

Early Career Turnover Model and Career Path for Self-realization: Findings in Korea's Information Security Industry

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ABSTRACT

Management of the workforce in the early career stage who enter information security work after graduating from college or university so that they can continue to develop their information security careers without leaving the organization can be a solution to the problem of absolute shortage of staffing and lack of skills. This is because the workforce can improve their job skills, and organizations can build a stable, cost-effective human resource management system. This paper constructed and verified a turnover intention research model focusing on the factors that affect the turnover intention of early-stage workforce who took their first steps in society as an information security workforce after graduating from university or college; it confirmed that self-realization is a crucial factor. Furthermore, with in-depth interviews, the career path information of skilled workers, which is essential information necessary for self-realization, was analyzed, and the direction of HRM for self-realization of the workforce in the early career stage was presented.

Keywords: Information Security, Turnover Model, PLS, Early Careers, Self-Realization, Career Path

I . Introduction

In its World Competitiveness Report, the WEF has recognized Korea's strengths in innovation capability and ICT penetration (WEF, 2019; WEF, 2020). Since the early 2000s, Korea's university enrollment rate has remained above 70% (Statistics KOREA,

November 18, 2021); that means the majority of working-age Koreans have a basic level of knowledge, so there are no difficulties in recruitment and employment or the supply of labor compared to demand. However, the school-age population has declined, making the quantitative labor supply difficult. Moreover, since the 1997 currency crisis, individuals

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have shifted their mindset from a lifetime job to a lifetime career. Companies are minimizing costs by quickly sourcing outside talent instead of investing in retaining and developing their workforce. As a result, organizations face the challenge of preventing voluntary turnover in the workforce they already have and the challenge of selectively hiring skilled workers from outside the organization. Voluntary turnover can cost organizations money to prepare, recruit, select, orient, and train new hires and can even reduce productivity (Tracey and Hinkin, 2008).

It is generally accepted that career mobility is driven by clear expectations of gaining expertise, expanding job functions, and advancing status (Schein, 1978). Workers interpret the level of knowledge and skills they possess, as well as the certifications they hold, as solid signals that give them an advantage in the labor market (Connelly et al., 2011; Spence, 1973; Spence, 1976). Workers are willing to pay to acquire these signals (Spence, 1973), including higher pay, career advancement opportunities, and prestige. New entrants to the labor market, or those at the beginning of their careers, choose to leave voluntarily based on their current education and credentials rather than on the accumulation of experience within an organization. Seventy percent of prime-age workers in their 20s and 30s spent three years or less in their first job (average 3.3 years) (SARAMIN, 2020). When looking at the percentage of people who kept their main job in 2018 and 2019, entry (34.3%) and exit (23.7%) were most active among those under 30.

Furthermore, while the retention rate is 37.1% for those with less than one year of service, the retention rate increases to 75.1% for those with 1-3 years of service, and the retention rate approaches 88% to 97% for those with more than one year of service (Statistics Korea, 2021). Managing the volun-

tary turnover rate of the initial workforce can be interpreted as lowering the career development of individuals and the cost of workforce management for companies. As one in three ICT professionals intend to leave their jobs, and the main reasons for wanting to go are dissatisfaction with career development potential (43.8%), dissatisfaction with working conditions other than wages (21.9%), and dissatisfaction with wages (19.2%) (IITP, 2021), it is necessary to study the turnover of information security personnel in the early career stage because the turnover of technical personnel can lead to complete departure through a job change.

Today, the role of information security is no longer limited to protecting information infrastructure or IT assets. Still, it affects all areas of an organization's business (Shahim, 2021), and this is the role of the information security workforce. In recent years, there has been a focus on the shortage of the right people for the job rather than an absolute quantitative deficiency (Crumpler and Lewis, 2019; Furnell, 2021; Jun et al., 2009; Kim and Jung, 2006; Vogel, 2016; ISC², 2020). This is because the cyber risks organizations face are unpredictable, making it challenging to be proactive and intermittent, requiring a highly skilled workforce with agility and expertise (Crumpler and Lewis, 2019; GAO, 2018). Managing the turnover intentions of early-career employees is critical to retaining skilled workers. The turnover rate of information technology employees has long been a primary concern for CIOs and senior managers, especially in technical roles because losing talented workers affects the organization's overall performance. Employees' experience significantly impacts the quality of their work, especially since technical workers have a long learning curve and require constant retraining on rapidly evolving technologies. Therefore, the turnover of employees

in information technology departments should be handled with great importance with a professional workforce management system (LeRouge et al., 2006; Mak and Sockel, 2001; Naidoo, 2016). In addition, it is necessary to manage the workforce considering the characteristics of the work that are different from those handled through typical processes such as human resources or marketing (Chang et al., 2012).

To analyze their turnover intention characteristics, we reviewed the traditional turnover models and validated them on individuals with less than three years of work experience who entered information security jobs. We were motivated to conduct this research because managing employees' turnover intentions early in their careers is the first step in ensuring a stable workforce. We also wanted to validate the turnover characteristics of employees in information security roles because they play a critical role in managing organizational risk, and because the loss of talent due to turnover is greater than in other fields. This paper is based on the proposition that helping the early career workforce right after graduating from academics to develop their careers serially as information security practitioners is an alternative way to solve the workforce shortage in the long run. This paper is organized as follows: Chapter 2 reviews the literature on turnover models, and Chapter 3 presents the research model. In Chapter 4, the research model is tested using actual data. Chapter 5 analyzes the career path of skilled workers, and Chapter 6 pulls out implications based on the analysis results and suggests the direction of management for an early career workforce in information security.

II. Literature Review

2.1. Turnover Intention

Turnover is a topic that should be approached from a preventive perspective. Therefore, the actual object of the studies was not the turnover but the turnover intention. Because turnover can be identified after it occurs, but turnover intention can predict turnover behavior (Kim et al., 2021). This is because turnover intention is the strongest predictor of turnover. Some studies have suggested that turnover intention may be a precursor to turnover (Kraut, 1975). Others have theorized that turnover intention predicts turnover behavior through the Turnover Process Model (Hom et al., 2017; Mobley, 1977). Some define turnover intention as the abandonment of the role of organizational membership by an individual who receives financial rewards from an organization (Mobley, 1982), a thoughtful and deliberate plan to leave an organization (Tett and Meyer, 1993), or a psychological state that may manifest itself as turnover behavior in the future (Lee and Jie, 2012). In other words, turnover intention is a psychological state in the planning process and ultimately affects turnover behavior.

Turnover intention or turnover is a very important issue in talent management or organization management because the turnover of organizational members affects the remainder and the entire organization. For example, the dismantling of tacit knowledge, destruction of communication channels, and disruption of business continuity may occur. It also affects individuals who perform turnover (Griffeth and Hom, 1995; Hom et al., 2017; Kim et al., 2021; Mak and Sockel, 2001; Mobley, 1982; Tracey and Hinkin, 2008). Turnover intention is an traditional topic, but recently, research has continued to identify factors affecting turnover intention in order to reduce the turnover rate in terms of organizational human resource management, and job satisfaction is viewed as a significant factor (Pratama et al., 2022; Xue et

al., 2022). Above all, turnover has the positive effect of providing new career development opportunities and inducing an increase in wages for individuals. However, when leaving the first job after completing formal education, he/she may not be able to use what have learned and forget it, and may also miss opportunities to improve their skills, which may result in leaving the labor market (Cho and Kim, 2018; Park and Chen, 2009; Yoo and Kim, 2016). Moreover, the negative impact of turnover is greater in organizations that require expertise in specific knowledge and skills because hired people are slow to replace the roles of skilled workers (Miller, 1986).

This paper defines turnover intention as the state of an organization member has willing to leave the organization potentially and voluntarily.

2.2. Turnover Model

After March and Simon (1958) refined the turnover model, turnover models that consider various influencing factors and pathways began to appear in earnest. March and Simon (1958)'s model does not presuppose empirical evidence, but it focuses on systematizing the factors that affect the turnover decision, and the model attempts to explain individual behavior through the function of the labor market. Porter and Steers (1973) stated that employee turnover and absenteeism in organizational settings are interesting topics for researchers interested in studying individual behavior. They considered turnover and absenteeism as a form of leaving the organization and only studied voluntary turnover and absenteeism. Porter and Steers (1973) were interested in job satisfaction among the various factors of turnover.

Mobley (1977) noted that the relationship between job satisfaction and turnover in the existing literature consistently shows a significant negative correlation,

but the actual correlation coefficient value is low. Therefore, he argued that other variables should be studied to mediate the relationship between job satisfaction and turnover behavior in the turnover decision process and proposed a new model of turnover by adding psychological and economic factors to mediate the relationship between job satisfaction and actual turnover. Price (1977) proposed a model of employee turnover based on a sociological perspective, incorporating economic and psychological concepts and combining them with structural dimensions related to the work environment, such as the degree of job repetition and centralization, which affect employee disposition and behavior. The model is structured by dividing the variables that affect turnover into direct and indirect. The direct influencing variables are job opportunities and turnover intention, while the indirect influencing variables are job awareness, general training, and family responsibilities. They argued that they affect turnover through turnover intention.

2.3. Turnover Intention Impact Factors

Existing studies have focused on personal and environmental factors, such as job satisfaction and organizational commitment, as antecedents to turnover, so they have not considered factors that explain retention, such as what makes employees hesitate to leave the organization and why they stay in the current organization even if they have turnover intentions (Eun et al., 2018). Some studies have found that job attitudes such as job satisfaction and organizational commitment have little effect on employee retention and turnover (Griffeth et al., 2000), while others have found that an individual's psychological state of wanting to stay or leave the organization and perceived control over the decision is more crit-

ical to turnover than job attitudes (Hom et al., 2012). Some researchers have argued that the earlier studies in turnover research dealt with the relationship between job satisfaction and turnover and that later studies dealt with organizational commitment and turnover. However, others have pointed out that the research models of 20 years ago are still prevalent and that research is being conducted to test or slightly modify them (Steel, 2002).

2.4. Career Path and Career Development

Career paths can help motivate people to enter or advance by showing them a successful future and preventing them from leaving an organization or job. Organizations can use career paths to create and manage talent development plans.

IT professionals are more interested in career advancement than other professions, and research has shown that providing clear career paths can impact IT workforce motivation, career advancement and retention, and reduce turnover. In order to retain and motivate employees working in IT, organizations should provide appropriate career paths (Crepeau et al., 1992; Igbaria et al., 1995), and consider that IT employees' motivation to perform is influenced by their satisfaction with their work situation and their perception of the effectiveness of management policies on career development (Mak and Sockel, 2001). In addition, organizations should create an environment that meets the needs of IT personnel to achieve their professional career goals and become part of the larger IT community, including supporting the use of the latest technologies, encouraging participation in professional societies, providing professional training, and job rotation (Chang et al., 2012).

Regarding career paths or career pattern types,

Kim and Kim (2011) modeled the process of information security personnel's job mobility using Markov chains and predicted the composition of information security personnel by the job. In addition, they argued that human resources mobility could take various forms, such as human resources mobility between jobs and workforce mobility between industries. A preliminary analysis of workforce mobility paths should be conducted for information security job fields that must be fostered as a long-term industry outlook or strategic goal. Joseph et al. (2012) utilized the National Longitudinal Survey of Youth (NLSY79) to identify the IT workforce's career paths and mobility patterns. Joseph et al. (2012) pointed out that existing studies on career paths only consider movement within an occupation or organization or training between professions or organizations and suggested that a study that considers both moves within a discipline or organization and activity outside a field or organization (Boundaryless Career Mobility) is needed for the career mobility of IT workers. Song and Kim (2016) stated that it is necessary to develop a curriculum suitable for the National Occupational Standards (NCS) to train personnel ideal for information security jobs. Song and Kim (2016) stated that developing a curriculum suitable for the National Competency Standards (NCS) to train a workforce is ideal for information security jobs, and the curriculum can be utilized to recruit a new workforce and develop a career path model. So, a job turnover model that considers the career path is necessary to teach the workforce required by the industrial demand; for this purpose, a study on tracking the movement path of the workforce is required.

Berlich (2013) was interested in the career motivations of CISOs due to the increasing importance of the role of the CISO. In particular, he focused

on the psychological behavior of CISOs at the time of their appointment and interviewed 22 former and current CISOs to identify the career patterns of CISOs. Berlich (2013) is not interested in the career path of CISOs per se but instead identifies the factors that enabled an individual to become a CISO and reach the position classify the types of career development based on this. Therefore, it is a limitation that it is impossible to identify the job or job movement process for career formation in detail. Burley et al. (2014) pointed out that there is a significant investment in developing information security personnel worldwide. Still, the supply of well-trained information security professionals is insufficient, and it argued that this could be solved by explicitly defining and professionalizing the information security profession itself. It suggests that the primary method is to clearly define the role and career path of the personnel (or work). Estes et al. (2018) argued that to improve the utilization of the NICE Cybersecurity Workforce Framework in the United States, it is necessary to map the jobs and occupations presented in the framework. They also argued that including education and certification in the mapping would help organizations develop career paths for employees and help employees obtain the information they need to set their career goals and shape their careers. In addition, career paths can help prospective information security workers (those who want to enter the profession) address concerns about whether the work is a good fit for them and help employers assess whether prospective workers are the kind of people they want to hire.

Jun and Kim (2018) examined the reasons for the turnover and showed representative turnover routes of information security workers in Korea. They found that information security workers in information security companies move to peer compa-

nies for various reasons. In contrast, information security workers in IT companies move to information security to secure expertise for career advancement. They also found that information security workers in government, public, and educational institutions move to financial insurance companies for "remuneration and profit." Park and Kim (2020) analyzed the job mobility paths of information security workers based on the National Competency Standards (NCS) and tried to predict changes in the workforce for each job. To do so, they modeled the job mobility of information security personnel as a Markov chain based. Rather than tracking an individual's career, most studies identify career moves based on the frequency and timing of job or job-to-job transitions. This has the limitation of being unable to show when an individual moved from one job to another to reach their final position.

III. Research Model

3.1. Research Subjects

Information security workers who are 30 years old or younger and have been working for less than three years are eligible for this study. To test the research model, we used data from the Graduates Occupational Mobility Survey (GOMS). This is a government-approved statistic that is surveyed and released with the goal of securing empirical data on the labor market entry and settlement process of college graduates (KEIS, 2021). The Graduate Occupational Mobility Survey provides the current occupation of each respondent based on the Korean Employment Classification of Occupations (2018) (MEL, 2017).

Job codes classified as information communica-

<Table 1> Occupations related to Information Security and ICT

Information Security and ICT Related Occupations in Korean Employment Classification of Occupations		Variable Name For The Sample Population
Medium category	Subcategory (Code)	
Telecommunications R&D and Engineering and Technology	Computer Hardware and Telecommunications Engineers (131)	-
	Computer Systems Specialist (132)	-
	Software Developer (133)	-
	Data-Network and System Operations Specialist (134)	Early Career ICT
	Information Security Specialist (135)	Early Career Information Security
The total sum of the final sample		1,940 units

Note: Graduate Occupational Mobility Survey is based on the Korean Employment Classification of Occupations (2018) (MEL, 2017)

<Table 2> Filtering Procedure of the Research Data

Stage 1	Raw Data	2015-2019 Graduate Occupations Mobility Survey Data
Stage 2	by profession	Only ICT or information security
Stage 3	by industry	Only ICT or information security
Stage 4	by labor type	Only full-time employees, including temporary workers able to continue working
Stage 5	by company size	Remove the samples that no more than 4 employees at the time of the survey
Final Stage	Final Data	After standardization based on conditions; Only the remaining samples are used for research

tions and information security jobs are #131, #132, #133, #134, and #135. Of these, the #134 were defined as ICT jobs, and the #135 were defined as information security, and samples were selected. The number of samples corresponding to this is 1940 (See <Table 1>), and extracted the research sample. Although the scope of information and communication jobs was broadly categorized, we set only Data-Network and System Operations Specialists (134) as the ICT, similar to information security jobs, information and communication. We compared them with information security to verify whether job mobility characteristics emerged between groups.

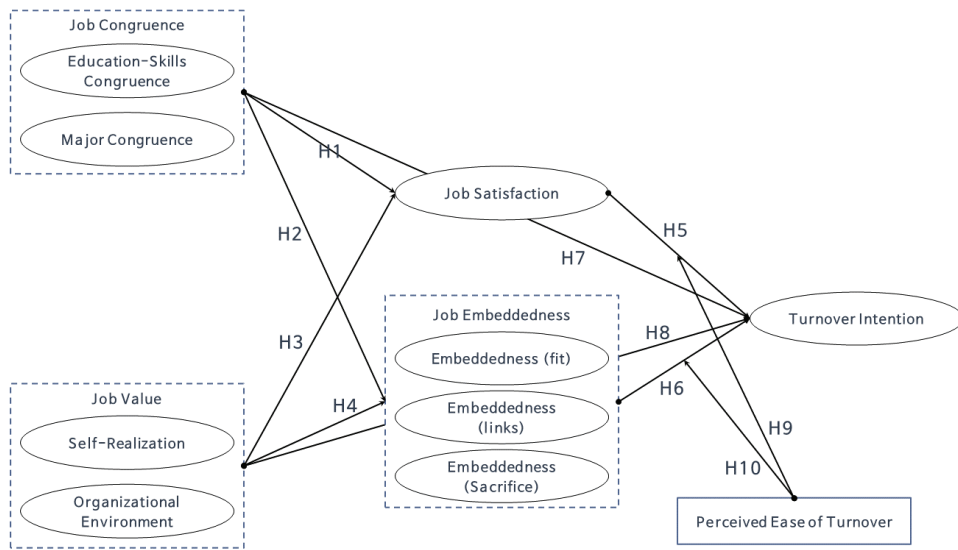
We utilized data from the Graduate Occupational Mobility Survey (2014~2018 GOMS) from 2015 to 2019, the years in which the survey was conducted with the same items. The total number of samples

was 90,581, and the final sample of 1,940 was used in the study after standard sampling procedures, as shown in <Table 2>.

3.2. Research Model

Through the literature on turnover intention and turnover model, we confirmed that job satisfaction, organizational commitment, and job orientation are the main influencing factors on turnover intention. We constructed a turnover model based on these variables. The research model is shown in <Figure 1>, and the description of each variable is shown in <Table 3>.

The research model was constructed as a structural equation model. Structural equation modeling is a statistical technique for verifying correlations be-



<Figure 1> Research Model

<Table 3> Variable Descriptions

Variables	Descriptions
Turnover Intention	A condition in which a regularly compensated member of an organization intends to voluntarily leave the organization in the future for a position outside the organization.
Job Satisfaction	Positive feelings or attitudes about the job you do or the job you are working for
Job Embeddedness	A state of value or feeling that you expect to lose by leaving your organization ✓ Embeddedness (fit): the emotional state of feeling that you may lose a job/organization that is a good fit with your personality/values. ✓ Embeddedness (links): Feeling that you may lose your relationships and social position in the organization. ✓ Embeddedness (Sacrifice): the emotional state of feeling that you could lose the financial and psychological stability you have received from the organization.
Job Congruence	The degree to which the academic level, skill level, and significant knowledge required by the job match the one possessed ✓ Education-Skills Congruence: the degree to which the education and skill level required by the job is consistent with the education and skill level you have. ✓ Major Congruence: the degree to which the knowledge and skills required by the job are consistent with your major (or major knowledge).
Job Value	The value an individual is placing on your job or workplace ✓ Self-Realization: The degree to which an individual is satisfied with the intrinsic value of being a member of an organization. It refers to the motivation to perform a job or task based on personal values or career goals. ✓ Organizational Environment: The degree to which individuals are satisfied with the extrinsic values they seek while working as a member of an organization. The environment provided by the workplace (working hours, comfortable facilities, fairness of the personnel system, etc.)
Perceived Ease of Turnover	Perception that receiving a job offer from an outside source could lead to another job in addition to the current one

tween variables. It has been used mainly in sociology and psychology but is now widely used in various academic fields (Woo, 2012).

The research hypotheses are as follows:

- H1. Job Congruence will affect Job Satisfaction positively.*
- H2. Job Congruence will affect job Embeddedness positively.*
- H3. Job Value will affect Job Satisfaction positively.*
- H4. Job Value will affect job Embeddedness positively.*
- H5. Job Satisfaction will affect Turnover Intention negatively.*
- H6. Job Embeddedness will affect Turnover Intention negatively.*
- H7. Job Congruence will affect Turnover Intention negatively.*
- H8. Job Value will affect Turnover Intention negatively.*
- H9. The effect of Job Satisfaction on Turnover Intentions will be influenced by Perceived Ease of Turnover.*
- H10. The effect of Job Embeddedness on Turnover Intention will be influenced by Perceived Ease of Turnover.*

IV. Empirical Analysis

4.1. Research Model Validation

SPSS and Smart PLS 3.3.3 were used to evaluate the research model. To determine the focused validity of the measurement items, the bootstrap method of PLS was used to check the t-value, which indicates the significance of the measures loaded on the constructs and the factor loading value of the measures

loaded on the constructs. A factor loading value of 0.7 or higher and a t-value of 1.96 or higher are recommended (Fornell and Larcker, 1981). As a result, all the t-values utilized in this study are above 1.96, and the factor loadings of the items are above 0.7, indicating that the items are focused and valid. The internal consistency of the items was tested by composite reliability (CR), average variance extracted (AVE), and Cronbach's Alpha coefficient. The CRs of all measures were above the threshold of 0.7 advocated by Bagozzi and Yi (1988). Cronbach's alphas were generally above the 0.7 suggested by Nunnally and Bernstein (1994) and Gefen et al. (2000). The AVEs of the variables are all above the 0.5 offered by Fornell and Larcker (1981) and Chin (1998). Therefore, the model shows a high degree of internal consistency. To ensure the discriminant validity of the measurement model, we conducted a confirmatory factor analysis to check the cross-loading. The factor loadings of each construct must be greater than the factor loadings of other constructs to be considered discriminant (Chin, 1998), and this requirement was also met. Statistical significance was verified through the t-value provided by the bootstrapping method of Smart PLS.

The Goodness of Fit of the model was determined using R^2 . The R^2 for turnover intention, job satisfaction, Embeddedness (fit), Embeddedness (links), and Embeddedness (sacrifice) are 0.180, 0.558, 0.386, 0.551, and 0.570, respectively. All are above the 0.100 thresholds for adequacy (See <Table 4>).

4.2. Validation of Research Hypotheses

<Table 5> shows the results of testing the hypothesis of early career information security and early career ICT workers on Turnover Intention. The two groups differ in terms of Job Embeddedness. For

both groups, Education-Skill Congruence affects Job Satisfaction, but Major Congruence does not significantly affect Job Satisfaction. Regarding the effect of Job Congruence on Job Embeddedness, information security is mainly affected by Education-Skill Congruence and ICT by Major Congruence.

Regarding the effect of Value on Job Satisfaction, only Self-Realization significantly affects Job Satisfaction in information security, but both Self-Realization and Organizational Environment substantially impact Job Satisfaction in information and communication technology. The result of Job

<Table 4> Construct Validity and Reliability

(N=1,940)

Variables	Measurement questions	Factor loadings	t-value	CR	Communality	R square	AVE	Cronbach's α	GoF
Education-Skills Congruence	a142	0.921	114.541	0.877	0.781	-	0.781	0.726	0.611
	a143	0.845	48.851						
Major Congruence	a144	0.897	30.468	0.893	0.807	-	0.807	0.761	
	a146	0.900	35.544						
Self-Realization	a131	0.834	101.379	0.856	0.665	-	0.665	0.748	
	a136	0.800	70.844						
	a139	0.812	80.155						
Organizational Environment	a129	0.834	102.011	0.836	0.630	-	0.630	0.707	
	a130	0.769	60.451						
	a134	0.777	70.530						
Job Satisfaction	a140	0.937	260.831	0.927	0.865	0.558	0.865	0.844	
	a141	0.923	180.855						
Embeddedness (fit)	a138	1.000	0.000	1.000	1.000	0.386	1.000	1.000	
Embeddedness (links)	a132	0.703	43.336	0.862	0.679	0.551	0.679	0.756	
	a135	0.880	125.140						
	a137	0.876	121.979						
Embeddedness (Sacrifice)	a126	0.781	63.882	0.839	0.634	0.570	0.634	0.712	
	a127	0.778	63.292						
	a133	0.829	95.264						
Turnover Intention	a297	1.000	0.000	1.000	1.000	0.180	1.000	1.000	
Perceived Ease of Turnover	a285	1.000	0.000	1.000	1.000	-	1.000	1.000	
Perceived Ease of Turnover	Embeddedness (links)	1.047	44.086	1.000	0.679	-	1.000	1.000	
	Embeddedness (fit)	1.044	44.302	1.000	0.844		1.000	1.000	
	Embeddedness (Sacrifice)	1.035	45.026	1.000	0.803		1.000	1.000	
	Turnover Intention	1.058	44.964	1.000	0.937		1.000	1.000	

<Table 5> Validation Results of Research Hypotheses

Hypothesis		Early Career Information Security				Early Career ICT			
		Path coefficient (β)	t-value	p-value	Result	Path coefficient (β)	t-value	p-value	Result
H1	JC \rightarrow JS (+)				Partial Adoption				Partial Adoption
	H1-1 ESC \rightarrow JS	0.170	3.000	0.003	Adoption	0.084	1.993	0.046	Adoption
	H1-2 MC \rightarrow JS	0.119	1.280	0.201	Rejection	0.081	1.855	0.064	Rejection
H2	JC \rightarrow JE (+)				Partial				Partial
	H2-1 ESC \rightarrow JE (fit)	-0.214	2.921	0.004	Rejection	0.042	0.906	0.365	Rejection
	H2-2 ESC \rightarrow JE (links)	0.093	1.473	0.141	Rejection	0.017	0.358	0.721	Rejection
	H2-3 ESC \rightarrow JE (sacrifice)	0.165	3.214	0.001	Adoption	-0.008	0.202	0.840	Rejection
	H2-4 MC \rightarrow JE (fit)	0.083	1.022	0.307	Rejection	0.122	2.380	0.017	Adoption
	H2-5 MC \rightarrow JE (links)	-0.008	0.122	0.903	Rejection	0.024	0.589	0.556	Rejection
	H2-6 MC \rightarrow JE (Sacrifice)	0.006	0.101	0.919	Rejection	0.075	2.134	0.033	Adoption
H3	JV \rightarrow JS (+)				Partial				Adoption
	H3-1 SR \rightarrow JS	0.489	5.020	0.000	Adoption	0.410	8.031	0.000	Adoption
	H3-2 OE \rightarrow JS	0.156	1.336	0.182	Rejection	0.376	7.673	0.000	Adoption
H4	JV \rightarrow JE (+)				Partial				Adoption
	H4-1 SR \rightarrow JE (fit)	0.735	7.166	0.000	Adoption	0.488	7.713	0.000	Adoption
	H4-2 SR \rightarrow JE (links)	0.546	6.002	0.000	Adoption	0.433	7.432	0.000	Adoption
	H4-3 SR \rightarrow JE (Sacrifice)	-0.008	0.077	0.939	Rejection	0.232	3.932	0.000	Adoption
	H4-4 OE \rightarrow JE (fit)	-0.023	0.203	0.839	Rejection	0.139	2.166	0.030	Adoption
	H4-5 OE \rightarrow JE (Links)	0.261	2.789	0.005	Adoption	0.385	7.275	0.000	Adoption
	H4-6 OE \rightarrow JE (Sacrifice)	0.742	8.453	0.000	Adoption	0.554	10.336	0.000	Adoption
H5	JS \rightarrow TI (-)	-0.393	2.391	0.017	Adoption	-0.367	3.836	0.000	Adoption
H6	JE \rightarrow TI (-)				Rejection				Rejection
	H6-1 JE (fit) \rightarrow TI	0.267	2.279	0.023	Rejection	0.048	0.589	0.556	Rejection
	H6-2 JE (links) \rightarrow TI	0.116	0.800	0.424	Rejection	0.132	1.349	0.178	Rejection
	H6-3 JE (Sacrifice) \rightarrow TI	-0.188	1.127	0.260	Rejection	-0.141	1.520	0.129	Rejection
H7	JA \rightarrow TI (-)				Rejection				Rejection
	H7-1 ESC \rightarrow TI	0.072	0.775	0.439	Rejection	0.039	0.686	0.493	Rejection
	H7-2 MC \rightarrow TI	-0.035	0.450	0.653	Rejection	-0.070	1.226	0.220	Rejection
H8	JV \rightarrow TI (-)				Rejection				Rejection
	H8-1 SR \rightarrow TI	0.182	0.998	0.318	Rejection	-0.121	1.245	0.213	Rejection
	H8-2 OE \rightarrow TI	0.081	0.531	0.595	Rejection	0.071	0.767	0.443	Rejection

<Table 5> Validation Results of Research Hypotheses (Cont.)

Hypothesis		Early Career Information Security				Early Career ICT				
		Path coefficient (β)	t-value	p-value	Result	Path coefficient (β)	t-value	p-value	Result	
H9	JS*PET → TI (-)	0.116	0.470	0.639	Rejection	-0.108	1.441	0.150	Rejection	
H10	JE*PET → TI (-)				Rejection				Partial	
	H10-1	JE (fit)*PET → TI	-0.199	1.220	0.223	Rejection	-0.033	0.439	0.660	Rejection
	H10-2	JE (links)*PET → TI	-0.027	0.154	0.877	Rejection	0.005	0.076	0.939	Rejection
	H10-3	JE (Sacrifice)*PET → TI	0.042	0.196	0.844	Rejection	0.214	2.813	0.005	Adoption

Note: 1. For “A → B (+)”, this is a shorthand way of saying that A has a positive effect on B.
 2. For ‘A*C → B’, a shorthand way of saying that the effect of A on B will be affected by C.
 3. Significance Level: *p < 0.05, **p < 0.01, ***p < 0.001
 Abbreviations.
 JC: Job Congruence, JS: Job Satisfaction, ESA: Education-Skill Congruence,
 MA: Major Congruence, JE: Job Embeddedness, JA: Job Value, SR: Self-Realization,
 OE: Organizational Environment, TI: Turnover Intention, PET: Perceived Ease of Turnover

Values on Job Satisfaction differs between the two groups. Self-Realization of information security has no significant effect on Embeddedness (sacrifice), and Organizational Environment has no significant impact on Embeddedness (fit). On the other hand, Self-Realization and the Organizational Environment of the ICT workforce considerably affect all aspects of Embeddedness.

The effect of Job Satisfaction on Turnover Intention is negative for both information security and ICT. Embeddedness (fit) affects positively information security's Turnover Intention, but ICT does not significantly impact it. Job Congruence and Job Value do not directly impact Turnover Intention of both groups, but Job Congruence and Job Value mainly affect Turnover Intention through the mediating of Job Satisfaction. Perceived Ease of Turnover significantly moderates the relationship between ICT's Embeddedness (sacrifice) and Turnover Intention.

V. Turnover Intent and Career Path Information

5.1. Research Subjects and Basic Statistics

As shown in the validation of the research model, Self-Realization is an important factor influencing turnover intentions of early career information security professionals. The constructs of self-actualization are satisfaction with autonomy and authority in the job, satisfaction with personal career development potential, and satisfaction with job-related education or training. Therefore, to manage the turnover intentions of early career professionals, organizations need to provide them with job appropriate training and respect their autonomy and authority in performing their jobs. In addition, to prevent self-actualization from mediating Embeddedness (fit) and leading to turnover intentions, organizations should provide them with the belief that they can grow and develop their careers in their current organizations. In this

regard, career path information from experienced employees in the same industry can positively impact early career self-actualization variables.

This paper examines and categorizes the career turnover process of information security professionals who developed their careers by performing information security tasks, focusing on job turnover timing. We concentrate on boundaryless career mobility, recognizing the limitations of existing career path studies that focus on turnover within a job or organization, and wanted to consider both directions within a position or organization and activity outside a job or organization (boundaryless career) in the career mobility of IT personnel (Savickas, 2005; Super, 1969).

We conducted in-depth interviews with 21 people from July 24, 2019, to August 16, 2019 (first round) and 19 people from October 15, 2019, to November 20, 2019 (second round). We collected 40 responses conducting team leaders and above, and 39 were analyzed, excluding one not qualifying for the study sample.

Most respondents are in their 40s and have more than ten years of overall work experience. Regarding information security work experience, 71.8% have 10+ years to less than 20 years, 17.9% have 20+ years, and 10.3% have 5-10 years. About 20% of the respondents have only information security experience, and most also have non-information security experience. The respondents' final education level is 43.5% master's, 35.9% bachelor's, and 15.4% doctorate. Most of the respondents earned their doctorate after they started working. The most common majors are computer and telecommunications (49%) and information security (15%). Most respondents learned about IT at university, while information security was studied at the masters and doctoral levels. In addition, most executive-level and above re-

spondents who perform information security management roles have earned a doctorate in information security. Fifty-one percent of respondents are employed in small and medium-sized enterprises, and 21% in medium-sized enterprises. Only 8% are in the public sector (government departments, universities, etc.), all of whom came to the public sector from the private sector, where they held senior or executive-level positions. Respondents' main reasons for leaving their jobs are self-development (35%) and dissatisfaction with salary and benefits (25%). Respondents hold certifications in information security and privacy management systems (ISO 27001, ISMS, PIMS, ISMS-P), as well as CISA, CISSP, and Engineer Information Processing. Respondents' reasons for entering the field of information security include company demand for security personnel, transfer to a dedicated security department, and job change.

5.2. Career Path of the Information Security Experts

Respondents' ultimate career goals for information security include CISO, Information Security Business Manager, and the CEO. Respondents' current jobs are shown in <Table 6>.

The career path of each respondent is shown in <Figure 2>. The number of job changes refers to the number of times the respondent moved from job A to job B. The number of job changes was divided into two categories: those who performed only job A and those who served both positions A and B simultaneously. For example, if an employee moves from information security management (M) to information security management (M) and information security incident response (R), one job change is considered to have occurred. The number

<Table 6> Job Classifications for Information Security Practitioners

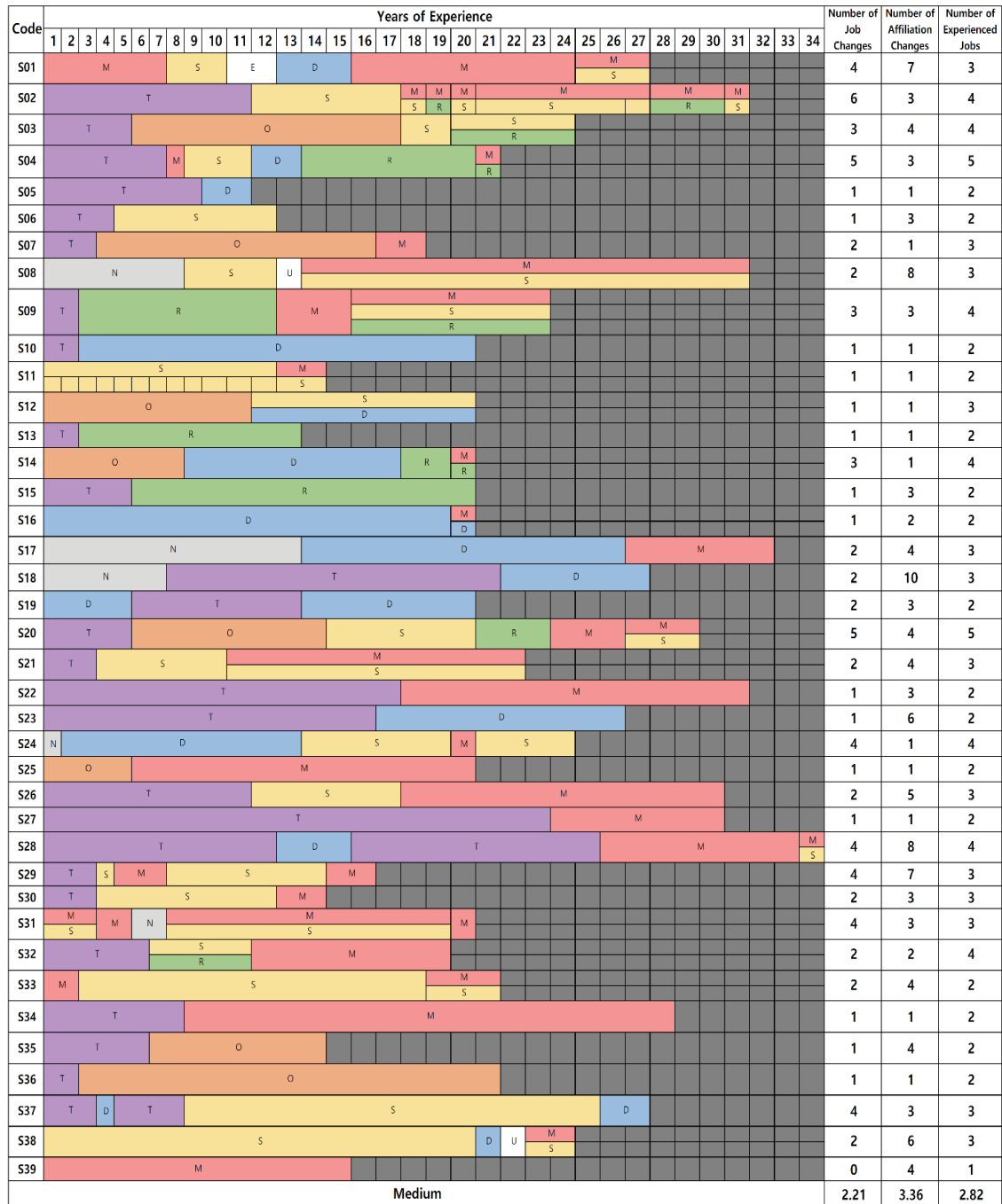
Role		Code	Definition
Information Security	Management	M	Policy and Strategic Planning, Project Management, Education, Privacy Protection, Internal Audit and Risk Management
	Operation	O	System Security, Network Security
	Analysis & Service	S	Security Consulting, Certification, Security Review
	Incident Response	R	Security Monitoring, Incident Detection, Forensic and Investigation, Malicious Code Analysis and Response
	Architect & Development	D	Security System Development, Sales and Security Continuity Services, Security Engineers, Computer and Information Systems Manager
ICT		I	[Managerial] Computer and Information Systems Manager
		T	[Technical] Programmer, SW/HW Engineer, Network/System Operation
Non-ICT		N	Non-ICT Job
Unemployment		U	Unemployed
		E	Enrolled in school

of jobs held is the number of all jobs held in the career path and is equal to the number of colors in the career path (except for white, which indicates unemployment). 61% of respondents started their careers in technical telecommunications roles, while 28% started in information security

All respondents have moved jobs an average of two times, with the highest turnover being six. They have also moved jobs an average of 3 times, with the highest turnover being ten. They have had an average of 3 positions, the most being 5. Respondents with 20 years of work experience or less had an average of two job changes, two affiliation moves, and two job experiences, while those with more than 20 years of experience had an average of three job changes, four affiliation moves, and three job experiences. 52% of respondents with less than 20 years of experience and 72% with more than 20 years of experience perform information security management duties alone or in combination. This indicates that more information security management competencies are required as the number of years of experience increases.

VI. Implications and Further Study

The implications of this paper are as follows. First, variables are utilized in turnover models in various fields, such as social, economic, and psychological, but job satisfaction is a common factor. This study focuses on job satisfaction and the factors that affect job satisfaction as one axis among various variables. Job satisfaction begins with the question of why people leave their jobs, and since the 2000s, the discussion of why people stay in organizations (job embeddedness) has gained attention. This study differs from previous studies in that it utilizes both the factors of turnover (job satisfaction) and retention (job commitment) to establish a model. In addition, it is characterized by separating job embeddedness into details (fit, links and sacrifice) and confirming that each of the three factors works differently. Second, for the practical application of the turnover intention model, it is necessary to distinguish the sample group in detail, considering the characteristics of the research subjects. When comparing the influencing factors of the turnover intention of early career in-



Note: S1 through S39 are unique numbers for respondent identification. The alphabet in each bar graph is the codename used in the job classification of the information security proficient respondents in <Table 6>

<Figure 2> Respondents' Career Paths and Career Mobility Characteristics

formation protection workers and early career information and communication workers, we found that the two groups influencing factors of the turnover intention are different. To apply the study's results on employee perceptions and behaviors to human resource management in the future, it is necessary to make a detailed distinction between employees and the work environment. Third, it should be recognized that information security personnel and information and communication personnel have different work contents and require expertise, knowledge, and skills. Both information security and ICT early career workers in this study are 55% computer and telecommunications majors. However, the degree to which they believe their major helps them in their work only affects the Embeddedness (fit) of early career ICT workers. While the majors and knowledge of those entering the information security and ICT workforce are similar, those in ICT are more likely to believe that their work fits their aptitudes and interests, while those in information security are not. This means that in practice, the content of the work and the knowledge and skills to do it well are different between information security and ICT workers. Therefore, early-career information security professionals need additional technical training before entering the workforce. Fourth, organizations should pay attention to and take advantage of the Self-Realization needs of early career information security workers. In particular, it is important to show them that they can continue to grow in their current organization as they gain experience and expertise. Self-Realization is the most significant positive influence on Job Satisfaction and Embeddedness (fit). On Turnover Intention, Job Satisfaction has a negative effect, and fit has a positive effect. In other words, Self-Realization can indirectly reduce turnover intention and increase it simultaneously.

To manage the turnover intentions of early-career information security professionals, it is important to continue to provide them with job-appropriate training and show them successful alternative career paths so that they believe they can grow and advance in their current organization.

It is common for information security analysts to enter with an IT background, but there are many different paths to entry. In addition, Generation Z and Millennials enter cybersecurity work through more diverse paths than previous generations. Unlike the Baby Boomer generation, only 38% start in IT and enter through self-study rather than formal education. This suggests that the younger generation highly perceives cybersecurity as a job with good opportunities. Still, that cybersecurity work is so broad, and the boundaries of work are subtle that it proves the need for continuous efforts to secure uniqueness that differentiates it from IT work.

The career ladder, where employees work their way up through the ranks of an organization, has long since collapsed, giving way to the gig worker, who provides short-term, contract-based labor to meet an employer's needs. Organizations have to change their workforce management paradigms. Workers are looking to find their core competencies and grow professionally in the face of job insecurity while also balancing their personal lives. What remains constant, however, is that both organizations and their workforce should retain existing talent than to hire new talent. For technical talent, the biggest driver of turnover is a perceived lack of learning and growth opportunities and a desire for Self-Realization. The career paths of those with years of experience in a single role provide a compass for early careerists to navigate their way to Self-Realization. The information security labor shortage involves both skill shortages and absolute

quantitative shortages. Managing the turnover intentions of early-career professionals entering the workforce to build a more skilled workforce and

maintain retention is an alternative to addressing both qualitative and quantitative shortages.

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