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A Study on the Job Career Patterns of Korean IT Personnel

Kyoungnam Lee*

■ Abstract ■

With the increasing severity of the shortage of highly-skilled IT personnel, more and more attention is being paid to the professional career path and systematic career management of IT employees. Although some studies have been conducted to describe the current status of IT personnel, limited attempts have been made to analyze the career paths or career patterns of IT professionals from a longitudinal perspective. In this context, this study explored the job career patterns of IT professionals in Korea and examined their relationship with subjective and objective career success. To identify job career patterns over time, detailed information about jobs and positions were used and an optimal matching analysis (OMA) was conducted to calculate the dissimilarity matrix between employees' career sequences, while a cluster analysis was used to categorize the meaningful groups based on this dissimilarity data. This analysis revealed that career patterns among Korean IT personnel are more varied than previously thought. These career types have a significant relationship with individual profiles, such as age, education, industry and company size, and account for significant variations in the three main career success variables, i.e. quality of life, assessment of software quality, and wage level. It is expected that the findings of this study will contribute to refining the Korean career path so as to retain IT personnel, and raise the need to improve the low quality of life and poor SW work environment of IT personnel.

Keyword : Career Patterns, IT Personnel, OMA Analysis, Job Mobility

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* Associate Fellow, Korea Information Society Development Institute, Dept. of ICT Strategy Research

1. Introduction

Looking at the recent global market capitalization of global companies, the top ten companies include seven leading information technology (IT) companies such as Google, Microsoft, Apple, Amazon, and Facebook (Thomson Reuters, 2017). This is a dramatic increase compared with ten years ago, when only three IT companies were included (Thomson Reuters, 2017). Thus many global companies are trying to recruit and retain brilliant IT professionals to enhance their competitiveness.

Korea has achieved remarkable economic growth based on the IT manufacturing industry, which encompasses mobile communications handsets, memory semiconductors and flat displays. Now, however, the center of gravity of the IT industry has shifted from manufacturing to the software development and information services sectors. In this situation, Korean IT companies are trying to attract skilled IT employees, but it is well known that it is difficult to retain IT talents due to diverse factors, such as the severe shortage of skilled personnel, high labor intensity, dissatisfaction with quality of life, and the frequent turnover of workers among others.

Given the high demand for skilled IT technicians, a considerable amount of research has been conducted on the career management of IT employees in developed countries (Igbaria and Siegel, 1993). Generally, many prior studies on IT personnel have focused on the dual tracks of technical and managerial tracks, while recent studies have concentrated more on identifying broader new career paths beyond these two unduly restrictive paths. Ginzberg and Baroudi (1988) showed that there might be more diverse career orientations than the dual path; while Crepeau et al. (1992) proved that information system technicians have additional career preferences beyond technical and managerial preferences, such as stability, service, and identity.

In Korea, some cross-sectional studies have been conducted on the poor working environment of the SW industry; however, limited attempts have been made to analyze the career paths or career patterns of IT personnel longitudinally. With the increasing seriousness of the shortage of highly-skilled IT personnel, ever more attention is being paid to professional career paths and the systematic career management of IT employees. For example, some practitioners and researchers have pointed out the absence of professional career tracks that are similar to the dual career track, and have suggested that Korean IT companies should introduce similar career systems in Korea (Choi et al., 2012). However, the uncritical adoption of the Western scheme without adequate verification might lead to confusion; in addition, the dual track concept has been criticized for its lack of practical applications.

The goals of this study, therefore, are to identify the various career patterns in the Korean IT industry with longitudinal data and to investigate the relationships between the individual profiles and the career success of IT personnel. By addressing these issues, this paper provides a deeper understanding of careers in the IT workforce compared to previous research.

The structure of this study is as follows : Section 2 reviews previous research to identify the career patterns of IT personnel and to ascertain factors identified as playing a significant role in career management; Section 3 outlines the measures and methods used in this study; Section 4 presents the results of the study; and Section 5 discusses the theoretical and practical implications of its findings, along with its limitations and suggestions for future research.

2. Theoretical Framework

2.1 Career Patterns of IT Personnel

The earlier approaches on the career paths for general organizations assumed that all workers hope to be promoted into managerial positions over time. So traditional career path programs rewarded employees with managerial positions regardless of their desire to do the job (Biemann, Zacher and Feldman, 2012).

On the other hand, the research of career showed that dual ladder career exist especially for engineers including SW engineers. In that, some SW workers prefer to pursue technical accomplishments and expertise, but not managerial roles and responsibilities (Chesebrough and Davis, 1983; Igbaria and Siegel, 1993, Igbaria et al., 1995; Joseph et al., 2012, Ramakrishna and Potosky, 2002). For example, Crepeau (1992) and Igbaria (1991) proved that the dominant career orientations for information systems employees were technical and managerial. Since these researches, many companies have introduced the dual ladder system to give IT technicians the opportunity to continuously use technical skills without interference with managerial and communicational roles.

However, recent studies have pointed that dual career is too restrictive for IT personnel considering IT specific situations such as project-based or outsourcing-based jobs (Arthur, 1994; Igbaria et al., 1999; Briscoe and Hall, 2006; Gerber et al., 2009; Tremblay et al., 2002). For example, Igbaria and Siegel (1995) suggested that IT personnel cannot be classified as either managerial or technical in their career aspirations and the dual ladder cannot provide a complete model for the career needs of IT personnel.

Adding to the above stream of research, there has been criticism that previous studies on careers have been too focused on the psychological and cognitive aspects (Ang and Slaughter, 2000; Joseph et al., 2012). So research on the physical and actual career mobility in individuals' work histories should be tried in further studies. Recently, with the development of methods for analysis of work history data such as OMA, a few relevant studies have investigated (Joseph et al., 2012; Kovalenko and Mortelmans, 2014).

Based on these previous reviews, this research tried to category the career path of the Korean IT personnel with the longitudinal job histories and to check the dual or diverse career patterns.

2.2 Individual Profiles

Previous research has shown that the individual attributes of gender, level of education, and majors strongly influence individuals' career decisions and opportunities in the workforce (Feldman and Ng, 2007; Joseph et al., 2007; Joseph et al., 2012).

As the proportion of females in the IT field is very low, many researchers have tried to identify the factors that hinder female careers, such as heavy workloads and long hours, or the existence of a glass ceiling for the promotion of women (Truman and Baroudi, 1994; Griffiths and Moore, 2010). Especially, females tend to remain in the early career stage because they leave the workforce for family and other reasons.

The level of education is an important factor in IT career paths in that IT professionals are usually portrayed as having, at the very least, a bachelor's degree (Ang and Slaughter, 2004). Furthermore, engineers who follow the managerial career track usually pursue an MBA, in contrast to engineers favoring the technical track, who usually pursue graduate or doctoral studies (Tremblay et al., 2002).

The majors of IT personnel are broad and heterogeneous because IT jobs are very diverse, ranging from software engineering and system administration to consultancy, and because the main employers are widely distributed across almost every industry; hence, with the high demand for IT skills, knowledge about a specific industry is required. In particular, a relatively high proportion of IT project leaders and managers tend to have a business management major, whereas a relatively high proportion of IT system analysts tend to have an IT-related major (Lee, 2012). In addition, research by Joseph et al. (2012) indicated that personnel without a major in an IT discipline have more diverse but shorter IT career tracks, unlike employees majoring in IT related disciplines, who typically have longer IT careers.

Many studies have shown that as engineers get older, the probability of their holding a managerial position rises (Biddle and Roberts, 1994). In the IT industry, it is well known that the average career length of IT personnel is shorter than that of engineers (Lee, 2012; Lee, 2014; Joseph et al., 2012).

2.3 Career Success

Career success can be defined as "the accomplishment of desirable work-related outcomes over time" (Arthur et al., 2005; Verbruggen, 2012). Career scholars agree that career success has both an objective and a subjective side (Feldman and Bolino, 1996; Kovalenko and Mortelmans, 2014; Verbruggen, 2012). Objective career success is usually measured by wage levels, which are tangible and can be observed by others. Subjective career success, however, refers to each individual's own perceptions of their career based on subjectively chosen standards (Verbruggen, 2012; Kovalenko and Mortelmans, 2014). This is usually measured by job satisfaction, career satisfaction, and quality of work.

Generally, managerial career paths are more highly compensated than technical tracks because managers are perceived to play an important role in improving organizational performance (Joseph et al., 2012). In the IT industry, however, the roles of SW developers and engineers can be equally or even more salient and have a decisive impact on organizational performance, so the wages of SW architects may be higher. For example, the average wages of SW architects are higher than those of general managers in the US.

In addition to this, the assessment of job quality and quality of life could be important variables for IT personnel, in that it is widely known that the dissatisfaction of IT engineers is very high and the quality of life is very low in Korea (Lee, 2012).

Given the theoretical framework described here, the current research questions can be framed as follows :

1) What are the patterns of job changes during the course of IT careers in Korea? Are there any diverse career paths?

2) Is there a relationship between career patterns and individual profiles, such as gender, age, and education?

3) Is there a relationship between career pattern and career success, such as wage and quality of life?

3. Methodology

For the purpose of this study, quantitative research based on the retrospective job history data of 323 IT personnel was conducted, and several distinct career types were constructed through optimal matching analysis (OMA) and cluster analysis. Up until now, studies on IT personnel careers typically examined the most recent movement and a single point at current information with regression analysis (Lee, 2012; Choi et al., 2012), which has a limitation in that it cannot address much of the information across individual work histories or examine the patterns of job change (Joseph et al., 2012; Vinkenburg and Weber, 2012).

In contrast, this study applied the sequence analysis approaches of Abbott and Hrycak (1990), Blair-Loy (1999) and Joseph et al. (2012) in order to identify the job career paths of IT personnel. This approach consisted of two steps, i.e. an optimal matching analysis of job career sequences, followed by a cluster analysis, with the aim of categorizing meaningful groups based on dissimilarity data (Halpin, 2010).

〈Table 1〉 Respondents Profile

Variables		Sample	Percent
Total		323	100
Gender	Male	285	88.2
	Female	38	11.8
Education	College	23	7.1
	Bachelor	212	65.6
	Graduate	88	27.2
Major	IT related	130	46.9
	Others	147	53.0
Industry	IT Service	213	65.9
	Package/ Embedded SW	110	34.1
Type	Large	98	30.3
	Small/ Freelancer	225	65.7

Characteristic	Mean	Std. Dev	Min	Max
Age	38.6	4.684	26	50
Career	11.2	4.296	5	20
Turnover	2.2	1.821	0	8
Job satisfaction	3.64	0.773	1	5
Job ability	3.86	0.619	1	5
Quality of life	2.36	0.913	1	5
SW Quality assessment	3.41	0.731	1	5
Wage	4.05	0.878	1	7

3.1 Subjects

An online questionnaire was developed and distributed to software development portals where many software professionals actively seek information about software skills and seminars.[1] In total, 502 software professionals completed the survey; these respondents included programmers, system management engineers, consultants, technical support engineers, and project managers.

1) This survey was conducted by the Korea Information Society Development Institute and was published under the title, A Research on ICT Job Market and Job Creation Policy (KISDI, 2013).

Because the main focus of this study was long-term job career patterns, a sub-sample of the survey used for this analyses. Considering the distribution of the responses, only those individuals who had at least five but less than twenty-one years of IT job experience were included. Respondents with less than a high school degree were excluded because they provided no information about a major, which is an important variable in this study. Therefore, the resulting sample consisted of 323 IT workers (in <Table 1>), with a mean age of 38.6 years (SD = 4.7) and a mean career tenure of 11.2 years (SD = 4.3). These data were right-censored because the respondents have not yet reached the end of their career, but they nonetheless account for a significant portion of their careers from the start to at least 6 years or at most 20 years.

3.2 Methods

This survey retrospectively investigated the job history of the respondents since graduation from college or university, from their first job to their current job. To identify job career patterns over time, a combination of jobs and positions was used. Jobs were coded into 7 categories : C (Coding/Designer), A (Architect), Q (Testing/Quality Management), P (Project Leader/Manager), S (Consultant), M (System Administrator/Technical Support), and T (Sales Engineer), while positions were coded as follows : a (staff member), b (assistant manager), c (manager), d (deputy general manager/general manager), e (director), and f (president). For the analyses, the careers held by respondents were recoded into one of the 42 (7×6) categories presented in <Table 2>.

For example, consider the following career sequence for a respondent : Ca Ca Ca Ca Ca Cb Cb Cb Pc Pc Pc Pc Pc. This sequence shows that the respondent spent eight years in a Coding/Designer job (C), of which five years were spent as a staffer (a) and three years as an assistant manager (b), followed by five years as a Project Manager (P) in a manager's position (c).

Next, an optimal matching analysis (OMA) was conducted to calculate the dissimilarity matrix between employees' career sequences. OMA measures the similarity or dissimilarity between employees' career sequences by calculating the costs of switching from one sequence to another sequence (Joseph et al., 2012; Stovel and Bolan, 2004). By allocating costs to substitutions, insertions, and deletions,[2] pairs of sequences can be compared, and the sequences that "cost" the least in terms of switching to another are considered the most similar (Abbott and Forrest, 1986; Joseph et al., 2012). This was followed by a cluster analysis in which Ward's Linkage method was applied to the matrix computed from the OMA in order to find meaningful groups whose career sequences are very similar to each other (Halpin, 2010). Finally, a Chi-square and an ANOVA test were conducted to examine the relationships between career typology and individual characteristics or career success.

2) For example, sequence A (1 1 2 3 4 5 6) can be transformed into sequence B (2 1 2 3 4 6 7) by substituting 2 for 1 at the beginning, and by deleting 5 and inserting 7 at the end. As the frequency of these transitions increases, the distance between the sequences and the (indel) cost increases.

〈Table 2〉 Exemplars of Career Sequences of individuals

Group	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Developer I	Ca	Ca	Ca	Ca	Cb	Cb	Cb	Cb												
	Ca	Ca	Cb	Cb	Cb	Cb	Cb	Cb												
Developer II	Ca	Ca	Ca	Cb	Cb	Cc	Cc	Cc	Cc	Cc										
	Ca	Ca	Ca	Cb	Cb	Cb	Cb	Cc	Cc	Cc										
Developer III	Ca	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cd							
	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cd	Cd							
	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Cc	Pd	Pd	Pd	Pd	Pd	Pe					
Developer IV	Ca	Ca	Ca	Cb	Cb	Cb	Cb	Cb	Cd	Cd	Cd	Cd	Cd	Cd	Cd					
	Ca	Ca	Cb	Cb	Cb	Cc	Cc	Cc	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd	Cd			
Project manager I	Ca	Ca	Ca	Ca	Ca	Cb	Cb	Cb	Pc	Pc	Pc	Pc	Pc							
	Pb	Pb	Pb	Pb	Pc	Pc	Pc	Pc	Pc	Pc	Pd	Pd	Pd							
Project manager II	Ca	Ca	Ca	Cb	Cb	Cc	Cc	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd				
	Ca	Ca	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd	Pd					
System Administrator	Ma	Ma	Ma	Mb	Mb	Mb	Mb	Mc	Mc	Mc	Mc	Mc	Mc							
	Ca	Cb	Cb	Cb	Mc	Mc	Mc	Mc	Mc	Mc	Mc	Mc	Md	Md						
Others																				
Testing/Quality management	Qa	Qb	Qb	Qc	Qc	Qc	Qc	Qc	Qc	Qc	Qc	Qc	Qc							
Consultant	Sa	Sa	Sa	Sc	Sc	Sc	Sc	Sd	Sd	Sd	Sd	Sd	Sd	Sd	Sd	Sd	Sd	Sd	Sd	
Technical support	Ta	Ta	Ta	Tc	Tc	Tc	Tc	Tc	Tc	Tc	Tc									
Frequent movement	Pb	Pb	Pb	Ac	Ac	Mc	Mc	Cb	Cb	Cb										

Note : C(Coding/Designer), A(Architect), Q(Testing/Quality management), P(Project leader/manager), S(Consultant), M(System administrator/Technical support), T(Sales engineer)//a(staff member), b(assistant manager), c(manager), d(deputy General manager/general manager), e(director), f(president).

3.3 Measures

3.3.1 Individual Characteristics

Age was calculated from date of birth. Gender was coded as male (0) or female (1). Education consisted of three levels of degree attainment, i.e. college (1), university (2), and postgraduate (3), which was the final education degree at the time of responding to the questionnaire. Major concerned the major held by the respondents at the time of their first job, and was coded as (1) if a person's major was coded as computer engineering, application software engineering, and information and technology engineering, and as (0) for all other majors.

3.3.2 Career Success

The career success variables consisted of an assessment of subjective aspects, such as job satisfaction, ability satisfaction, work intensity, quality of life (QoL), and objective wage level. Subjective career success was measured using the 5-point Likert scale item (Greenhaus et al., 1990), which has been widely used to measure satisfaction in the career literature. The response options ranged from (1) "strongly disagree" to (5) "strongly agree." The objective level of wage consisted of seven tiers, i.e. (1) below 1 million won (US$ 895) per month; (2) 1~2 million won (US$ 895~1,793) per month; (3) 2~3 million won (US$ 1,793~2,685) per month; (4)

3~4 million won (US$ 2,685~3,580) per month; (5) 4~5 million won (US$ 3,580~4,475) per month; (6) 5~10 million won (US$ 4,475~8,950) per month; and (7) 10 million won (US$ 8,950) or above per month.

4. Results

4.1 Career Patterns

Using optimal matching analysis and cluster analysis, eight IT job career patterns were identified, as shown in <Table 3>, and classified into four categories.

The first career category was Developers (Developer I, Developer Ⅱ, Developer Ⅲ, and Developer Ⅳ), who spent the majority of their careers working on software coding and design. However, there were differences in career tenure among these groups (Developer I = 6.36 years; Developer Ⅱ = 9.47 years; Developer Ⅲ = 10.04 years; and Developer Ⅳ = 14.37 years).

The second career category was Project Managers (PM I and PM Ⅱ), who spent the majority of their careers as project leaders and managers (PM I = 9.29 years, PM Ⅱ = 11.30 years). The PM I group was characterized by respondents who moved on to project management after a relatively short tenure as a developer.

The third career category was System Administrators (SA), who spent most of their careers as system administrators (9.85 years), while the fourth and final group consisted of employees in other jobs, such as sales engineers, testing and quality management, and consultants, or employees with no apparent career pattern.

〈Table 3〉 Mean Career Mobility Within and Across Career Paths

Jobs \ Group	Dev I	Dev Ⅱ	Dev Ⅲ	Dev Ⅳ	SA	PM I	PM Ⅱ	Others	Total	F-values
Coding/Designer	6.36 (2.57)	9.47 (3.05)	10.04 (2.14)	14.37 (3.67)	1.28 (2.06)	2.13 (3.01)	4.00 (2.27)	0.63 (1.16)	5.78 (5.19)	144.7^{***}
Architect	0.93 (2.61)	0.11 (0.51)	0.00 (0.00)	0.00 (0.00)	0.28 (0.91)	0.26 (1.44)	0.30 (0.92)	0.71 (2.52)	0.40 (1.71)	1.92^{*}
Testing/ Quality management	0.00 (0.00)	0.04 (0.19)	0.00 (0.00)	0.20 (1.18)	0.10 (0.44)	0.00 (0.00)	0.05 (0.22)	1.14 (2.98)	0.25 (1.40)	4.53^{***}
Project leader/ project manager	0.16 (0.61)	0.09 (0.49)	1.54 (2.89)	0.14 (0.55)	0.20 (0.91)	9.29 (3.74)	11.30 (2.87)	2.85 (3.87)	2.31 (4.23)	106^{***}
Consultant	0.21 (1.10)	0.00 (0.00)	0.46 (0.98)	0.09 (0.51)	0.20 (1.26)	0.19 (1.08)	0.00 (0.00)	1.53 (3.65)	0.41 (1.82)	4.4^{***}
System administrator/ Technical support	0.16 (0.52)	0.06 (0.30)	0.33 (0.92)	0.26 (0.95)	9.85 (4.59)	0.19 (0.79)	0.20 (0.62)	1.20 (2.68)	1.56 (3.75)	107.14^{***}
sales engineer	0.00 (0.00)	0.09 (0.69)	0.42 (1.44)	0.00 (0.00)	0.00 (0.00)	0.19 (0.75)	0.00 (0.00)	2.08 (4.35)	0.45 (2.07)	7.5^{***}
Career Tenure	7.84 (3.79)	9.91 (3.04)	12.79 (3.35)	14.97 (3.24)	11.88 (3.94)	12.26 (2.91)	15.85 (2.48)	10.15 (4.40)	11.16 (4.30)	20.94^{***}
Cluster size	61 <18.9>	53 <16.4>	24 <7.4>	35 <10.8>	40 <12.4>	31 <9.6>	20 <6.2>	59 <18.3>	323 <100.0>	

Note : < > = %; ( ) = standard deviation; $^{***}< 0.001$, $^{**}< 0.05$, $^{*}< 0.01$; Dev = developer, SA = System Administrator, PM = Project Manager.

4.2 Career Patterns and Individual Profiles

<Table 4> presents the profiles of individuals in each career path along with the results of the ANOVA and Chi-square tests.

Overall, significant differences were observed for age and education. The average age of the Developer Ⅳ, PM Ⅰ and PM Ⅱ groups was significantly higher than that of the other groups ($F = 10.8$, $p < .001$). Here, this shows that individuals who were significantly older were more likely to follow the project manager career pattern.

In addition, there was a significant relationship between education and career pattern ($\chi^2 = 23.82$, $p < 0.05$). The Developer Ⅲ and Project Manager groups, with 13 years of experience on average, were found to be more likely to have a graduate degree than the other groups.

Meanwhile, gender and major, against all expectations, showed no relationship with the career patterns of IT personnel. In the case of gender, this result could be attributable to the

〈Table 4〉 Individual Profiles of Each Career Path

Individual characteristics		Dev Ⅰ	Dev Ⅱ	Dev Ⅲ	Dev Ⅳ	SA	PM Ⅰ	PM Ⅱ	Others	Total	F/χ^2
Cluster size		61	53	24	35	40	31	20	59	323	
Age (average)		35.8 <4.8>	37.4 <3.8>	39.8 <3.4>	41.9 <3.6>	39.2 <4.9>	40.5 <3.6>	41.9 <3.3>	37.8 <4.7>	38.6 <4.7>	10.80^{***}
Career (average)		7.8 <3.8>	9.9 <3.0>	12.8 <3.4>	15.0 <3.2>	11.9 <3.9>	12.3 <2.9>	15.9 <2.5>	10.2 <4.4>	11.2 <4.3>	20.94^{***}
turnover (average)		1.6 <1.6>	2.3 <2.1>	2.6 <1.6>	2.8 <1.9>	1.8 <1.7>	2.9 <1.7>	1.9 <1.4>	2.1 <1.8>	2.2 <1.8>	2.98^{***}
Gender	Male	52 (85.3)	43 (81.1)	23 (95.8)	33 (94.3)	38 (95.0)	28 (90.3)	19 (95.0)	49 (83.1)	285 (88.2)	9.97 (df = 7)
	Female	9 (14.8)	10 (18.9)	1 (4.2)	2 (5.7)	2 (5.0)	3 (9.7)	1 (5.0)	10 (17.0)	38 (11.8)	
Education	College	3 (4.9)	4 (7.6)	4 (16.7)	2 (5.7)	4 (10.0)	2 (6.5)	1 (5.0)	3 (5.1)	23 (7.1)	23.82^{**} (df = 14)
	Bachelor's	48 (78.7)	34 (64.2)	9 (37.5)	23 (65.7)	29 (72.5)	14 (45.2)	14 (70.0)	41 (69.5)	212 (65.6)	
	Graduate	10 (16.4)	15 (28.3)	11 (45.8)	10 (28.6)	7 (17.5)	15 (48.4)	5 (25.0)	15 (25.4)	88 (27.2)	
Major	IT-related	28 (56.0)	24 (54.6)	10 (45.5)	15 (44.1)	18 (52.9)	10 (37.0)	5 (27.8)	20 (41.7)	130 (46.9)	7.54 (df = 7)
	Others	22 (44.0)	20 (45.5)	12 (54.6)	19 (55.9)	16 (47.1)	17 (63.0)	13 (72.2)	28 (58.3)	147 (53.1)	
Industry	IT Service	43 (70.5)	31 (58.5)	17 (70.8)	14 (40.0)	28 (70.0)	20 (64.5)	13 (65.0)	47 (79.7)	213 (65.9)	17.89^{**} (df = 7)
	Package Embedded SW	18 (29.5)	22 (41.5)	7 (29.2)	21 (60.0)	12 (30.0)	11 (35.5)	7 (35.0)	12 (20.3)	110 (34.1)	
Type	Large	20 (32.8)	10 (18.9)	6 (25.0)	6 (17.1)	14 (35.0)	9 (29.0)	7 (35.0)	26 (44.1)	98 (30.3)	12.58^{*} (df = 7)
	Small Freelancer	41 (67.2)	43 (81.1)	18 (75.0)	29 (82.9)	26 (65.0)	22 (71.0)	13 (65.0)	33 (55.9)	225 (69.7)	

Note : ( ) = %; < > = standard deviation; $^{***}p < 0.001$; $^{**}p < 0.05$; $^{*}p < 0.01$; Dev = developer, SA = System Administrator.

low number of female IT workers in the labor market, and to the fact that the sample was too small to test the relationship. In fact, the IT workers in our sample were predominantly male (88.2%). Though there was no significant difference, female IT employees were more often employed in the early stage, such as the Developer I, Developer Ⅱ and PM I groups. Major also showed no significant relationship with career patterns, although the Developer I, Developer Ⅱ and System Administrator groups had slightly more majors in IT-related disciplines.

4.3 Career Patterns and Career Success

<Table 5> shows the relationship between career patterns and career success, such as satisfaction, quality of life (QoL), software quality assessment, and wage. Overall, significant differences were observed for QoL, software quality assessment, and wage ($F = 2.0$, $p < 0.01$; $F = 3.58$, $p < 0.001$; $F = 9.27$, $p < 0.001$, respectively).

The average perception of quality of life was very low in all groups; more specifically, the average among the Developer I group was lower than that of the other Developer groups. Similarly, the average assessment of SW quality by the Developer I group was significantly lower than that of the Developer Ⅲ group. Objective wage was significantly higher in the Developer Ⅳ (mean = 4.57, SD = 0.74) and PM Ⅱ (mean = 4.95, SD = 0.83) groups than the other groups. However, job satisfaction-against expectations-showed no relationship with the career patterns of IT personnel.

5. Discussion

As mentioned earlier, the research objective of this study is to identify the typology of career movement across IT jobs and to examine the relationships with the individual profiles or career success of IT employees. Based on the results thus derived, this section concentrates on the following points :

First, this analysis reveals that the career patterns of Korean IT personnel were more varied than previously thought. It also proved that an unexpectedly large proportion of the technical professional group have more than ten years of experience (Developer Ⅲ, Developer Ⅳ). In other

〈Table 5〉 Career success across careers (ANOVA)

Group / Jobs	Dev I	Dev Ⅱ	Dev Ⅲ	Dev Ⅳ	SA	PM I	PM Ⅱ	Others	Total	F-values
Job satisfaction	3.46 <0.81>	3.64 <0.62>	3.67 <0.76>	3.60 <0.65>	3.60 <0.81>	3.61 <0.84>	4.00 <0.79>	3.75 <0.84>	3.64 <0.77>	1.3
Job ability	3.79 <0.66>	3.87 <0.62>	3.71 <0.69>	3.83 <0.45>	3.90 <0.67>	3.97 <0.48>	4.05 <0.60>	3.85 <0.66>	3.86 <0.62>	0.77
Quality of life	2.18 <0.90>	2.43 <1.03>	2.88 <0.85>	2.31 <0.83>	2.28 <0.85>	2.45 <0.93>	2.05 <0.51>	2.42 <0.97>	2.36 <0.91>	2.00^{*}
SW Quality assessment	3.15 <0.75>	3.49 <0.61>	3.83 <0.82>	3.34 <0.76>	3.25 <0.67>	3.52 <0.51>	3.75 <0.55>	3.42 <0.83>	3.41 <0.73>	3.58^{***}
Wage	3.52 <0.92>	3.83 <0.80>	4.17 <1.05>	4.57 <0.74>	4.18 <0.90>	4.45 <0.72>	4.95 <0.83>	3.81 <1.14>	4.05 <0.99>	9.27^{***}

Note : < > = standard deviation; $^{***}< 0.001$, $^{**}< 0.05$, $^{*}< 0.01$; Dev = developer, SA = System Administrator.

words, contrary to the idea that SW developers who have not moved on to become managers generally exit their IT careers early, this study revealed that there is a distinctive technical IT career track for them.

In addition to this, it appears that in Korea there is a career type in which an employee becomes a project manager at an unusually early stage of their career (PM I). One explanation for this is that the structure of the software industry consists of small and subcontracted companies who foster developers to perform the tasks of managers without sufficient development experience. Another track in the IT career path concerned the system administrator (SA) groups, who are characterized by relatively low mobility between different jobs. This group may become entrenched in their earliest jobs because of their stable status within a relatively large company.

Second, this study also shows that there were significant relationships between career patterns and individual profiles. The group consisting of professional IT developers with more than fifteen years of experience had a relatively high percentage of IT personnel working either in a small company or as freelancers, in the package and embedded SW industry. This group also included a high percentage of IT personnel who did not major in an IT-related program. Otherwise, the group consisting of project managers with more than fifteen years of experience had a relatively high proportion of IT employees in larger companies.

The level of education was also significantly related to an individual's career pattern. Especially, the project manager group with comparatively short-term development experience (PM I) and the developer groups with 13 years of experience on average (Dev Ⅲ) had a relatively high proportion of IT personnel with a graduate degree. Half of these groups received a graduate degree after employment. This result is consistent with the findings of previous research in that engineers who want to remain in technical positions tend to obtain graduate degrees in major fields, whereas those who opt for the managerial career track usually pursue an MBA (Tremblay et al., 2002). Otherwise, the percentage of graduate degrees in the Developer Ⅳ and PM Ⅱ groups was no higher. One possible explanation for the low rates of graduate degrees is that these groups have little incentive to pursue a graduate degree because they might think their age and career tenure exceed the appropriate age.

The relationship between gender and career pattern was not proved in this study due to the small size of the female sample. Nevertheless, the fact that the proportion of female IT workers was observed to be relatively low in the late career stage of developers and project managers suggests that they may have run up against certain invisible barriers in the course of their careers.

Third, a significant relationship between career pattern and career success was observed. The wage variable representing objective success had a differential relationship with career pattern, showing managers' wage (PM I mean = 4.45, PM Ⅱ mean = 4.95) to be higher than that of the other groups (total mean = 4.05). Generally, managers are thought to play a key role in improving company performance, so organizations tend to pay managers more than technical personnel (Joseph et al., 2012). In the

IT industry, however, the roles of developer and technician may be more important, so the wages of SW professionals such as SW architects might be higher than those of general managers. For example, the average wage of SW architects is higher than that of managers working in the IT industry in the US (Lee, 2012). According to the results of this study, the wage of SW engineers was slightly lower than that of managers with a similar number of years of experience. This finding could be interpreted to mean that in Korea SW engineers with considerable work experience are not better treated than managers, unlike the US. For a more rigorous analysis, it will be necessary to compare wages after controlling for other variables such as age, education, and company size.

In Korea, the QoL variable representing subjective success was very low across all groups. This reflects the very poor working conditions of IT employees, a fact that has been constantly singled out as one of the most significant and pressing problems to solve (Lee, 2012; Choi et al., 2012). Notably, the QoL of developers in the early career stage was lower than that of developers in the late career stage.

6. Implications

6.1 Implications

This study adds to the existing research in several ways. First, there has been only a limited amount of empirical research on career patterns in Korean IT situations to date. Thus the typology of careers identified in this study deepens our understanding of the diversity of career paths available to the IT workforce. Methodologically speaking, the Optimal Matching Analysis (OMA) applied in this study was a relatively new method of analyzing the career patterns of Korean IT personnel. Hence, this methodology could be useful for wider research using longitudinal data.

Second, this research also enhances our knowledge of the relationship between distinct career patterns, individual profiles and career success. This study suggests that there are distinct professional IT developer groups, PM groups with short development experience, and SA groups with little job mobility. IT companies have attempted to find ways to retain competent IT personnel by offering uniform career management for developers. Consideration of these diverse career patterns and individual profiles may be helpful in designing a more practical approach to career management (Igbaria and Siegel, 1993; Igbaria et al., 1995; Joseph et al., 2012).

Third, the evaluation of quality of life (QoL) of Korean IT workers was very low across all groups, and significantly so in the early stage of developers and project managers with 13 years of experience on average. This suggests that both the poor working environment and the structure of the SW industry need to be improved in the long run.

6.2 limitations and Future Research

Some limitations of the present study should be noted. First, the career data are based on a retrospective survey, and thus might have been subject to recall bias among the respondents. In this study, however, two questions about information on the current job were asked, and the results were double-checked to minimize the number of incorrect responses.

Another limitation concerns the use of variables (job satisfaction, quality of life, software quality assessment) measured by a single indicator. This approach may have affected reliability because the respondents were not likely to respond to such questions consistently. Thus, a more valid and reliable measure of these variables might be applied with a multi-item instrument.

Third, generalization of the results is limited by the fact that this analysis was restricted to Korean data, although this allowed a more detailed focus across longitudinal career patterns within the specific context of IT development.

Fourth, the sample size is insufficiently large to estimate the partial effects of the types of patterns on career success.

Therefore, in terms of future research, this paper suggests that longitudinal studies with panel data are needed to clearly verify the career patterns and their relationships with individual profiles and career success variables.

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◈ About the Authors ◈

Kyoungnam Lee (klee@kisdi.re.kr)

Kyoungnam Lee is currently an Associate Fellow of the Korea Information Society Development Institute (KISDI). She is a Ph.D. Candidate in the Science & Technology Studies (STS) at Korea University. Her current research interests include IT service, innovative business models, intelligent information & knowledge management, employment and etc.