have positive impacts on job satisfaction and stress. The reverse assumption, on the contrary, is not appropriate. Therefore, a new research model may be formulated as shown in Figure 2. This new model includes the union of the variables from the previous two studies. In this model, 15 directional relationships are postulated. Most of these relationships are positive, except those leading to job stress. The purpose of this study is to investigate the potential effects among the factors of corporate climate, IS climate, IS sophistication, IS quality, and job satisfaction, and their effects on job stress as well.

RESEARCH METHOD

Subjects

The data for this study were collected from a sample of 500 subjects randomly selected from a national IS management association. Each of these subjects comes from a different company. The questionnaire with a cover letter were sent to these subjects. Six weeks later, a second wave of mailing was sent to those who did not return their responses. Finally, a total of 110 questionnaires were received, giving a 22% response

rate. However, six of the responded questionnaires were unusable due to excessive missing values. This gives us 104 usable ones of which 79 were received from the first-wave mailing while 25 were received from the second-wave mailing. Table 1 provides the characteristics of these respondents. The diverse distribution of each demographic variable indicates the absence of response bias which may come from a particular class of subjects.

Measures

Based on the research model depicted in Figure 2, a four-part questionnaire was developed. The first part contains 30 items of which 22 items measure the corporate climate and 8 items measure the IS climate. The second part contains a description of IS sophistication [3] and 2 items measuring the sophistication. The third part contains 29 items of which 8 items measure the job satisfaction and 21 items measure the degree of job stress as perceived by the respondent. All these items are adopted from Li and Shani [7]. Finally, the fourth part contains 4 items adopted from Ives, et al. [6] measuring the IS quality. In addition to these items, 16 demographic items were included in the questionnaire to provide a profile of each respondent. Most of the items for the research variables, except those two for the IS sophistication, ask the respondent to indicate the extent to which he or she agrees with the condition described by the item on a 7-point Likert-type scale, ranging from 1 (strongly disagree/dissatisfied) to 7 (strongly agree/satisfied). Therefore, the data collected by this study are self-report scores that represent the perception of the respondents toward the conditions of the questionnaire items.

Composite Scores

For the purpose of analyzing the research model, a composite average of item scores was computed for each research variable. For example, IS sophistication as a whole comes from two items, organizational sophistication and technological sophistication, thus its composite average is the total score of the 2 items divided by 2. Likewise, corporate climate uses 22 items to find the average and IS climate uses 8 items, while IS quality uses 4 items, job satisfaction uses 8 items, and job stress uses 21 items.

Procedure for Analysis

Before we begin the analysis, the non-response bias of the data must be examined. A series of chi-square tests are first performed between the two samples obtained from the two waves of mailing. The results show no significant difference in any item responded between the two samples, indicating there is no significant non-response bias. Since all the questionnaire items are adopted from previous studies, they should possess psychometric quality. The results of our analyses reconfirm the existence of this quality in our questionnaire. The alpha reliability coefficients [4] in this study are 0.92, 0.88, 0.87, 0.84, and 0.90 respectively for corporate climate (22 items), IS climate (8 items), IS quality (4 items), job satisfaction (8 items), and job stress (21 items). All of them exceed the threshold of 0.7 as recommended by Nunnally [9, p. 245]. These findings allow us to continue the analysis in the following sequence. First, the descriptive statistics of the research variables are examined to identify the distribution patterns of the responses. Second, a one-way analysis of variance is performed for each research variable against each demographic variable. This is to find if any significant difference in perception exists among the different groups of subjects corresponding to the classes of a demographic variable. Third, a correlation analysis is conducted to explore the static relationships among research variables. Finally, a path analysis is used to evaluate the dynamic impact of organizational factors on IS quality, job satisfaction, and job stress.

RESULTS AND DISCUSSION

Descriptive Statistics

The descriptive statistics of the composite scores for the research variables are listed in Table 2. It appears that most the research variables, except job stress, have their average values above the point of indifferent perception (4.0). This indicates that corporate climate, IS climate, IS sophistication, IS quality, and job satisfaction are more likely to be positive than job stress. The ranges of responses also show that IS climate has the largest spread while job stress has the smallest spread. The standard deviations of the variables are about one point on the 7-point scale. Moreover, Figure 3 exhibits the patterns of response distribution in terms of each research variable. It reveals that most of the subjects have large dispersion between their individual response scores (indicated by the long line between the two extreme points of a subject). Only a few have narrow dispersions, as indicated by the short lines. Fortunately, no of the subjects has a dispersion that is close to zero, which indicates inconsistency in responses and must be excluded from the study. According to the postulated relationship, job-stress variable and job-satisfaction variable should have some degree of dispersion since they have a reverse relationship. Unless the subject checked the point of indifferent across all the questionnaire items, there should be some dispersions between job-stress score and the scores of the other variables. A scrutiny of Figure 3 reveals that the responses of each variable are randomly distributed above and below the mean score, supporting the assumption for statistical analysis.

Analysis of Variance

In order to identify the differences among the demographic classes of subjects in terms of each research variable, a series of analysis of variance were performed. First, corporate-climate scores were examined against the three classes of company's industry type. No significant difference was found among the three classes of subjects. That is, scores of the perception toward corporate climate are not significantly different among the three types of industry. Similarly, each research variable was examined against each and every demographic variables listed in Table 1. A total of 128 analyses of variance were conducted. The results show that the length in the present job appears to pose significant differences in the subjects' perception toward IS climate ($p < 0.05$) and job satisfaction ($p < 0.05$). Based on the corresponding correlation coefficients, the longer a person has stayed in his/her present job, the more positive the person is perceiving toward IS climate ($r = 0.2126$) and job satisfaction ($r = 0.2023$). There were no significant differences found in the other tests of hypothesis, indicating the validity of analyzing the sample as a whole group, though they are coming from different demographic classes.

Correlation Analysis

Based on the research model, the relationships between job stress and the other research variables should be negative while the relationships among the latter group of variables should be all positive. The results of correlation analysis confirm the significance of all these postulated relationships at the $p < 0.10$ level of two-tailed t test (see Figure 4). In fact, all but one relationships are significant at the $p < 0.001$ level. Specifically, seven absolute correlation values are larger than 0.50. These include corporate climate relating to IS climate (0.65), job satisfaction (0.62), and job stress (-0.60); IS climate relating to IS quality (0.69), job satisfaction (0.57), and job stress (-0.53); and job satisfaction relating to job stress (-0.56). The least significant relationship is between IS sophistication and job satisfaction (0.18). Each and every sign of the correlation coefficient is consistent with the corresponding relationship posited in the research model (see Figure 2).

Path Analysis

The correlation analysis reported above describes the static relationships among the six research variables. In order to better understand how the research variables interact with one another, ultimately to affect the IS managers' level of job stress, path analysis was conducted. The resulting path model and its path coefficients are shown in Figure 5. This model is a full model in which 9 out of the 15 possible path coefficients are significant at the $p < 0.10$ level of two-tailed t test. Those that are significant at the $p < 0.01$ level are highlighted with heavy lines (see Figure 5). These include corporate climate leading directly to IS climate (0.596), IS sophistication (0.379), job satisfaction (0.460), and job stress (-0.316); IS climate leading to IS quality (0.681); and job satisfaction leading to job stress (-0.262).

According to the "theory trimming" process [1,2,5], any path having the absolute coefficient value below 0.05 should be excluded from the full model and the remaining paths constitute a restricted model. The coefficients of this restricted model should be recalculated and reexamined. This trimming and recalculation process should be applied to the subsequent restricted models until the absolute values of all the path coefficients in a model are above the 0.05 cutoff point. Following this practice, the full path model went through one iteration of trimming and recalculation. The final restricted model consisting of 14 paths is shown in Figure 6. This restricted model appears to have excellent goodness of fit based on the criteria listed in Table 3.

In this model, 9 out of the 14 possible path coefficients are significant at the $p < 0.10$ level of two-tailed t test. Furthermore, six of the 9 path coefficients are significant at the $p < 0.01$ level, similar to the full model. These include corporate climate leading directly to IS climate (0.596, $p < 0.001$), IS sophistication (0.379, $p < 0.001$), job satisfaction (0.460, $p < 0.001$), and job stress (-0.313, $p < 0.01$); IS climate leading to IS quality (0.681, $p < 0.001$); and job satisfaction leading to job stress (-0.264, $p < 0.01$). Each of these path coefficients represents the direct effect of one variable on the other variable. In addition, there are indirect effects and total effects. The indirect effect is the effect of a variable on another variable via some other variables. The value of such indirect effect is the product of all the path coefficients lying on this indirect path. Therefore, in order to identify the causality between two variables, it is more desirable for the total of indirect effects between these two variables to be as close to zero as possible. Finally, the total effect is the sum of the direct effect and all indirect effects. Table 4 shows all the effects between the research variables in the restricted model. Note that each indirect effect listed in the table is the sum of all indirect effects between each pair of variables.

CONCLUSIONS

This study extends the causality model of IS work stress proposed by Li and Shani [7] by including IS quality as a intervening variable and allowing the organizational contextual factors to have directional relationships. Based on the results of the path analysis, several conclusions may be drawn.

First, corporate climate appears to have strong impacts on IS climate, IS sophistication, job satisfaction and job stress. It does not have significant impact on IS quality. This is consistent with the findings of Li and Shani [7] and Li and Rogers [8]. It implies that corporate management should improve corporate climate such as innovation and adaptability, quality of work life, organizational mission and policies, process flexibility, organizational resources, to name a few.

Second, IS climate appears to have a strong impact on IS quality. It has a less stronger impact on job satisfaction. This is consistent with the finding of Li and Rogers. It implies that a harmonious working IS environment is most likely to bring forth the quality of IS services and the satisfaction with career, job

contents, and reward system. Corporate management and IS management should work together to make it happen.

Third, job satisfaction appears to have a less stronger impact on job stress. This is consistent with the finding of Li and Shani. This implies that in order to reduce job stress, corporate management may start with improving the job satisfaction in the company. One may improve job satisfaction by improving the performance measurement and reward system, job design, career path, and other related organizational factors. Since job satisfaction is influenced by corporate climate, the latter factor must be improved at the same time. In essence, corporate climate is the most influential factor toward job stress.

Finally and surprisingly, IS quality, contrary to the results of the correlation analysis, does not have significant impact on job satisfaction nor job stress although the signs of path coefficients are consistent with the postulated relationship. Perhaps, IS quality should be treated as an outcome or effect variable instead of an intervening cause variable, similar to the way it was treated by Li and Rogers.

REFERENCES

- [1] Bartol, K.M. "Turnover among DP Personnel: A Causal Analysis ," *Communications of the ACM*, 26, 10 (October 1983), 807-811.
- [2] Billings, R.S., and S.P. Wroten, "Use of Path Analysis in Industrial/Organizational Psychology: Criticisms and Suggestions," *Journal of Applied Psychology*, 63, 6 (1978), 677-688.
- [3] Cheney, P.H., and G.W. Dickson, "Organizational Characteristics and Information Systems: An Exploratory Investigation ," *Academy of Management Journal*, 25, 1, (March 1982), 170- 184.
- [4] Cronbach, L.J. "Coefficient Alpha and the Internal Structure of Tests," *Psychometrika*, 16 (1951), 297-334.
- [5] Heise, D.R. "Problems in Path Analysis and Causal Inference," In E.F. Borgatta and G.W. Bohrnstedt (eds.), *Sociological Methodology*. San Francisco: Jossey-Bass, Inc., (1969), 38-73.
- [6] Ives, B., M.H. Olson, and J.J. Baroudi, "The Measurement of User Information Satisfaction," *Communications of the ACM*, 26, 10 (October 1983), 785-793.
- [7] Li, E.Y., and A.B. Shani, "Stress Dynamics of Information System Managers: a Contingency Model," *Journal of Management Information Systems*, 7, 4 (Spring 1991), 107-130.
- [8] Li, E.Y., and J.C. Rogers, "Organizational Characteristics and Information System Quality: A Comparative Analysis," *Proceedings of the 27th Annual Meeting of Decision Sciences Institute*, Orlando, Florida, Nov. 24-26, 1996, 856-858.
- [9] Nunnally, J.C. *Psychometric Theory*, 2nd edition. New York: McGraw-Hill, 1978.

Table 1. Demographic Profile of the Respondents (N= 104)

Characteristics	N	%	Characteristics	N	%
<i>Company's Industry Type:</i>			<i>Sex:</i>		
Product manufacturing	31	29.8	Female	29	27.9
Product non-manufacturing	28	26.9	Male	75	72.1
Services	45	43.3	<i>Age:</i>		
<i>Annual Company Sales:</i>			26-35	27	25.9
Small (less than \$100 million)	42	40.4	36-45	44	42.3
Medium (\$100 m. to less than \$500 m.)	25	24.0	46-55	21	20.2
Large (\$500 million or above)	37	35.6	56 or older	12	11.6
<i>Number of Company Employees:</i>			<i>Level of Education:</i>		
100 or less	17	16.4	Completed high school	30	28.9
101 to 500	38	36.5	Completed college degree	25	24.0
501 to 1,000	18	17.3	Some graduate work	20	19.2
Over 1,000	31	29.8	Completed graduate degree	29	27.9
<i>Annual Department Budget:</i>			<i>Marital Status:</i>		
Small (less than \$1 million)	33	31.7	Married	85	81.7
Medium (\$1 m. to less than \$5 million)	45	43.3	Not married	19	18.3
Large (\$5 million or above)	26	25.0	<i>Length in Present Company:</i>		
<i>Number of Department Employees:</i>			Less than 3 years	17	16.3
10 or less	39	37.5	3 to 5 years	33	31.7
11 to 50	45	43.3	6 to 10 years	29	27.9
51 to 200	13	12.5	Over 10 years	25	24.1
Over 200	7	6.7	<i>Length in Present Job:</i>		
<i>Years of Company's EDP/MIS Usage:</i>			Less than a year	17	16.3
Less than 5 years	21	20.2	1 to 2 years	28	26.9
5 to 10 years	24	23.1	3 to 5 years	42	40.4
11 to 20 years	39	37.5	Over 5 years	17	16.3
Over 20 years	20	19.2	<i>Physical Exercise:</i>		
<i>History of EDP/MIS Department::</i>			Regularly exercise	15	14.4
Less than 5 years	29	27.9	Some exercise	44	42.3
5 to 10 years	26	25.0	Rare exercise	37	35.6
11 to 20 years	32	30.8	No exercise at all	8	7.7
Over 20 years	17	16.3	<i>Computer Courses Taken:</i>		
<i>Level of Management:</i>			2 or less	13	12.4
Top management	70	67.3	3 to 6	12	11.5
Middle management	20	19.2	7 or more	79	76.0
Operating management	14	13.5			

Table 2. Summary Statistics of the Research Variables (N= 104)

Research Variable	No. of Items	Mean	Std. Dev.	Median	Maximum	Minimum	Range
Corporate Climate	22	4.38	0.93	4.29	6.86	2.05	4.81
IS Climate	8	4.87	1.11	5.00	7.00	1.38	5.62
IS Sophistication	2	4.85	1.24	5.00	7.00	2.00	5.00
IS Quality	4	5.30	1.10	5.50	7.00	2.25	4.75
Job Satisfaction	8	4.90	1.04	4.88	7.00	2.13	4.87
Job Stress	21	3.85	0.99	3.76	6.38	1.67	4.71

Table 3. The Assessment of the Goodness of Fit for the Restricted Model

Assessment Criterion (N=104)	Criterion Value
Total Coefficient of Determination ^a	.578
Chi-square Test Statistics ^b	.100
Probability of Chi-square Test ^c	.747
Goodness of Fit Index (GFI) ^d	1.000
Adjusted Goodness of Fit Index (AGFI) ^e	.993
Root Mean Square Residual ^f	.004

^a Total coefficient of determination is the closer to one, the better the fit.

^b Chi-square test statistics is the closer to zero, the better the fit.

^c Probability of chi-square test is the larger than 0.10, the better the fit.

^d Goodness of fit index (GFI) is the closer to one, the better the fit.

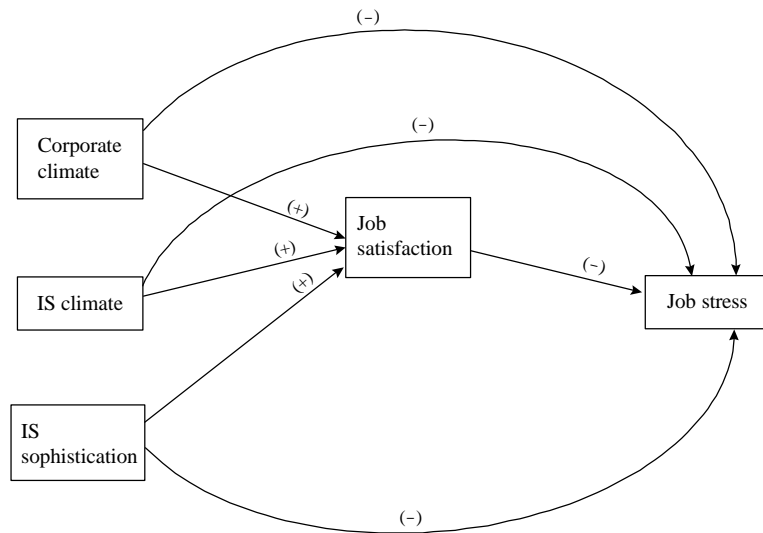
^e Adjusted goodness of fit index (AGFI) is the closer to one, the better the fit.

^f Root mean square residual is the closer to zero, the better the fit.

Table 4. The Path Effects of the Restricted Model

Path Effect (N=104)	IS Sophistication (R ² = .143)	IS Climate (R ² = .443)	IS Quality (R ² = .495)	Job Satisfaction (R ² = .438)	Job Stress (R ² = .437)	
Corporate Climate:	Total	.379	.652	.424	.616	-.602
	Indirect	.000	.055	.504	.156	-.289
	Direct	.379	.596	-.079	.460	-.313
	T-value	4.132****	7.467****	-.839	4.597****	-2.856****
IS Sophistication:	Total		.146	.256	-.062	-.068
	Indirect		.000	.099	.055	-.007
	Direct		.146	.157	-.117	-.061
	T-value		1.822*	2.036**	-1.403	-.744
IS Climate:	Total			.681	.309	-.240
	Indirect			.000	.042	-.082
	Direct			.681	.267	-.159
	T-value			7.232****	2.182**	-1.524
IS Quality:	Total				.062	-.016
	Indirect				.000	-.016
	Direct				.062	.000
	T-value				.591	
Job Satisfaction:	Total					-.264
	Indirect					.000
	Direct					-.264
	T-value					-2.668****

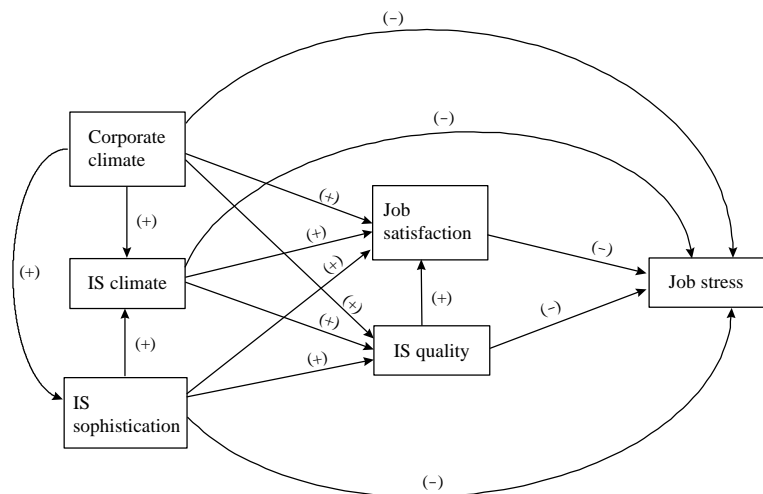
* p < 0.10; ** p < 0.05; *** p < 0.01; **** p < 0.001



Legend: (+) denotes positive effect
 (-) denotes negative effect

Source: Adapted from Li and Shani [1991]

Figure 1. A Causality Model of IS Work Stress



Legend: (+) denotes positive effect
 (-) denotes negative effect

Figure 2. A Research Model for Organizational Factors, IS Quality, Job Satisfaction, and Stress

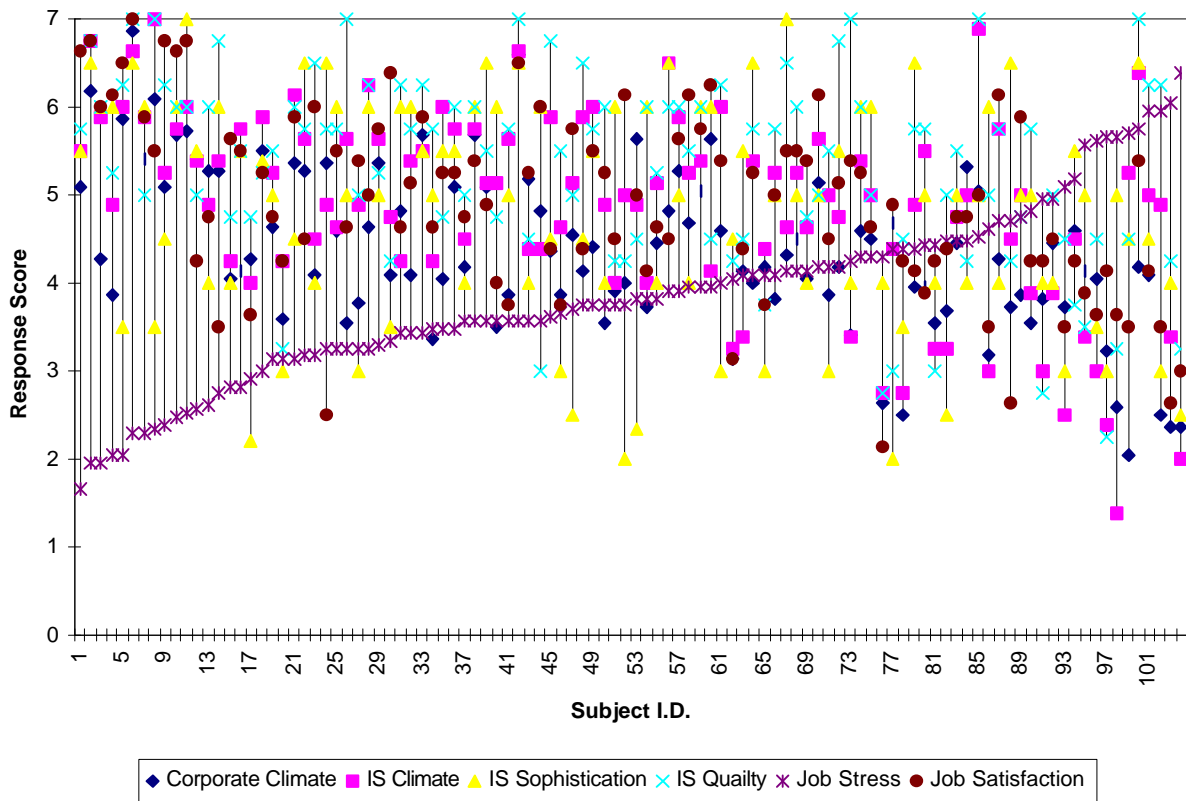
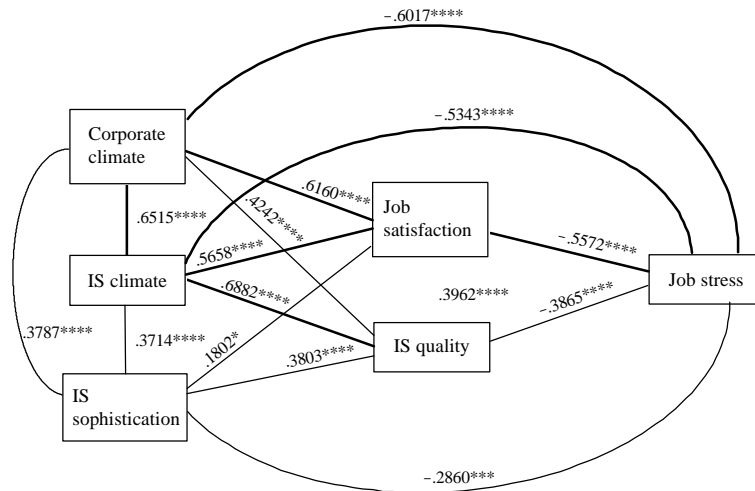


Figure 3. Distribution of Responses



Legend:

- * $p < 0.10$
- ** $p < 0.05$
- *** $p < 0.01$
- **** $p < 0.001$

Figure 4. Coefficients of Correlation among Research Variables

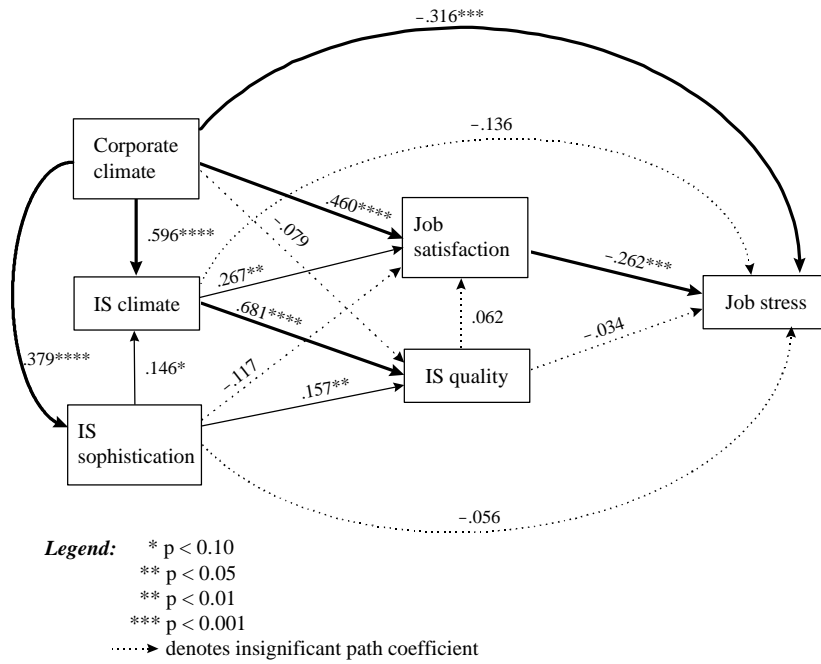


Figure 5. Path Coefficients of the Full Model

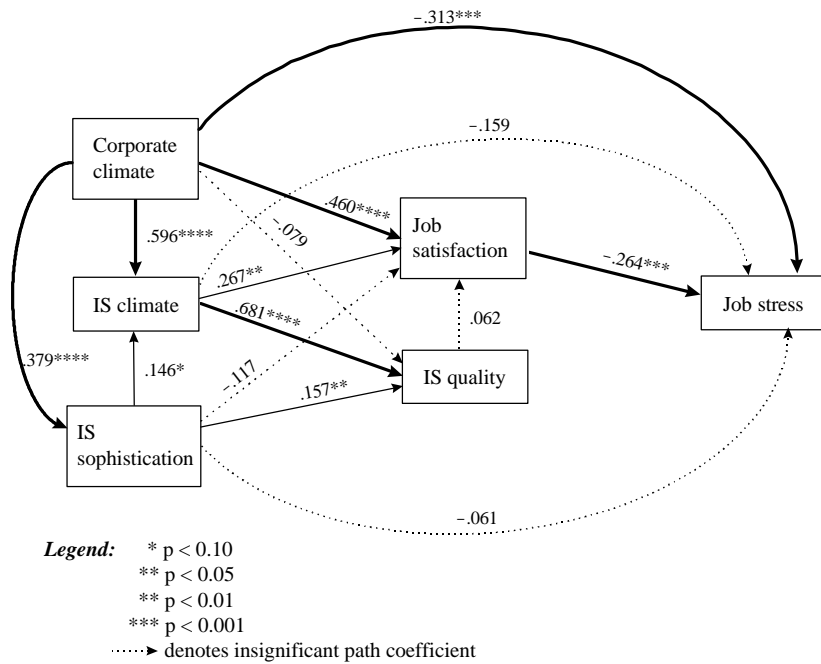


Figure 6. Path Coefficients of the Restricted Model