

## ANALYSIS OF JOB STRESS'S IMPACT ON JOB PERFORMANCE AND TURNOVER OF CYBERSECURITY PROFESSIONALS

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**ABSTRACT.** *This study examines the causal relationships of how cybersecurity professional's work attitudes, such as job stress and job satisfaction, affect their outcomes, such as job performance and turnover intention, key positive and negative indicators for organizational effectiveness. 157 cybersecurity professionals from diverse industries, especially from the IT industry, participated in responding to the survey questionnaire. Missing values in 7 responses made excluded from the analysis. Results of structural equation modeling show that job stress has a direct positive effect on turnover intention. Job satisfaction has direct positive and negative effects on job performance and turnover intention respectively. Job satisfaction acts as a mediating variable between job stress and turnover intention. Senior management must understand and properly manage cybersecurity professional's job stress, one of the key precursors to turnover intention, and make efforts to raise job satisfaction for higher job performance and lower turnover intention.*

**Keywords:** Cybersecurity professional, Job stress, Job satisfaction, Job performance, Turnover intention

**1. Introduction.** Recent state-sponsored cyberattacks, such as Sony hacking, and massive personally identifiable information (PII) disclosure incidents have urged senior managements to consider increasing the investment on cybersecurity human resources, such as cybersecurity incident responders as well as cyber defense-related systems, such as firewall and SIEM.

While considerable research has helped evaluate and improve technology resiliency, human resiliency has been understudied despite the important role of humans in the design and execution of cybersecurity programs [1].

Many cybersecurity behavior studies have focused on insider threats or social engineering, not on how cybersecurity professionals in an organization think and behave. Studies on those cyberthreat related activities may have amplified the negative aspects of cybersecurity-related behaviors. It is necessary to realign the study focus on the behavior of cybersecurity professionals, the key human resources, who respond to cyber emergencies by 24/7, rather than on technical solutions or misconducts.

Nominet published the report [2] that almost all CISOs (91%) say that they suffer moderate or high stress, with 60% saying that they rarely disconnect from their job and that most concerning is the 17% of CISOs who admitted to turning to medication or

alcohol to deal with job stress. The previous report shows that many high-ranking cybersecurity professionals are exposed to job stress and some of them are even struggling with mental health issues. High job stress or low job satisfaction of cybersecurity professionals, especially among CISOs surveyed in the previous report, may lead to many serious organizational and personal issues, resulting in organizational productivity losses and personal distresses. To reduce the damage from those vicious relationships, it is necessary to empirically explore the meaningful behavior patterns of cybersecurity professionals and make recommendations for senior management, based on the research results.

The purpose of this study is to examine both main and mediating effects of job stress and job satisfaction on job performance and turnover intention. Testing both main and mediating effects allows for us to have a comprehensive examination of job stress and job satisfaction as well as job performance and turnover intention among cybersecurity professionals in organizational settings.

## 2. Literature Review.

**2.1. Job stress.** Job stress is the response people may have when presented with work demands and pressures that are not matched to their knowledge and abilities and which challenge their ability to cope [3]. Job stress was measured with 13 job stress scale items developed by Parker and DeCotiis which presents a job stress model [4]. The empirically verified model by surveying 367 restaurant managers shows that a number of potential stressors are associated with first-level outcome (job stress) and that experienced job stress will sometimes, but not always, lead to organizationally and individually relevant second-level outcomes, such as reduced job performance and voluntary turnover. The initial Cronbach's Alpha of job stress in this study was .899.

**2.2. Job satisfaction.** Locke defined job satisfaction as a pleasurable or positive emotional state resulting from the appraisal of one's job or job experiences [5]. Job satisfaction was measured with 5 job stress index items developed by Brayfield and Rothe [6]. The initial Cronbach's Alpha of job satisfaction in this study was .861.

**2.3. Job performance.** Job performance is defined as the total expected value to the organization of the discrete behavioral episodes that an individual carries out over a standard period of time [7]. Job performance is a means to reach a goal or set of goals within a job, role, or organization, but not the actual consequences of the acts performed within a job [8]. Performance in a job is strictly a behavior and a separate entity from the outcomes of a particular job which relate to success and productivity.

Job performance was measured with 7 job performance index items developed by Williams and Anderson [9]. The initial Cronbach's Alpha of job performance in this study was .899.

**2.4. Turnover intention.** Turnover intention is defined as an individual's awareness of the likelihood of leaving an organization in the near future [10].

A comprehensive review paper, tracking 100-year research trends on turnover, acknowledges that, given its predictive superiority, turnover intentions have served as a surrogate or proxy for turnover when quit data are unavailable [11]. A review paper on turnover of IT professionals, reviewing narratives of 33 existing studies and conducting meta-analytic structural equation modeling, indicates that the considerable body of research on IT turnover intentions represents an important first step toward understanding IT turnover behavior [12].

Turnover intention was measured with 13 scale items developed by Lee [13] and adapted from Mobley et al. [14]. The initial Cronbach's Alpha of turnover intention in this study was .868.

### 3. Research Model Design.

3.1. **Research model.** This study proposes and tests an organizational behavior model for cybersecurity professionals, which consists of the causal relationship between work attitudes, such as job stress and job satisfaction, and work outputs, such as job performance and turnover intention. The research model of this study is shown in Figure 1.

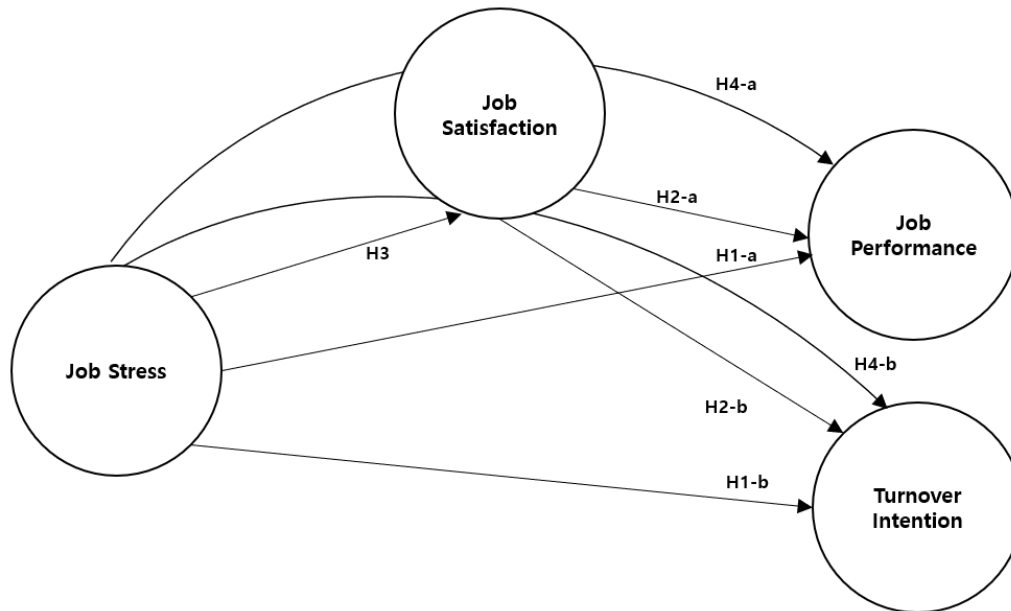


FIGURE 1. Research model

Since there are few empirical studies on behaviors of cybersecurity professionals, this study intends to adopt and reaffirm that causal relationships empirically verified in other industries, such as healthcare and ICT, can be applied to those in the cybersecurity industry.

3.2. **Hypothesis setting.** Based on the literature review, the following relationships between work attitudes and work outputs are hypothesized.

**Hypothesis 1:** Job stress will be negatively associated with job performance (H1-a) and positively with turnover intention (H1-b).

Job stress has the effect of lowering performance and increases turnover intentions [3,4].

**Hypothesis 2:** Job satisfaction will be positively associated with job performance (H2-a) and negatively with turnover intention (H2-b).

Researchers have been particularly interested in exploring relationships between job satisfaction and individual performance [15]. Job satisfaction has also invariably been reported to be negatively related to turnover and intent to leave [16].

**Hypothesis 3:** Job stress will be negatively associated with job satisfaction (H3).

Most of the research on organizational stress has focused on its relationship with job satisfaction. Job stress and satisfaction are inversely related [17].

**Hypothesis 4:** Job satisfaction will mediate the relationship between job stress and job performance (H4-a) and the relationship between job stress and turnover intention (H4-b).

Job stress was both directly and indirectly related to job performance through job satisfaction and propensity to leave [18]. Job satisfaction fully mediated the relationship between stressful work and intention to leave the employer [19].

## 4. Methodology.

**4.1. Samples.** The questionnaire was implemented on an online survey platform for survey response accuracy and responder's convenience. All questions used five-point Likert scales from 1) Strongly Disagree to 5) Strongly Agree for the consistency.

Requests to participate in the online survey with the specific URL to which cybersecurity professionals can access were e-mailed individually and posted on two online forums with more than 1,000 members, in which cybersecurity professionals actively participate. The survey lasted for 5 days from 31 May to 4 June 2019. 157 cybersecurity professionals responded to the online survey. After reviewing all responses, 150 responses were included in the analysis and the other 7 responses were removed due to missing data or the same answers in responses. Table 1 shows the demographic characteristics of responders. Male responders are 76.7%. Responders in 40s are 46.7%. Responders with working years between 1 ~ 3 years are 21.3%.

TABLE 1. Demographic characteristics of responders

Demographic Variable	Frequency	Percentage	
Gender	Male	115	76.70%
	Female	35	23.30%
Age (years)	20s	25	16.70%
	30s	46	30.70%
	40s	70	46.70%
	50s	9	6.00%
Working year	< 1	21	14.00%
	1 ~ 3	32	21.30%
	3 ~ 6	28	18.70%
	6 ~ 9	21	14.00%
	9 ~ 12	17	11.30%
	≥ 12	31	20.70%
Total	150	100%	

**4.2. Analysis procedures.** Statistical analyses were performed with SPSS 25 for survey data verification and basic statistical tests and with AMOS 20 for structural equation modeling (SEM).

The reliability tests were performed to check the internal consistency of variables. The criterion for internal consistency and reliability is over .6 of Cronbach's Alpha.

The multicollinearity among variables was checked using a correlation matrix and variance inflation factor (VIF). Two criteria for multicollinearity existence are correlation value over .8 and VIF value over 10.

This study used SEM with maximum likelihood (ML) estimation. A confirmatory factor analysis (CFA) was performed for a measurement model. The model fit of SEM was evaluated with the criteria,  $\chi^2$  (CMIN,  $p > .005$ ), Tucker-Lewis index (TLI,  $> .9$ ), comparative fit index (CFI,  $> .9$ ) and the root-mean-square error of approximation (RMSEA,  $< .05$ ). The  $\chi^2$  for a single model is interpreted as the test of difference between the hypothesized model and the identified model with a smaller value indicating better fit (Kline, 1998). Most SEM models do not meet this criterion  $p > .005$ . The  $\chi^2$  is sensitive to sample size. A value of  $\chi^2/df$  was reported together and a value of  $\chi^2/df$  less than 3 indicated a reasonable fit [20]. For both the TLI and CFI, a value of 0.90 was considered acceptable. And RMSEA values below 0.05 are good fit, and between 0.05 and 0.08 are considered acceptable [20].

5. **Results.** This study consists of two exogenous variables (job stress and job satisfaction) and two endogenous variables (job performance and turnover intention).

The initial Cronbach’s Alpha values of all 4 variables are over 0.8 because all scale items used in this study were used and verified in the previous empirical studies, not developed in this study.

All correlation values were less than .5 (Table 2). All VIF values were also less than 2. No multicollinearity was observed among variables.

The initial SEM model after the first CFA was not fit because model fit values do not meet the criteria ( $\chi^2$ : 1488.922, DF: 881, CMIN/DF: 1.690, TLI: .857, CFI: .867, RMSEA: .068).

TABLE 2. Means, standard deviation, and correlation coefficients for observed variables

	Mean	S.D.	Job Stress	Job Satisfaction	Job Performance	Turnover Intention
Job Stress	2.7569	.79628	1			
Job Satisfaction	3.6173	.79662	-.312**	1		
Job Performance	4.0819	.58548	-.192*	.351**	1	
Turnover Intention	3.2282	.74842	.398**	-.413**	.145	1

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

Especially TLI and CFI values are under .9. Several iterations of CFA to improve the model were undergone by removing scale items with Squared Multiple Correlations less than .4.

The final CFA model (Table 3) adopted in this study is fit, satisfying model fit criteria ( $\chi^2$ : 294.750 ( $p < .001$ ), DF: 165, CMIN/DF: 1.786, TLI: .904, CFI: .917, RMSEA: .073).

Table 4 shows all direct paths’ standardized coefficients and critical ratios with significance probability ( $p$ -value). Job stress has a negative relationship with job satisfaction ( $\beta = -0.365$ ; H3), not with job performance (H1-a) and has a positive relationship with turnover intention ( $\beta = 0.364$ ; H1-b). Job satisfaction has a negative relationship with turnover intention ( $\beta = -0.411$ ; H2-b) and has a positive relationship with job performance ( $\beta = 0.392$ ; H2-a).

Table 5 shows all direct paths’ standardized coefficients and critical ratios with significance probability ( $p$ -value). Job satisfaction has a mediating relationship between job stress and turnover intention ( $p < .001$ ; H4-b), not between job stress and job performance (H4-a).

6. **Conclusions.** This study examines the main and mediating effects of job stress and job satisfaction on job performance and turnover intention among cybersecurity professionals. The study results support all relationships related to job satisfaction and turnover intention. The relationship between job stress and turnover and through job satisfaction (mediation) is one of the key relationships supported in this study.

The relationship between job stress and job performance is not supported in the study result. This is due to the non-linear or inverted U-shaped characteristics of the relationship between job stress and job performance [17]. At the lower level of job stress, job performance can increase. However, at the high level of job stress, job performance may decrease. This may imply that the moderate level of job stress can raise job performance.

TABLE 3. Confirmatory factor analysis

Latent Variable	Observed Variable	Estimate		S.E.	C.R.
		B	$\beta$		
Job Satisfaction (Cronbach's Alpha = .861)	j_sat_1	1	0.812		
	j_sat_2	0.692	0.639	0.086	8.005***
	j_sat_3	0.987	0.821	0.091	10.854***
	j_sat_4	0.976	0.771	0.097	10.065***
	j_sat_5	1.015	0.69	0.116	8.786***
Job Stress (Cronbach's Alpha = .852)	j_st_12	0.988	0.704	0.128	7.7***
	j_st_11	1.177	0.724	0.149	7.896***
	j_st_08	1.162	0.753	0.142	8.172***
	j_st_06	1.137	0.781	0.135	8.423***
	j_st_02	1	0.704		
Job Performance (Cronbach's Alpha = .898)	j_per_1	1	0.812		
	j_per_2	0.956	0.859	0.08	11.968***
	j_per_3	0.998	0.832	0.087	11.466***
	j_per_4	0.933	0.785	0.088	10.624***
	j_per_7	0.864	0.708	0.093	9.29***
Turnover Intention (Cronbach's Alpha = .862)	ti_5	1	0.859		
	ti_6	0.842	0.681	0.094	9***
	ti_8	0.829	0.73	0.084	9.866***
	ti_10	0.865	0.661	0.1	8.661***
	ti_11	0.995	0.773	0.093	10.66***

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

TABLE 4. The analysis of direct paths between variables

Path	Estimate		S.E.	C.R.
	B	$\beta$		
Job Stress $\rightarrow$ Job Satisfaction	-0.347	-0.365	0.092	-3.754***
Job Stress $\rightarrow$ Job Performance	0.049	0.067	0.071	0.694
Job Stress $\rightarrow$ Turnover Intention	0.43	0.364	0.109	3.936***
Job Satisfaction $\rightarrow$ Turnover Intention	-0.512	-0.411	0.111	-4.594***
Job Satisfaction $\rightarrow$ Job Performance	0.303	0.392	0.077	3.911***

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

TABLE 5. The analysis of indirect paths among variables

Path	Estimate	S.E.	95% Confidence Interval
Job Stress $\rightarrow$ Job Satisfaction $\rightarrow$ Job Performance	-.105	.056	-.259 ~ -.029
Job Stress $\rightarrow$ Job Satisfaction $\rightarrow$ Turnover Intention	.178***	.069	.073 ~ .351

\* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$

The key contribution of this study is that it empirically verifies behavioral causal relationships between work attitudes and work output by surveying cybersecurity professionals, although the relationship has been repeatedly verified in other industries.

Senior management needs to understand that a cybersecurity professional with high job stress will consider leaving the organization soon. To retain cybersecurity professionals who are considering leaving the organization and experiencing emotional distress at work, it is important to look beyond difficult situations with which they are encountering. It is

necessary to take proactive actions for cybersecurity professionals not to turnover. One of possible actions would be to raise job satisfaction with diverse methods, such as raising wage, training opportunity or organizational support, in advance. Job satisfaction also makes cybersecurity professionals work happily with higher performance and stay longer in the organization.

This study examined only the relationship between work attitudes and outputs. For future studies, researchers can examine antecedents of job stress and job satisfaction with larger transnational samples.

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