

THE CAREER PATHS LESS (OR MORE) TRAVELED: A SEQUENCE ANALYSIS OF IT CAREER HISTORIES, MOBILITY PATTERNS, AND CAREER SUCCESS¹

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This paper examines the objective career histories, mobility patterns, and career success of 500 individuals, drawn from the National Longitudinal Survey of Youth (NLSY79), who had worked in the information technology workforce. Sequence analysis of career histories shows that careers of the IT workforce are more diverse than the traditional view of a dual IT career path (technical versus managerial). This study reveals a new career typology comprising three broad, distinct paths: IT careers; professional labor market (PLM) careers; and secondary labor market (SLM) careers. Of the 500 individuals in the IT workforce, 173 individuals pursued IT careers while the remaining 327 individuals left IT for other high-status non-IT professional jobs in PLM or lower-status, non-IT jobs in SLM careers. Findings of this study contribute to refining the concept of “boundaryless” careers. By tracing the diverse trajectories of career mobility, we enrich our understanding of how individuals construct boundaryless careers that span not only organizational but also occupational boundaries. Career success did not differ in terms of average pay for individuals in IT and PLM careers. By contrast, individuals in SLM careers attained the lowest pay. We conclude this study with implications for future research and for the management of IT professionals’ careers.

Keywords: Management of IT human resources; longitudinal, careers, sequence analysis, IT profession boundaryless, mobility

*Two roads diverged in a wood, and I—
I took the one less traveled by,
And that has made all the difference
Robert Frost (1916, The Road Not Taken)*

Traditionally, researchers have portrayed IT careers as composed of two distinct paths: a technical IT career or a managerial IT career (e.g. Chesebrough and Davis 1983; Kaiser 1983; Zabusky and Barley 1996). Individuals in technical IT careers are characterized as holding deep commitment to the technical orientation of the IT profession (Ginzberg and Baroudi 1988) and choosing to remain in technical IT jobs for the duration of their careers (Kaiser 1983). Such technical IT professionals work in multiple organizations over the course of their technical IT careers (Kaiser 1983). Technical IT professionals typically measure career success in terms of

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accumulated technical accomplishments, expertise, and the reputation for skill (Ginzberg and Baroudi 1988; Zabusky and Barley 1996).

Individuals in managerial IT careers, on the other hand, are characterized as holding to a managerial orientation (Ginzberg and Baroudi 1988), moving from technical IT jobs to managerial IT jobs, usually within an organization. Managerial IT professionals typically measure career success in terms of promotions attained within an organization (Zabusky and Barley 1996). The assumption underlying both IT careers (technical IT and managerial IT) is that individuals in these careers will continue to remain within the IT profession for the duration of their careers (Karahanna and Watson 2006).

In a closer reading of the IT careers literature, Ginzberg and Baroudi (1988) noted that the empirical evidence indicates that individuals' careers in the IT workforce are comprised of multiple organizations and occupations. This description of careers as comprising multiple organizations and occupations is consistent with the concept of a "boundaryless" career (Greenhaus et al. 2008). A boundaryless career is composed of a sequence of jobs that go beyond the boundaries of a single employment setting (DeFillippi and Arthur 1996, p. 116). The boundaryless career is often contrasted with the traditional career of an "organization man" that unfolds within a single firm (Whyte 1956). This traditional career is typified by individuals climbing a career ladder comprising of jobs with increasing responsibility and status within an organization (Hall 1976; Rosenbaum 1979).

Following Ginzberg and Baroudi's (1988) review of IT careers and reconceptualization of careers as boundaryless (DeFillippi and Arthur 1996), we propose that traditional portrayals of IT careers as having only two homogenous career paths are unduly restrictive. IT careers have been buffeted by drastic changes in the demand and supply of IT labor since the 1970s (Ang and Slaughter 2000). In the 21st century, rapid technological advancements coupled with market pressures arising from globalization have forced organizations to become leaner and less able to offer job security and life-long employment (Ang and Slaughter 2000; Slaughter and Ang 1996). In fact, research (e.g., Ituma and Simpson 2009) has begun to notice that contemporary IT careers are indeed boundaryless in nature—with IT professionals moving across organizations, not bound to a single employer (Josefek and Kauffman 2003; O'Mahony and Bechky 2006), or moving across occupations, not bound to the IT profession (Reich and Kaarst-Brown 1999, 2003).

The goals of this study, therefore, are to (1) identify and describe the contemporary careers of individuals in the IT workforce, (2) examine their mobility across occupations and

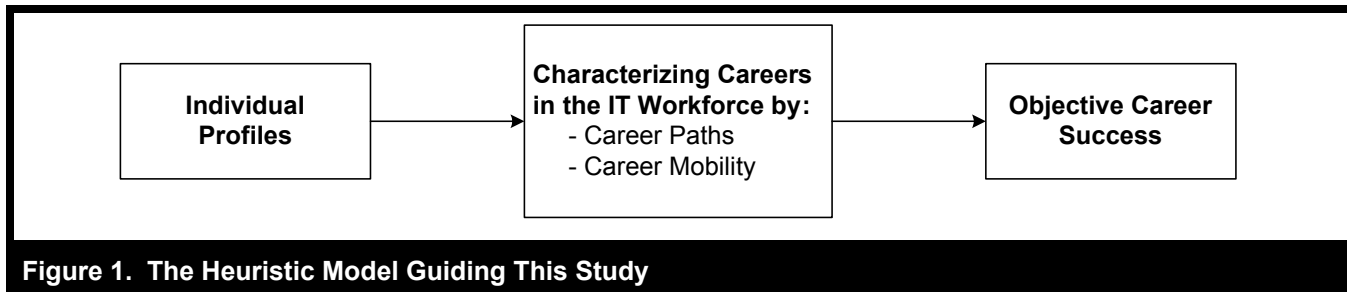
organizations within their subscribed careers, (3) differentiate the profiles of individuals associated with a given career, and (4) assess the objective career success associated with the identified contemporary careers. By addressing these issues, this paper espouses a more nuanced understanding of contemporary careers in the IT workforce compared to those presented in current IT literature.

Figure 1 presents the overall heuristic model that guides the theoretical foundations of this study, the data analysis, and the discussion of the results. In the following sections, this study first provides a discussion of the theoretical foundations of careers in terms of the career paths and career mobility. This study then expounds on the antecedents (i.e., individual profiles) and consequences (i.e., objective career success) associated with careers in the IT workforce. Specifically, we discuss the profiles of individuals (i.e., the overall set of personal attributes that are argued to characterize individuals in career paths). We then focus on understanding objective career success, in terms of pay as an external and observable indicator of accomplishment (Feldman and Ng 2007).

Characterizing Careers in the IT Workforce

A career is defined as "a sequence or combination of occupational positions held during the course of a lifetime" (Super 1957, p. 286). The traditional career model prescribes that careers progress in an orderly fashion and in sequential stages within an occupation and organization (Levinson 1978; Super 1957). Yet, scholars question the applicability of this traditional career model in a work environment where careers are increasingly shaped by multiple employers (Arthur and Rousseau 1996; Sullivan 1999) and occupational communities (Ginzberg and Baroudi 1988; Van Maanen and Barley 1984). Consequently, scholars have concluded that the traditional career model is an exception rather than the norm (Arthur and Rousseau 1996; Sullivan 1999), labeling nontraditional careers as "boundaryless careers" and "protean careers" (Arthur 1994; Hall and Mirvis 1995).

Research describes boundaryless careers and protean careers as "overlapping but distinct" concepts (Briscoe and Hall 2006a, p. 6). A protean career is self-directed, proactively managed, and driven by personally meaningful values and goals (Briscoe and Hall 2006a). It is depicted by psychological mobility, referring to one's perceived capacity to enact job changes (Sullivan and Arthur 2006). Psychological mobility, its antecedents and outcomes are interpreted from the career actor's perspective, "who may perceive a boundaryless future regardless of structural constraints" (Arthur and Rousseau 1996, p. 6).



In comparison, boundaryless careers are described in terms of interorganizational mobility; that is, job changes “across the boundaries of separate employers” (Greenhaus et al. 2008, p. 280). It is depicted by both psychological and physical boundary-crossing (Greenhaus et al. 2008). Physical mobility refers to actual job changes across structural or institutional boundaries such as jobs, firms, or occupations (Briscoe and Hall 2006b; Sullivan and Arthur 2006). In essence, physical mobility is conceptualized as an objective career change while psychological mobility is conceptualized as a subjective career change (Sullivan and Arthur 2006).

IT research has predominantly examined the psychological aspects of IT careers (since Ginzberg and Baroudi 1988). Consequently, research on the physical boundary-crossing behaviors in IT professionals’ careers remains scarce (Ang and Slaughter 2000). A recent review of the broader boundaryless careers literature also calls for research examining the physical components of boundaryless careers, its antecedents, and their consequences because psychological mobility may not be directly correlated with the physical, boundaryless notions of career mobility (Greenhaus et al. 2008).

Responding to these calls, this paper investigates the physical, boundaryless career mobility of individuals in the IT workforce. As highlighted by Greenhaus et al. (2008, p. 289), it is critical for researchers to “clarify the meaning and measurement of boundarylessness” by identifying different forms of nontraditional career mobility. Prior research predominantly conceptualizes and operationalizes boundaryless careers as interorganizational mobility. This paper takes an initial step of broadening this conceptualization and operationalization by also considering mobility within and across occupational and organizational boundaries.

In broadening the conceptualization and operationalization of boundaryless careers, research advocates analyzing the types and timing of career mobility revealed in individuals’ work histories (Greenhaus et al. 2008). Accordingly, we utilize the information available from individuals’ work histories to

characterize the careers in terms of (1) the types of career paths and (2) the types and timing of career mobility within a career path. By doing so, we obtain a comprehensive understanding of boundaryless careers in the IT workforce.

Career Paths

Career paths are models or prototypes characterizing the career sequences of a group of individuals. A career sequence depicts the succession of occupational jobs within an individual’s work history. In their seminal paper, Abbott and Hrycak (1990) analyzed the career sequences of German musicians in the 17th to 19th centuries. They described four major career paths (i.e., organists, court musicians, church musicians, and others) as musicians advanced from jobs lower in the hierarchy of the musical establishment to that of the music director or *Kapellmeister*. Blair-Loy (1999) added to this stream of research by examining the career sequences of women in the finance occupation. She identified two broad career paths: one characterized by orderly advancement up corporate career ladders within firms, and the other characterized by “disorderly career shifts between disparate fields and among several different organizations” (p. 1362). In another study of women in the workforce, Huang et al. (2007) and Huang and Sverke (2007) examined the career sequences of a cohort of Swedish women to identify two broad career paths: one conforming to traditional notions of upward mobility within an organization, and the other marked by exits from and reentry to the workforce for family reasons.

Adding to the above stream of research, this study analyses the career sequences of a cohort of individuals in the IT workforce. As noted earlier, prior research has identified two divergent career paths for IT professionals: a technical IT career and a managerial IT career (e.g., Chesebrough and Davis 1983; Kaiser 1983). However, given the increased heterogeneity in the IT workforce and the volatility of the IT work environment, it is important to examine anew whether contemporary IT professionals still follow traditional career paths or subscribe to other types of career paths.

Career Mobility

As noted above, this study broadens the conceptualization and operationalization of boundaryless careers by examining the types and timing of career mobility revealed in work histories. Based on the established career literature, this section discusses the various types of career mobility that comprise a career sequence and their timing within a career path.

Types of Career Mobility

Individuals may construct careers by moving across organizational or occupational boundaries (Greenhaus et al. 2008) or both simultaneously. Examining occupational mobility or organizational mobility alone presents a limited aspect of one's career. Organizational mobility has been frequently studied, as evidenced by the extant organizational turnover literature (e.g., Griffeth et al. 2000; Joseph et al. 2007), but this literature rarely examines individuals' destinations after they leave their organization (Kirschenbaum and Weisberg 2002). Consequently, there is a lack of understanding of whether those who change jobs across organizations remain within or leave their occupation.

Within an organization, the predominant focus of research has been on hierarchical mobility up a career ladder (Rosenfeld 1992). Such studies typically employ organizationally based tournament models (i.e., reaching a certain organizational level by a certain age or within a certain period of organizational tenure; Sullivan 1999) to predict career moves to the next higher rung on the corporate career ladder (Rosenbaum 1979). Such research, however, ignores the possibility that individuals may develop and progress in their careers via lateral moves within an organization. In these instances, moving to a new occupation within an organization does not necessarily reflect a promotion or a loss of a tournament; rather, it provides new opportunities for individual development (Greenhaus et al. 2008). Kaiser (1983) noted that some IT professionals held relatively higher organizational attachment and readily moved into functional jobs from IT jobs. She concluded that mobility to functional jobs might be motivated by restricted career opportunities within IT.

Reich and Kaarst-Brown (1999) provided an alternative explanation for IT professionals' mobility to functional jobs. They uncovered organizational initiatives that moved IT professionals out of IT jobs into functional jobs when job opportunities became available within an organization. Such moves to non-IT jobs are facilitated by the pervasiveness of IT in an organization and by the firm-specific skills gained by IT professionals when developing information systems for non-IT functional areas (Reich and Kaarst-Brown 2003). In

contrast to organizational initiatives to move IT professionals into line functions, Moore et al. (2001) report on initiatives by businesses, government, and universities to ease the entry into IT jobs from non-IT jobs and to reduce the time to proficiency in IT. These initiatives were introduced when the IT industry faced an acute shortage of IT professionals.

Given the possibilities for both organizational and occupational mobility in the IT workforce, this study examines three types of career mobility: (1) movements across organizations within occupations, (2) movements across occupations within organizations, and (3) movements across both occupations and organizations. By examining these types of career mobility, we gain insights into whether IT careers are indeed boundaryless across organizations as well as occupations.

Timing of Career Mobility

In addition, we investigate the timing of different types of career moves within individuals' career paths. For example, do individuals move early in their careers or late in their careers, or do they exhibit a steady rate of mobility throughout their careers? A longitudinal perspective of careers provides insights into the timing of career moves (Huang and Sverke 2007) which could not otherwise be obtained from cross-sectional approaches (Bailyn 2004).

Careers are increasingly recognized to be nonlinear, without clearly delineated career stages and predictable timing (Abbott 2003). Instead, individuals' careers may exhibit different rates of career mobility at different points in time. Indeed, Abbot and Hrycak (1990) urge researchers to examine the pattern of job changes that form a work history because individuals continually plan and structure their careers over time. Accordingly, we add to the careers literature by examining the timing of occupational and organizational mobility over the span of individuals' careers.

Antecedents and Consequences of Career Paths

In this section, we examine the profiles of individuals as antecedents characterizing individuals in career paths. We then focus on objective career success as a consequence of subscribing to a particular career path.

Individual Profiles

Individual profiles comprise a set of attributes that are best understood by the analysis of overall patterns of attributes

rather than by analysis of specific attributes (Greenwood and Hinings 1993). In essence, individual profiles present a holistic perspective of attributes that describe individuals in different career paths. Prior research has shown that the individual attributes of gender and human capital investments strongly influence individuals' career decisions and opportunities in the workforce (Feldman and Ng 2007; Griffeth et al. 2000; Josefek and Kauffman 2003; Joseph et al. 2007). Therefore, we focus on these sets of individual attributes in describing individuals in different career paths.

There is an extensive body of research examining the careers of females. The research suggests that females, compared to males, are more likely to pursue a boundaryless careers for its self-directedness and for its attainment of personally meaningful goals (Mainiero and Sullivan 2005). The research on career paths of females also tends to support the notion that females are more likely than males to leave the workforce either temporarily or permanently for family reasons (Blair-Loy 1999; Huang et al. 2007; Huang and Sverke 2007). Moreover, the labor market tends to be segmented by gender with an overrepresentation of females in secondary labor market jobs such as clerical and production-oriented jobs. Secondary labor market jobs are characterized by their relatively lower status, limited opportunities for promotion, autonomy, or the ability to independently bargain for favorable pay (Kalleberg and Sorensen 1979; Piore 1975). By comparison, males tend to congregate in the technical and managerial jobs, which are characterized by their relatively higher status, opportunities for promotion, autonomy, and favorable pay (Rosenfeld 1992; Tomaskovic-Devey and Skaggs 2002).

Within male dominated occupations, females report experiencing barriers to career advancement (Goodman et al. 2003; Stroh et al. 1996) and to mobility within the external labor market in search of alternative jobs (Keith and McWilliams 1999). As the IT workforce tends to be male dominated (Information Technology Association of America 2005), several studies have documented the negative career experiences of females in the IT workforce. These negative career experiences include stereotyping of and hostility toward females (Ahuja 2002), restricted career advancement opportunities (Leventman 2007), and a lack of informal networks to obtain information about alternative employment opportunities (Hartmann et al. 1986; Margolis and Fisher 2002).

Another key factor influencing individuals' careers is human capital. Human capital refers to individuals' productive competencies that result from accumulating knowledge, skills, and experience (Becker 1975). These competencies vary in their level of specificity from general to specific. General human

capital is transferable across domains (e.g., across jobs, organizations, industries, and professions) while specific human capital is constrained to a particular domain. Investments in general human capital facilitate career mobility as the accumulated human capital may be productively utilized in another occupation or organization (Fugate et al. 2004). On the other hand, investments in specific human capital decrease one's career mobility as changing an occupation and/or organization would entail a forfeit of the specific human capital that has been accumulated in a different occupation and/or organization (Feldman and Ng 2007; Joseph et al. 2011).

Objective Career Success

The career paths that individuals follow have implications for their objective career success. Prior research provides evidence that career paths conforming to traditional notions of upward mobility within an organization are associated with higher levels of pay (Blair-Loy 1999; Huang et al. 2007; Huang and Sverke 2007). In this study, we examine one key dimension of an individual's objective career success: pay. Individuals' career decisions often have a significant impact on their pay, because the returns to individuals' accumulated human capital may differ depending on their career decisions (Mithas and Krishnan 2008; Parent 2000), and individuals may be compensated differently because of the nature of their jobs (Combs and Skill 2003; Gerhart and Milkovich 1990).

Human capital theory suggests that obtaining a fit between one's human capital investment and the job requirements generates rewards in terms of higher pay (Ang et al. 2002; Slaughter et al. 2007). For example, if individuals possess general human capital, moving frequently across domains may not entail a decrease in pay (Mithas and Krishnan 2008). On the other hand, if individuals have accumulated occupation-specific human capital, such as data modeling and programming skills specific to the IT profession, leaving the IT profession will result in a depreciation of their stock of human capital, which will be reflected as lower pay. In addition, if individuals have accumulated firm-specific human capital such as knowledge of an organization's policies, they may find higher rewards by staying within the organization.

The nature of the job held may also influence one's level of pay due to the roles performed, responsibilities held, or power wielded (Combs and Skill 2003). For example, Gerhart and Milkovich (1990) reason that managers are compensated more than others lower in the organizational hierarchy because managers are perceived to have a greater impact on organizational performance compared to non-managers. Similarly,

a study of managerial pay (Carpenter and Wade 2002) shows that managers are likely to receive higher pay by virtue of their responsibilities, experience, and position. As such, organizations tend to pay more for managers compared to those in technical or staff positions (Cappelli and Cascio 1991). Accordingly, we compare the pay of individuals in different career paths as a means of evaluating their objective career success.

Method

This study adopts an inductive and quantitative approach to examine the career paths of individuals in the IT workforce. Identifying career sequences requires analyses not just at single points in time but across individuals' work histories (Abbott 2003). Accordingly, we employ an inductive approach to understand the complexities of individuals' career changes across time and employ quantitative analyses to address the generalizability of conclusions to the IT workforce. The analytical approach here differs from the approaches employed in prior studies on IT careers (Chesebrough and Davis 1983; Kaiser 1983; Tanniru 1983) in that a formal, replicable analysis of career sequences is conducted on a relatively large sample, using optimal matching (a sequence analysis technique) and cluster analyses.

We also make use of systematic coding strategies to describe individuals' career sequences. This study is also atypical in that we do not test empirical models identifying variables that explain or predict the career mobility or the career paths to which individuals will subscribe. Instead, we make use of a series of statistical tests to verify that the conclusions reached are indeed statistically significant. This inductive and quantitative approach, we believe, is the most appropriate to examine the complexities and nuances of career sequences in a relatively large sample of individuals in the IT workforce.

Data

We analyze actual work history data of a sample of respondents drawn from the National Longitudinal Survey of Youth 1979 (NLSY79; see Bureau of Labor Statistics 2008). The Bureau of Labor Statistics (BLS) began the NLSY79 program in 1979 by surveying a nationally representative sample of 12,686 respondents who were between 14 and 21 years old (as of January 1, 1979) and residing in the United States of America. The NLSY79 continues to track these respondents periodically over time. In each wave of data collection, respondents are surveyed using structured interview techni-

ques that collect detailed data on a broad range of topics including work history, job duration, and occupation.

For this study, we used the most recent NLSY79 data set released (as of 2008) by the BLS containing respondents' work histories from 1979 to 2006. As the respondents have yet to report retirement and their careers have yet to be completed, our data are right censored. Nevertheless, our data captures a significant portion of respondents' careers from their start between the ages of 18 and 21 years to the end of this study (as of 2006), between the ages of 42 and 49 years. Moreover, this data set is ideal for the analysis of careers as it contains detailed career related information on jobs held and job destinations following a career move, thus allowing us to construct career sequences from the beginning of respondents' careers.

Sample

We selected a sample of respondents from the NLSY79 data set using the following criteria: (1) respondents be at least 18 years and have attained a high school diploma or its equivalent; (2) respondents have worked in a full-time IT job for at least one continuous year anytime after entering the workforce between 1979 and 2006; and (3) respondents provide at least five contiguous years' worth of workforce data. The U.S. Youth Employment Provisions of the Fair Labor Standards Act (FLSA) restricts the types of employment for persons under the age of 18. Accordingly, we applied the "18 years and older" criterion to include respondents who were able to work in any job. We also considered respondents to begin their careers after attaining a high school diploma (or its equivalent) to avoid capturing transient vacation or part-time IT jobs.

Consistent with the BLS definition of a full-time, permanent job, incumbents in IT jobs were included in our sample if they had worked "for more than 35 hours a week" for "one continuous year in a job" (see Polivka 1996). This criterion ensured the selection of respondents who have regarded IT jobs as a full-time permanent job and not just as a temporary job.² It has been argued that individuals in temporary jobs are unlikely to undergo the same cognitive processes with regard to their careers as individuals in full-time, permanent jobs (Hulin et al. 1985).

²We conducted sensitivity analyses using a criterion of two years in an IT job in selecting respondents for inclusion in our sample. The results from this analysis are consistent with our original results.

We chose to exclude respondents who provided less than five years of workforce data because we required a sufficiently long career sequence for each respondent to compare the similarity of one career sequence adequately with another.³ After applying these criteria, our final sample comprised 500 respondents (or 3.94 percent) out of 12,686 respondents in the data set.

Coding

To obtain a career sequence for each respondent in our study data set, we followed Abbott and Hrycak's (1990) approach by expressing each respondent's work history as a sequence of jobs. We used one calendar year as the basic time interval in the career sequence. Respondents who switched jobs within a given calendar year were coded for their dominant job in that year. The dominant job refers to the job that the respondent held for the most amount of time (and for at least 13 weeks) in a calendar year (Bureau of Labor Statistics 2008).

The work history data in the NLSY79 contains detailed information about jobs held by respondents in each year. Jobs are coded, described, and categorized according to the Occupation Classification System (OCS; U.S. Census Bureau 1971, 2000) which distinguishes between 12 major job categories (e.g., professional, technical, managerial, clerical, sales, etc.) and identifies 417 separate subcategories (e.g., accountants, bank officers, chemical engineers, etc.). The OCS was refined in 2000 and 2002 to reflect the proliferation of jobs and job titles in the U.S. labor market. IT jobs coded by OCS include "Computer and Information Systems Managers," "Computer Systems Analysts," and "Database Administrators." A full list of IT jobs and their respective OCS codes are presented in Table 1.

Using these OCS codes, we noted each respondent's job in each year from 1979 to 2006 using the appropriate coding scheme in force at the time of data collection. For ease of analyses, we recoded jobs held by respondents into one of 13 broad job categories presented in Table 2. All non-managerial IT jobs codes (in Table 1) were recoded as technical IT jobs (i.e., "I") while Computer and Information Systems Manager jobs were recoded as IT managerial jobs (i.e., "M").⁴ All non-IT job codes in our sample were mapped

onto the remaining non-IT job categories (e.g., professional, technical, managerial, clerical, sales, etc.) and their codes (in brackets) as follows: non-IT manager ("G"), non-IT professional ("P"), technical administration and support ("J"), technician ("T"), sales ("S"), clerical ("C"); craft, production and service ("O"), military ("Y"), in school ("X"), unemployed ("U"), and out of the workforce ("Z").

We arranged respondents' careers into sequences of coded jobs from the point at which the individual entered the workforce. The average length of career sequences for the individuals in our sample is 22.2 years ($SD = 5.8$ years), with the maximum and minimum lengths at 28.0 years and 5.0 years, respectively.⁵ For example, consider the following career sequence for a respondent i : P P P P P P P I I I I I I M M. The length of respondent i 's career is 16 years. On entering the workforce, respondent i spent eight years in a non-IT professional job, then spent six years in a technical IT job, after which she moved into a managerial IT job for two years.

Analysis

We employed Abbott and Hrycak's (1990) sequence analytic approach to identify distinct career paths in our data. This approach comprises two separate analyses: an optimal matching analysis of career sequences to establish the inter-sequence distances between all pairs of career sequences in the study data set and a cluster analysis that uses the inter-sequence distances to group career sequences into meaningful clusters (i.e., career paths).

Optimal Matching Analysis

Optimal matching analysis (Sankoff and Kruskal 1983) is a statistical method that yields a measure of resemblance between pairs of career sequences. The technique calculates similarity scores between pairs of career sequences and measures the extent to which two career sequences differ by counting the number of substitutions, insertions, and deletions needed to transform one sequence into the other. By allocating costs to substitutions, insertions and deletions, pairs of

³We conducted sensitivity analyses by increasing the contiguous workforce data criterion to "at least 10 contiguous years' worth of workforce data." The results from this analysis are consistent with our original results.

⁴We made a reasonable assumption that for all individuals identified as IT managers in the OCS 2000/2002 codes, all of their prior contiguous jobs with Code 220 (Office Manager, not classified elsewhere) and Code 245

(Managers and Administrators, not classified elsewhere) should be coded as IT management as well.

⁵The average length of career sequences for males and females are not significantly different ($t = -1.53$, $df = 452.52$, $p = 0.172$). The average length of career sequences for males in our sample is 21.8 years ($SD = 6.0$ years), and the average length of career sequences for females is 22.6 ($SD = 5.5$).

Jobs	1970 Code	2000 Code	2002 Code
Computer and Information Systems Manager		11	110
Computer Systems Analyst/Computer Scientist	004	100	1000
Computer Programmer	003	101	1010
Computer Specialist	005		
Computer Software Engineer		102	1020
Computer Support Specialist		104	1040
Database Administrator		106	1060
Network and Computer Systems Administrator		110	1100
Network Systems and Data Communications Analyst		111	1110
Computer Hardware Engineer		140	1400

Source: Bureau of Labor Statistics "NLSY79 Attachment 3: 1970, 1980 & 2000/2002 Census Industrial & Occupation Classification Codes and 1977 Department Of Defense Enlisted Occupational Codes," 2006.

Jobs	Code	Definition
IT	I	Technical IT job (i.e., systems analyst; programmer; software and hardware engineer; IT support specialist; database, network and systems administrator; network and data communication analyst; computer specialist)
	M	Managerial IT job (i.e., computer and information systems manager)
Non-IT	C	Clerical job (e.g., clerk, secretary, office and administrative support worker)
	G	Non-IT managerial job (e.g., general manager, financial manager, sales manager)
	J	Technical administration and support job (e.g., computer/peripheral equipment operator, data entry clerk; computer, office equipment or automated teller repairer)
	O	Craft, production and service job (e.g., protective service, food and beverage worker, entertainer, janitor, service worker, laborer)
	P	Non-IT professional job (e.g., accountant, human resource executive, financial analyst, legal professional, engineer, psychologist, scientist, healthcare professional, teacher)
	S	Sales job (e.g., retail salesperson, insurance sales agent, advertising sales agent)
	T	Technician (e.g., engineering technician, healthcare technician, chemical technician)
Out of Civilian Workforce	U	Unemployed (i.e., is actively searching for employment during a job gap)
	X	Enrolled in School
	Y	Military service
	Z	Out of workforce (i.e., is not actively searching for work during a job gap)

sequences can be compared, and sequences that “cost” the least to be transformed into another are considered the most similar (Abbott and Forrest 1986). Once all sequences are analyzed, the outcome is a matrix detailing how similar each sequence is to all others in a given data set.

We use the optimal matching algorithm in ClustalG (Wilson 2002) to calculate the similarity scores for all career

sequences (Wilson et al. 1999). The similarity scores are rescaled into distance scores by dividing the similarity scores by 100 and subtracting from 1. The resulting distance matrix (dimensions: 500 rows by 500 columns) is then analyzed using cluster analysis to empirically group the various career sequences into clusters (Hair et al. 1995). Based on a sensitivity analysis of various insertion, deletion and substitution cost matrices and on the recommendations of Abbott and his

colleagues (Abbott and Forrest 1986; Abbott and Hrycak 1990) and of Sabherwal and Robey (1993), we set the insertion, deletion and substitution costs to the same value across all pairs of job codes. The rationale for doing this is that the cluster analysis algorithm is not sensitive to variations in distance matrices derived from different cost matrices.⁶

Cluster Analysis

We then conducted two sets of cluster analyses on the distance matrix derived from optimal matching analysis to identify distinct career paths in our data. First, a hierarchical agglomerative clustering technique was used to analyze the distance matrix derived from the optimal matching analysis and to group career sequences into “natural groups” (Aldenderfer and Blashfield 1984, p. 16) of career paths in the IT workforce. Specifically, we employed the two-step cluster analysis procedure in SPSS to analyze the distance matrix by specifying the 500 columns to represent the clustering variables and to determine the number of viable clusters in the data. The two-step clustering algorithm is well suited to analyze large data sets in which there are no predetermined numbers of clusters.

Accordingly, we did not limit the two-step clustering algorithm to produce a specific number of clusters but allowed it to determine, automatically, up to a maximum of 15 clusters (the default in SPSS). The clustering algorithm derives the candidate number of clusters by comparing model AIC fit statistics (Akaike’s Information Criterion; Akaike 1974) across different clustering solutions. The cluster solution that best fits the data is indicated by the greatest ratio of change in the AIC fit statistic between a cluster solution with n clusters and a two-cluster solution (Bozdogan 1987; Norušis 2008). The AIC fit index indicated that a three cluster solution best fits the data.

⁶Although substituting one occupation with another in a career sequence should intuitively incur costs, Monte Carlo studies (Abbott and Hrycak 1990) find that drastically different substitution costs for occupations all result in “overwhelming similarities” in cluster memberships (p. 164). As such, Abbott and Hrycak conclude that the cluster analysis “seems to behave robustly with variation in substitution costs” and that “differences in minor analytic decisions are unlikely to drastically change results” (p. 164). Our sensitivity analyses using different substitution costs results in an intra-class correlation of 1.0 ($p < 0.001$), indicating perfect consistency in the cluster memberships across different substitution scenarios. For example, we considered scenarios where a change from an IT job to a non-IT job would cost more than transiting from a non-IT job to another non-IT job. As this and other scenarios produced identical cluster memberships, we used the same relative costs as Abbott and Hrycak.

Second, we assessed the robustness of the results of the hierarchical agglomeration by reanalyzing the distance matrix with a nonhierarchical cluster analysis. Specifically, we employed a K-means clustering algorithm in SPSS and specified that three clusters be formed. The level of agreement in the resulting cluster memberships of the hierarchical and nonhierarchical clustering algorithms was very high (Cohen’s $kappa = 0.93$, $p < 0.001$), suggesting near perfect agreement (Landis and Koch 1977) across the two clustering algorithms.

Results

In this section, we report our results according to the heuristic model that guided our study (Figure 1). The following sections present the career paths identified from the analyses of career sequences, and the types and timings of career mobility from the analyses of movements across organizational and occupational boundaries. We then report our findings on the antecedents and consequences of career paths.

Career Paths

The sequence analysis of work histories reveals that there are three types of career paths in the IT workforce. Table 3 presents exemplars of career sequences for each career path. Table 4 provides the descriptive statistics showing the extent to which each occupation is represented in each career path.

The first cluster, which we label “Information Technology (IT) Career,” comprises 173 individuals (34.6 percent of the sample). From Table 3, we see that individuals in this career path, on average, enter the IT profession at a relatively early stage of their careers, after some non-IT work experience (3.9 years, $SD = 4.6$ years). These individuals tend to remain within the IT profession for the remaining duration of their careers or move into a managerial IT position at a later point in time.

The remaining two clusters include individuals who work in IT jobs for a significantly smaller proportion of their work histories. The second cluster, labeled “Professional Labor Market (PLM) Career,” is composed of 147 individuals (29.4 percent of the sample) who typically enter IT jobs at a relatively early stage of their careers after some non-IT work experience (5.0 years, $SD = 4.8$ years). Most of these individuals (95.2 percent) exit IT jobs after about two years of IT work experience (2.3 years, $SD = 2.9$ years). Individuals in this career path spend most of their careers in non-IT professional (27.4 percent) or non-IT managerial (16.9 percent) jobs.

Table 3. Exemplars of Career Sequences of Individuals[†]

Clusters	ID	Sequence																			
Information Technology (IT) Career (N=173; 34.6%)	1				I	I	I	I	X	X	X	X	I	I	I	I	I	I	I	I	I
	2								P	I	I	I	I	I	I	I	I	I	I	I	I
	3								P	P	P	P	I	I	I	I	O	O	I	I	I
	4							S	I	I	T	P	C	T	I	I	I	I	P	P	P
	5					C	O	I	I	I	I	I	I	I	I	M	M	M	M	M	M
	6		O	O	O	O	C	G	G	I	I	I	M	M	M	M	M	M	M	M	M
Professional Labor Market (PLM) Career (N=147; 29.4%)	7	C	G	P	I	C	C	C	C	C	C	C	C	C	C	C	C	G	G	P	
	8								T	P	P	P	P	I	T	P	Z	Z	Z	Z	
	9					O	X	C	O	G	P	C	P	G	C	C	C	G	G	G	
	10					X	I	I	I	S	S	P	S	P	G	G	G	G	G	G	
	11					P	P	P	P	O	P	I	S	S	S	G	G	G	G	G	
	12					P	P	P	P	P	P	P	I	G	G	G	G	G	G	G	
Secondary Labor Market (SLM) Career (N=180; 36.0%)	13						S	O	O	I	I	I	I	I	I	I	I	I	I	O	
	14					C	C	O	C	O	O	G	G	O	G	U	U	X	I	I	
	15	C	C	O	C	C	C	J	J	O	J	J	J	J	J	J	J	J	J	I	
	16					C	C	C	C	C	C	C	C	C	G	C	C	C	I	I	
	17	C	U	Z	S	C	G	C	C	I	O	O	O	G	C	C	C				
	18					O	O	O	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	X	

[†]See Table 2 for detailed meanings of codes. I: IT; M: IT Manager; C: Clerical; G: Non-IT Manager; J: Technical Admin & Support; O: Craft, Production, and Service; P: Non-IT Professional; S: Sales; T: Technician; U: Unemployed; X: In School; Y: Military Service; Z: Out of Workforce.

Table 4. Mean Proportion of Work History for Each Job Within Each Career Sequence

Jobs		IT Career	PLM Career	SLM Career	F
IT Jobs					
Technical IT	I	51.0%	12.8%	15.0%	284.88***
Managerial IT	M	7.6%	0.1%	0.0%	46.63***
Non-IT Jobs					
Non-IT Manager	G	2.7%	16.9%	4.1%	82.64***
Non-IT Professional	P	6.3%	27.4%	3.6%	142.70***
Clerical	C	4.2%	10.0%	20.2%	42.84***
Technical Administration & Support	J	2.3%	0.8%	8.4%	21.69***
Craft, Production and Service	O	5.1%	6.0%	20.6%	57.74***
Sales	S	2.0%	4.5%	3.7%	4.90***
Technicians	T	1.2%	3.9%	4.9%	8.06***
Out of Civilian Workforce					
Unemployed	U	0.5%	0.5%	1.1%	3.93***
In School	X	14.8%	14.2%	6.7%	27.80***
Military Service	Y	1.4%	0.6%	8.8%	22.26***
Out of Workforce	Z	1.0%	2.2%	2.9%	3.55*
Length of Sequence (years)	Mean	21.61	21.82	23.07	3.26*
	SD	5.93	5.53	5.86	

MANOVA: Hotelling's $T = 3.458$, $F_{(26, 968)} = 64.365^{***}$; * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

The term *professional labor market* is adapted from the labor market segmentation literature distinguishing between different types of labor markets (Althauser and Kalleberg 1981), which define the boundaries within which individuals develop careers. The firm internal labor market, for example, defines the firm as the labor market boundary as one's career progression occurs within a single firm. The PLM cluster includes individuals who spend a significant amount of their time moving within and between associated professional and managerial occupations, perhaps to explore and build general expertise (Wholey 1985). We thus label this cluster the "Professional Labor Market Career," where one's career is bounded by other non-IT professional and non-IT managerial occupations and where career progression involves movement within and across two or more associated professional occupations, not necessarily confined to a single employer (Wholey 1985).

The third cluster, which we label as "Secondary Labor Market (SLM) Career," is composed of 180 individuals (36.0 percent of sample). In contrast to the first two groups, individuals in this third cluster tend to enter IT jobs at a later stage of their careers after accumulating a significant amount of non-IT work experience (10.8 years, $SD = 6.6$ years). Like the individuals in PLM careers, individuals in SLM careers stay for a relatively short period in IT jobs (2.7 years, $SD = 2.7$ years). Unlike the individuals in PLM careers, however, individuals in SLM careers tend to move into occupations that are lower in economic status when they are not in the IT profession. The average Total Socioeconomic Index (TSEI; Hauser and Warren 1997)⁷ for the SLM career is 40.10 ($SD = 5.05$), which is significantly lower than the average TSEI of the PLM career (51.08, $SD = 5.85$; $t = 18.21$, $p < 0.001$) and the IT career (54.77, $SD = 5.41$; $t = 26.33$, $p < 0.001$). Individuals in SLM careers tend to spend more of their time in clerical (20.2 percent), craft (20.6 percent), military (8.8 percent), or technical administration and support (8.4 percent) types of positions.

The label of this group, "Secondary Labor Market Career," draws upon the concept of secondary labor market defined in the labor market segmentation literature (Althauser and Kalleberg 1981). SLM careers are typified by lower-tier jobs that tend to offer little to individuals in terms of status, opportunities for promotion, autonomy, or the ability to independently bargain for favorable pay (Kalleberg and Sorensen 1979; Piore 1975).

⁷The TSEI summarizes the prestige and economic status of an occupation relative to others (Hauser and Warren 1997). The TSEI is indicated by the education required and the earnings attained in each occupation. Higher TSEI scores reflect occupations possessing higher levels of prestige and economic standing.

Career Mobility

Although the previous analyses provided insights into the career paths that characterize individuals in the IT workforce, the analyses were restricted to only occupational mobility. As highlighted earlier, a boundaryless career may be boundaryless both across occupations *and* across organizations. However, prior research has yet to examine whether a career that appears boundaryless across occupations may still be bounded within organizations, or vice versa. To provide a more comprehensive understanding of boundaryless careers, we examine individuals' career mobility across both occupational and organizational boundaries.

Types of Career Mobility

As individuals may move across occupational and/or organizational boundaries, we identified three unique forms of career mobility (Figure 2): (1) *occupation only* mobility, referring to a job change from one occupation to another within the same organization; (2) *organization only* mobility, referring to a job change from one organization to another within the same occupation; and (3) *occupation and organization* mobility, referring to a job change occurring across both occupations and organizations simultaneously.

Figure 2 shows the total distribution of career mobility along occupational and organizational boundaries. Out of the 3,149 career moves made by individuals in our sample, 2,365 (74.5 percent) were across occupational boundaries. Out of the 2,346 occupational changes, 1,508 (64.3 percent) occupational changes took place within organizations. Only 803 (25.5 percent) of all career moves involved changing organizations but not occupations.

Table 5 provides further analysis of the average frequency with which the three types of occupational and organizational mobility occurred across the different career paths. Table 5 further affirms that the individuals in our sample change occupations more often than they change organizations (4.74 versus 3.29 times; $t = 10.94$, $df = 499$; $p < 0.001$).

Figure 3 provides a comparison of the average career mobility across the three careers in the IT workforce. Individuals in IT careers are significantly more likely to change organizations within an occupation, compared to individuals in PLM ($t = 3.47$, $df = 318$, $p < 0.001$) and SLM ($t = 3.74$, $df = 351$, $p < 0.001$) careers. Further, individuals in IT careers are significantly less likely to change occupations, compared to individuals in PLM careers (Table 5: 6.02; $SD = 2.86$) and SLM (Table 5: 5.40; $SD = 2.67$) careers. Taken together,

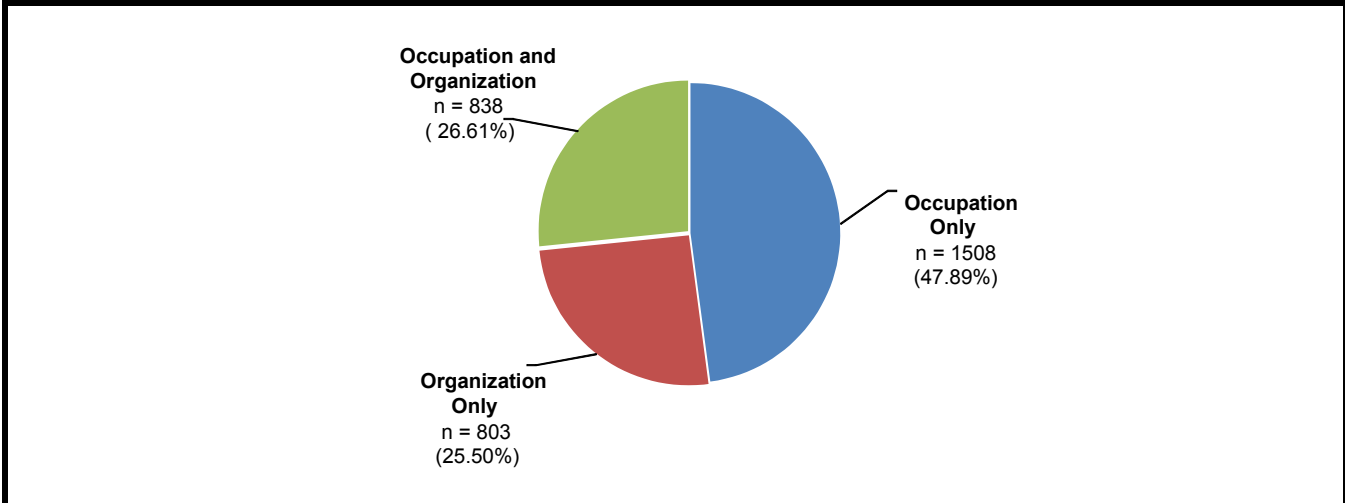


Figure 2. Occurrences of Career Moves in the Sample

Table 5. Mean Career Mobility Within and Across Career Paths

		IT Career	PLM Career	SLM Career	Total	F
Occupation Only Mobility	Mean (SD)	1.89 (1.85)	4.06 (2.31)	3.24 (2.37)	3.02 (2.35)	40.77***
		●————●				
Organization Only Mobility	Mean (SD)	1.97 (1.58)	1.41 (1.30)	1.39 (1.37)	1.60 (1.45)	8.94***
		●————●				
Occupation and Organization Mobility	Mean (SD)	1.05 (1.12)	1.94 (1.42)	2.07 (1.44)	1.68 (1.41)	29.89***
		●————●				
Total Career Mobility	Mean (SD)	4.91 (2.74)	7.41 (3.06)	6.71 (3.00)	6.29 (3.11)	31.87***
		●————●				
Total Number of Occupations	Mean (SD)	2.98 (2.44)	6.02 (2.86)	5.40 (2.67)	4.47 (2.95)	59.075***
		●————●				
Total Number of Organizations	Mean (SD)	3.04 (1.88)	3.36 (1.94)	3.48 (2.12)	3.29 (1.99)	1.800
		●————●				

Legend: ●————● Denotes significant pairwise two-tailed t-test comparisons at $p < 0.05$
 $*p < 0.05$, $**p < 0.01$, $***p < 0.001$

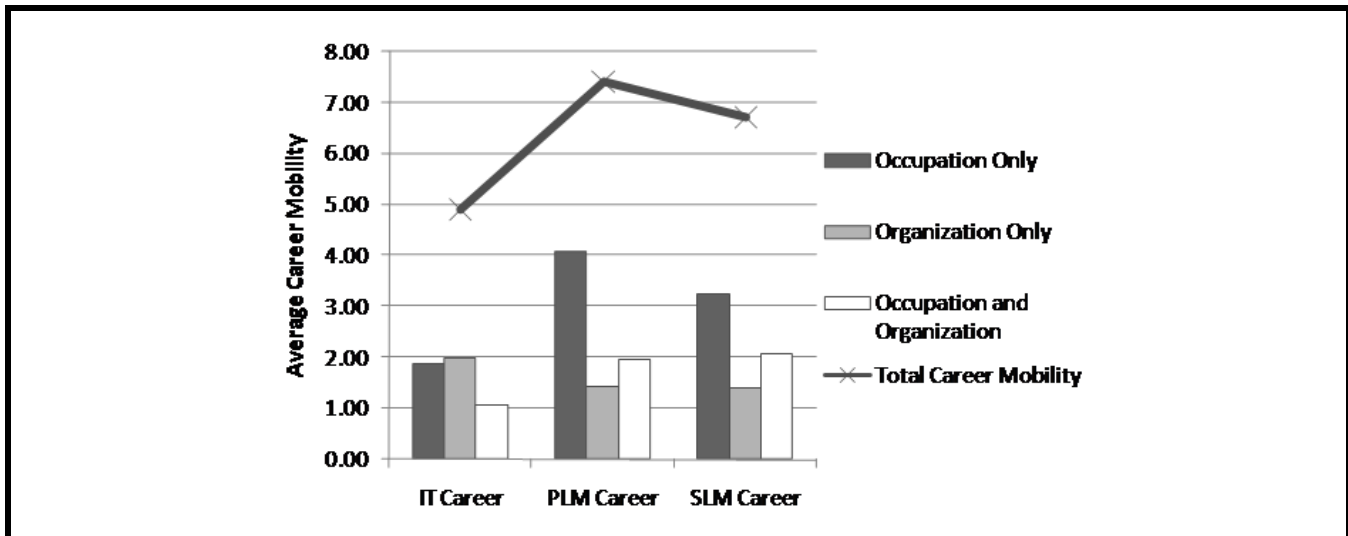


Figure 3. Average Career Mobility Across Careers in the IT Workforce

these results suggest that individuals in IT careers are not bounded by their organization, but remain relatively bounded within the IT profession.

Individuals in both the PLM ($t = 7.64$, $df = 318$, $p < 0.001$) and SLM ($t = 5.89$, $df = 351$, $p < 0.001$) careers move more frequently than those in IT careers. In particular, individuals in PLM and SLM careers exhibit significantly more occupation-only mobility than individuals in IT careers. These results show that individuals in the PLM and SLM careers are least bounded by their occupations and they demonstrate frequent occupational mobility within an organization.⁸

Timing of Career Mobility

We examined the timing of each type of career mobility using a repeated measures analysis of variance to test for dif-

⁸We conducted additional analyses to examine the extent to which individuals' mobility into the IT workforce, or to other organizations within the IT workforce (i.e., organizational turnover) is influenced by general availability of jobs. We used unemployment rate as a measure of general availability of jobs as it "is assumed to capture a sample's relevant job market" (Trevor 2001, p. 621). We find that a higher unemployment rate is negatively associated with the probability of mobility across organizations either into the IT workforce or within the IT workforce. Unemployment rate, however, is not significantly related to the probability of mobility into the IT workforce within organizations. This finding suggests that organizational mobility is more influenced by general availability of job opportunities than occupational mobility within organizations.

ferences in the profiles of career mobility across time. We found that the average organization only mobility ($Wilks' \Lambda = 0.97$, $F_{(8, 988)} = 1.90$, ns) and average occupation and organization mobility ($Wilks' \Lambda = 0.99$, $F_{(8, 988)} = 0.53$, ns) were not significantly different from each other over time across career paths. Our analysis showed that the average organization only mobility and the average occupation and organization mobility decreased over time as individuals grow older. This is consistent with career stage theory (Super 1957), which argues career exploration typically occurs in the initial stages of one's career, and that career exploration decreases over time.

There were, however, significant differences in the average occupation only mobility over time across clusters ($Wilks' \Lambda = 0.87$, $F_{(8, 988)} = 8.77$, $p < 0.001$). Figure 4 shows the average occupation only mobility undertaken by individuals in each career over time. Individuals in IT careers and PLM careers tend to change occupations within organizations in the early stages of their careers. Individuals in PLM careers, in particular, tend to exhibit occupation-only mobility within the first 12 years of their career, and this type of mobility declines steeply thereafter. In contrast, individuals in SLM careers tend to exhibit consistent occupation-only mobility over time, even in the last few years of their careers.

Individual Profiles

How do the profiles of individuals differ across career paths? As noted earlier, prior research has argued and shown that

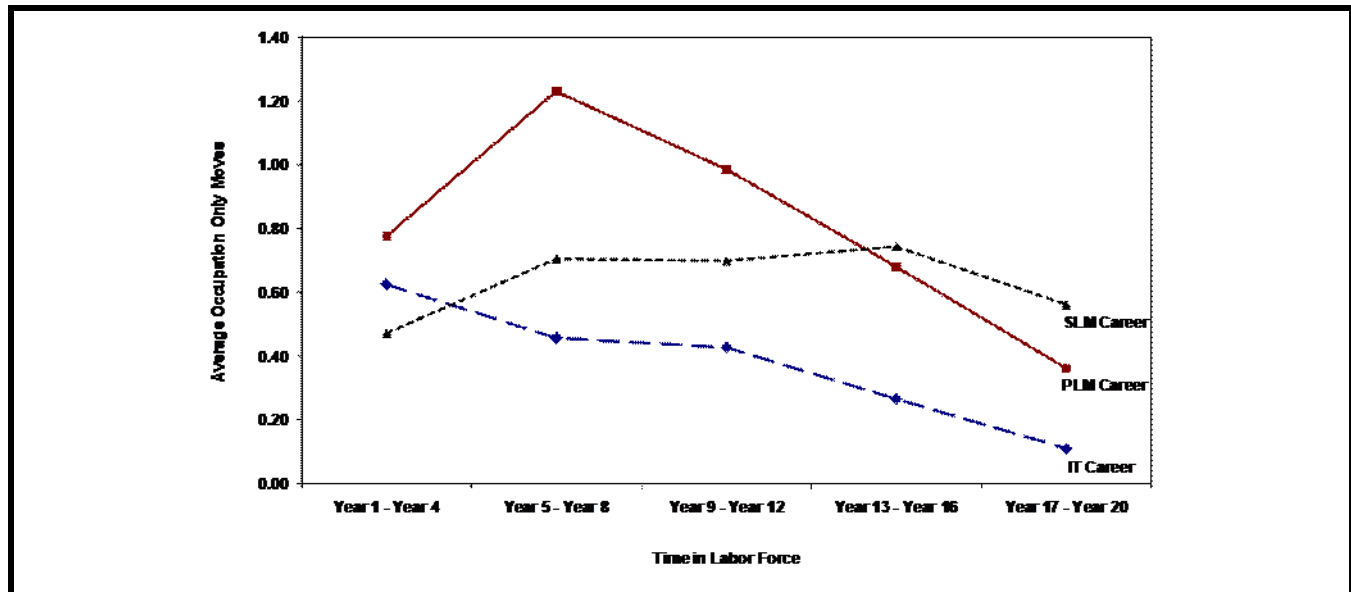


Figure 4. Timing of Occupation-Only Mobility Across Time

gender and human capital investments are strongly related to career decisions and career opportunities in the workforce (Feldman and Ng 2007; Greenhaus et al. 2008; Igarria and Chidambaram 1997). We thus profile the individuals within each career path in terms of their gender and human capital variables.

Human capital variables examined include education level, cognitive ability, and declared major in college. *Education Level* measured individuals' highest education attainment on four levels: (1) high school diploma or its equivalent; (2) high school diploma with some college education; (3) bachelor's degree; and (4) postgraduate degree. *Percentile Score on Cognitive Ability Test* was measured using the percentile score of the Armed Forces Qualifying Test (AFQT), which was administered to the NLSY79 respondents in 1980. The AFQT percentile score is a composite of four quantitative and verbal tests: mathematical knowledge, arithmetic reasoning, paragraph comprehension, and word knowledge (Bureau of Labor Statistics 2008). This variable tends to be correlated with educational level, as individuals usually advance to higher educational levels based on how well they score on such tests (Mayer 2000).

The NLSY79 also captures data about declared major in college. IT-related majors recorded in the NLSY79 include Computer and Information Sciences (code 0701), Information Sciences and Systems (code 0702), Data Processing (code 0703), Computer Programming (code 0704), Systems Analysis (code 0705), and Other Computer and Information

Sciences Major (code 0799). Accordingly, we recoded individuals' declared major in college as *IT-Related Major* or as *Non-IT Related Major*.⁹

Table 6 presents the profile of individuals in each career path. The IT career is predominantly male (72.8 percent; $\chi^2 = 18.58$, $df = 2$, $p < 0.001$). Individuals in IT careers are more likely, compared to individuals in other careers, to have attained a bachelor's degree or higher (83.2 percent) and majored in an IT-related program while in college (61.8 percent). These individuals also tend to score higher in the cognitive ability tests (78.48 percentile; $F_{(2, 483)} = 33.48$, $p < 0.001$). We label individuals in IT careers as "IT professionals" as their individual profile is consistent with the prototypical IT professional espoused in IT literature (Enns et al. 2006; Slaughter and Ang 2004; Slaughter et al. 2007).

By comparison, the PLM career is composed of a more balanced proportion of males and females (male: 55.1 percent; female: 44.9 percent). Like IT professionals, individuals in PLM careers are likely to have attained at least a bachelor's degree (79.6 percent) but with more individuals going on to attain a postgraduate degree (41.5 percent). Individuals in PLM careers are also as likely to score as well as individuals in IT careers on cognitive ability tests (at the 72.6

⁹Respondents who declared their majors include those with a postgraduate degree, bachelor's degree, and those who have high school with some college education.

Table 6. Individual Profiles of Each Career Path

		Sample	IT Career	PLM Career	SLM Career	χ^2
	N	500	173 34.6%	147 29.4%	180 36.0%	
Demographics Gender	Male	300 60.0%	126 72.8%	81 55.1%	93 51.7%	18.58*** (<i>df</i> = 2)
	Female	200 40.0%	47 27.2%	66 44.9%	87 48.3%	
Human Capital Education Level	Postgraduate Degree	134 26.8%	57 32.9%	61 41.5%	16 8.9%	113.97*** (<i>df</i> = 6)
	Bachelor's Degree	195 39.0%	87 50.3%	56 38.1%	52 28.9%	
	High School with Some College	95 19.0%	21 12.1%	16 10.9%	58 32.2%	
	High School Diploma	76 15.2%	8 4.6%	14 9.5%	54 30.0%	
IT-Related Major	Non-IT-Related Major	292 58.4%	66 38.2%	105 71.4%	121 67.2%	45.24*** (<i>df</i> = 2)
	IT-Related Major	208 41.6%	107 61.8%	42 28.6%	59 32.8%	
						<i>F</i>
Percentile Score on Cognitive Ability Test	Mean	69.70	78.48	72.60	58.75	33.46***
	SD	24.33	21.90	21.96	24.42	(<i>df</i> = 2, 483)

percentile). Unlike individuals in IT careers, individuals in PLM careers are less likely to have majored in an IT-related program in college (28.6 percent IT-related majors).

The SLM career is also composed of equal proportions of males and females (males: 51.7 percent; females: 48.3 percent), but individuals here have typically attained a lower education level compared to individuals in the other careers. Individuals in SLM careers tend to have attained a high school diploma or its equivalent (30.0 percent) or a high school diploma with some college education (32.2 percent). A smaller proportion of individuals in the SLM career have attained a bachelor's degree (28.9 percent) compared to the other two careers. Out of those who attended college, a third of the individuals (32.8 percent) in the SLM career majored in an IT-related program in college. Figure 5 summarizes the key individual profile differences across clusters.

Objective Career Success

The profiles of individuals, their career paths, and the experiences that individuals gain within their career paths have implications for their objective career success (Judge et al.

1995; Valcour and Ladge 2008). To evaluate whether objective career success differed across the career paths, we examine the average real annual pay of individuals in each career path. We computed the average real annual pay using a CPI deflator, with 1982-1984 as the base year (Bureau of Labor Statistics 2006), from individuals' reported total annual pay for each year.

Consistent with the characterization of careers in the secondary labor market, individuals in SLM careers obtained the least average real annual pay (\$18,225; *SD* = \$8,615; $F_{(2, 497)} = 31.02, p < 0.001$). Comparing the average real annual pay of IT professionals with individuals in PLM careers, individuals in IT (\$32,281; *SD* = \$18,593) and PLM (\$32,530; *SD* = \$27,773) careers are neither better off nor worse off than each other in terms of average real annual pay ($t = 0.093, df = 247.87, ns$). However, the variance in pay for individuals in PLM careers is higher than the variance in pay for IT professionals (Levene's test for homogeneity of error variances, $F_{(2, 497)} = 13.44, p < 0.001$).

Figure 6 presents the 25th percentile, median, and 75th percentile of real annual pay for individuals in each career. It appears that IT professionals consistently receive moderately

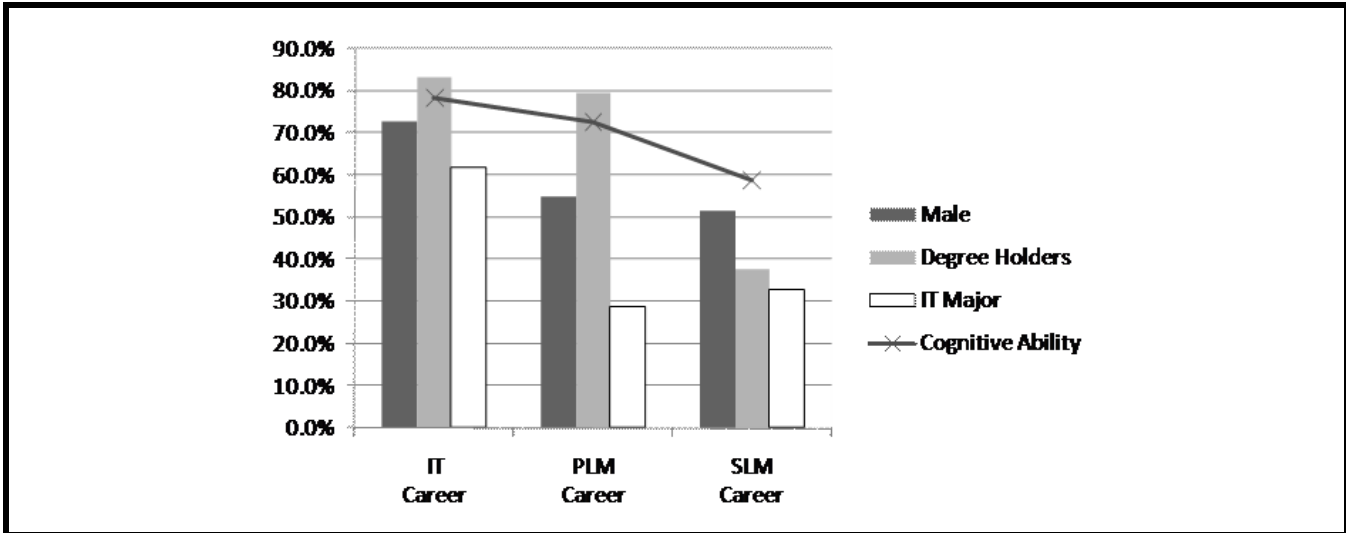
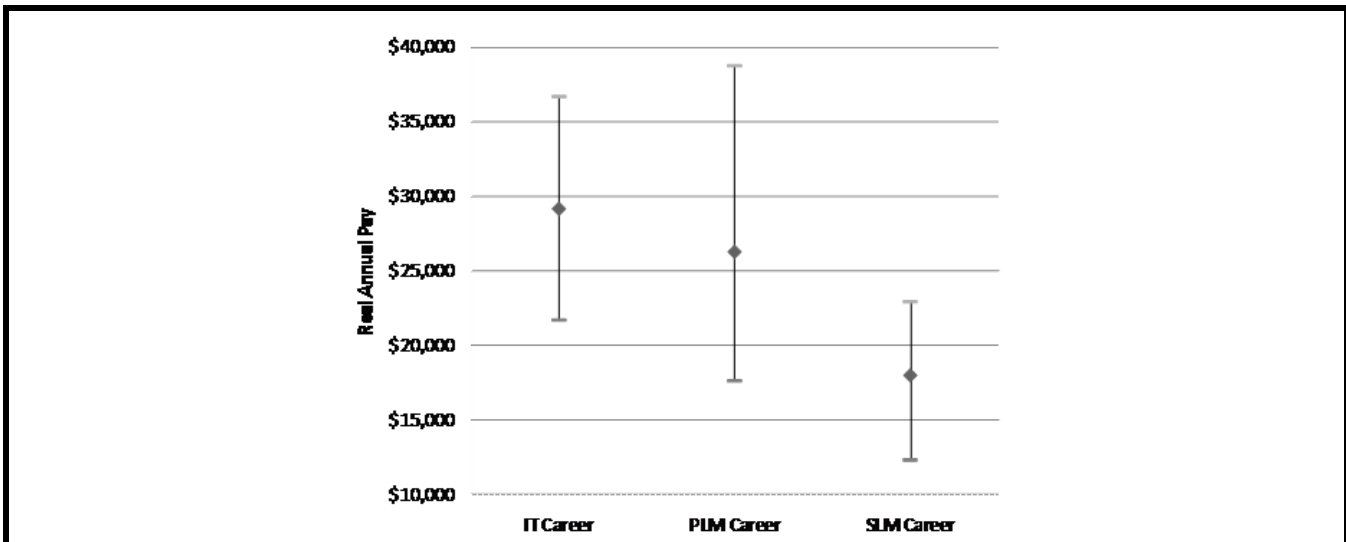


Figure 5. Individual Profiles Across Careers in the IT Workforce



Legend: The diamond represents the median real annual pay. The upper and lower horizontal bars represent the 75th and 25th percentiles, respectively, of real annual pay for a given career. Real annual pay was computed using a CPI deflator, with 1982–1984 as the base year.

Figure 6. Objective Career Success Across Careers in the IT Workforce

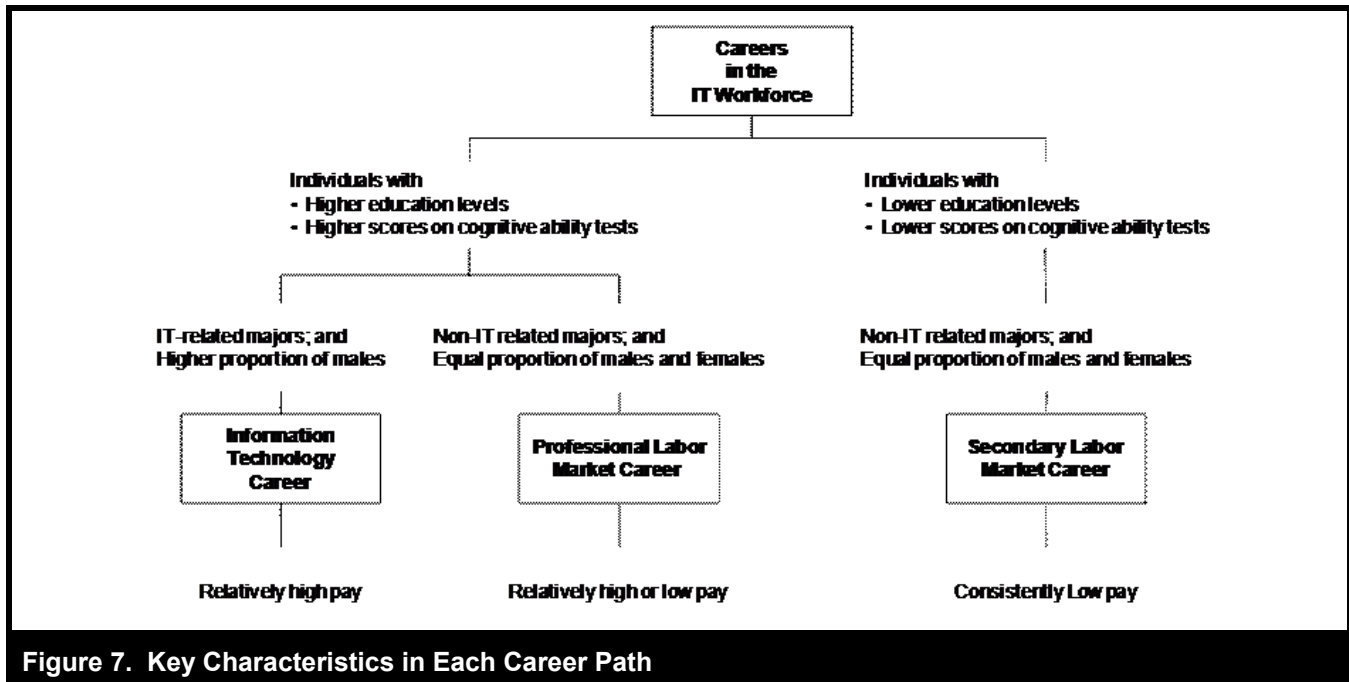


Figure 7. Key Characteristics in Each Career Path

high pay over the course of their careers (\$36,690 at the 75th percentile; \$29,152 at the median; and \$21,694 at the 25th percentile). By comparison, individuals in PLM careers are either better compensated (\$38,744 at the 75th percentile), or less well compensated (\$26,277 at the median; and \$17,630 at the 25th percentile) in terms of pay received given their frequent occupational mobility.¹⁰

Figure 7 summarizes our findings on the key characteristics differentiating individuals in each career path, and the resulting indications of objective career success.

Analyses of Sub-Career Paths

Although the cluster analysis identified three primary career paths, Aldenderfer and Blashfield (1984, p. 37) suggested the possibility of second order clusters with higher homogeneity nested within the larger first order clusters. To explore the possibility of second order career clusters, we subjected the career sequences within each primary career path to further hierarchical and nonhierarchical agglomeration. Our analysis reveals a more nuanced set of sub-career paths, nested within the three primary career paths (Appendix). This section describes the career paths and characteristics of individuals within these sub-careers.

¹⁰Real annual pay for SLM careers is \$22,938 at the 75th percentile, \$18,032 at the median, and \$12,310 at the 25th percentile.

Sub-Career Paths Within the Information Technology Career

Within the IT career, we find three sub-career paths: (1) technical IT, (2) managerial IT, and (3) late entry IT careers. These three sub-career paths differ in terms of the dominance of various occupations (Table A1 in the Appendix). Technical IT professionals hold the largest proportion of technical IT jobs in their work histories compared to individuals in the managerial IT and late entry IT careers. Technical IT professionals typically start in technical IT jobs very early in their careers (23.6 years of age, $SD = 2.5$ years), right after school (46 percent) or after a brief spell in non-IT jobs such as clerical (14 percent); craft, production, and service (13 percent); and technical administration and support (11 percent).¹¹ Thereafter, they tend to stay within the IT profession for the duration of their careers.

Managerial IT professionals, on the other hand, spend about a third (36 percent) of their work histories in non-IT occupations. Their career paths show that many incumbents experiment with non-IT occupations in early parts of their career, but they typically enter technical IT jobs by 26.2 years of age ($SD = 5.3$ years). These individuals enter IT jobs from

¹¹Technical administration and support jobs include Computer and Peripheral Equipment Operators, Key Punch Operators, Data Entry/Data Processing Machine Repairmen, and Computer/Automated Teller/Office Machine Repairers.

school, typically after postgraduate education (26 percent) or from non-IT jobs such as non-IT professional (20 percent); technical administration and support (16 percent); and non-IT managerial (12 percent). Thereafter, these individuals remain within the IT profession and work their way into managerial IT positions by the latter portions of their careers.

In contrast to the first two subgroups, about two-thirds (66 percent) of the work histories of late entry IT professionals are in non-IT occupations. Examining their career paths, we find that these individuals typically transit into the IT profession from non-IT jobs such as non-IT professional (27 percent); non-IT managerial (12 percent); craft, production, and service (12 percent); clerical (10 percent); technical administration and support (10 percent), and sales (10 percent). Individuals in this subgroup move into technical IT jobs during mid- or late-career (32.1 years in age, $SD = 5.9$ years) and tend to remain within the IT profession thereafter.

Although there are no significant differences in the demographics and human capital characteristics of individuals within the IT sub-careers (Table A2), we found that managerial IT professionals are paid significantly more (\$43,629, $SD = \$46,491$; $F_{(2, 170)} = 16.62$, $p < 0.001$) compared to technical IT professionals (\$29,667, $SD = \$11,616$) and late entry IT professionals (\$24,939, $SD = \$10,758$). In turn, technical IT professionals have accumulated more IT-specific human capital and, thus, are compensated significantly more than late entry IT professionals ($t = 2.33$, $df = 114.47$, $p < 0.05$).

Sub-Career Paths Within the Professional Labor Market Career

Individuals in PLM careers may be classified into one of two sub-career paths distinguished by the proportion of their career spent in non-IT professional jobs such as accounting, finance, human resources, or engineering (Table A3: 39 percent of career); and non-IT managerial jobs such as a finance manager, human resource manager, or general manager (29 percent of career). Hence, we name these two sub-career paths (1) technical PLM career and (2) managerial PLM career accordingly.

Individuals in these two sub-career paths do not differ significantly in their demographics and human capital acquired (Table A4). Individuals in a managerial PLM career (\$38,024, $SD = \$36,896$), however, earn significantly more on average than individuals in the technical PLM career (\$27,801, $SD = \$15,015$; $t = 2.14$, $df = 85.96$, $p < 0.05$).

Sub-Career Paths Within the Secondary Labor Market Career

Within the SLM career, we find five sub-career paths: (1) technical administration and support (TAS) career; (2) clerical career; (3) craft, production, and service (CPS) career; (4) military career; and (5) random career. Individuals in SLM careers appear to be the most heterogeneous, with significant differences across the five sub-career paths in terms of proportions of occupations and individual profiles (Tables A5 and A6). We describe the key differences below.

Individuals in the TAS career tend to work for long periods in technical administration and support jobs (Table A5: 42 percent) before entering technical IT jobs in the later stages of their careers. For these individuals, mobility into the IT profession appears to be an “upgrade” from the technical administration and support jobs that they have worked in for most of their careers. Similarly, individuals in clerical (C = 53 percent), CPS (O = 61 percent), and military (Y = 57 percent) careers tend to work for long periods in their respective dominant occupations. These individuals enter technical IT jobs later in their careers, typically about 11 to 14 years after starting their careers, but tend to stay in technical IT jobs for about 2 to 3 years. Finally, the individuals in the Random sub-career path tend to change occupations frequently (average of 7.9 career moves), and have no dominant occupation. Technical IT jobs appear to be only one of the “stops” for individuals in this sub-career path.

Individual profiles differ between the career paths. Significantly more females are in clerical careers (Table A6: 87 percent) compared to males. In contrast, significantly more males than females are in CPS (82 percent) and military (77 percent) careers. The gender compositions are balanced in TAS and Random sub-career paths. Individuals in TAS careers are more likely to be IT majors (57 percent) compared to individuals in other sub-career paths. The preceding differences in individual profiles appear to arise because individuals in SLM careers come from different walks of life—military personnel, blue and white collar workers, and individuals who do not settle down in any occupation. Despite their differences, the career outcomes of these individuals are similar: lower pay when compared to individuals in the IT and PLM careers.

Discussion

We undertook this study to achieve the following goals: (1) to identify and describe the contemporary careers of

individuals in the IT workforce; (2) to examine their mobility across occupations and organizations within their careers; (3) to differentiate the profiles of individuals associated with a given career; and (4) to assess the objective career success associated with contemporary careers. To accomplish these goals, we compiled a longitudinal data set comprising work histories of 500 individuals who worked in a full-time IT job at any point between 1979 and 2006 for at least a year. We analyzed their work histories using optimal matching, cluster analyses, and variance analyses.

Career Paths

This study finds that careers in the IT workforce are more varied than previously thought. Specifically, this study finds three broad career paths in the IT workforce: (1) information technology (IT) career; (2) professional labor market (PLM) career; and (3) secondary labor market (SLM) career. Within each of these three career paths are career that vary by the nature of the job and position. Together, these broad and specific career paths draw attention to a diverse range of careers that add new insights to the IT careers research.

IT professionals typically begin their venture into IT right after college or after a brief spell in a non-IT job. Thereafter, these IT professionals spend their remaining work histories in the IT profession. Within the IT career, some IT professionals choose to remain in technical IT jobs and follow a technical IT career. Other IT professionals transit from a series of technical IT jobs into a managerial IT job to pursue a managerial IT career. The technical IT and managerial IT careers typify the dual career paths described in the early IT careers literature (Chesebrough and Davis 1983; Ginzberg and Baroudi 1988; Kaiser 1983).

Within the sub-career paths in IT, we find support for our assertion that a dual career path in IT is unduly restrictive. We uncover a previously undocumented sub-career path: the late entry IT career. The late entry IT career represents a group of individuals who spend much of their early careers outside of IT and undertake a mid-career move into IT. Little is known about late entry IT professionals. As such, research examining their attitudes, motivations, and labor market experiences will complement existing research examining IT professionals whom organizations move out of IT to “seed the line” (Reich and Kaarst-Brown 1999, 2003).

Interestingly, only about a third (34.6 percent) of individuals in our sample adhered to an IT career. The remaining two-thirds (65.4 percent) of our sample spent brief periods in IT and went on to forge careers outside the IT profession.

The PLM and SLM careers forged by individuals who have worked in the IT workforce have yet to be documented in the IT literature. The PLM and SLM careers appear to comprise individuals who explore the viability of becoming IT professionals at some point in their work histories.

Individuals in PLM careers explore the viability of an IT job early in their work histories. After IT, the work histories of individuals in PLM careers are predominantly in non-IT professional and managerial jobs. The careers of these individuals may be further partitioned into two sub-career paths: (1) technical PLM, for those who stay predominantly in professional occupations, and (2) managerial PLM, for those who stay predominantly in managerial occupations. The career sequences of individuals in PLM careers appear to resemble those of the ex-IT professionals documented by Reich and Kaarst-Brown (1999, 2003). Although we do not have information about their underlying motivations and decisions to leave the IT profession, the available information about their job origins and destinations suggests that these individuals may exemplify a variation of the boundaryless career—a career where occupations do not pose boundaries and one where individuals choose to explore different occupations, typically within the security of their organization.

In comparison, the SLM career represents a group of individuals who operate predominantly in the secondary labor market for a large part of their work history. Individuals in this group are the most heterogeneous of the three broad career paths. They appear to come from all walks of life ranging from blue collar workers to clerical staff to military personnel who are looking for a chance to renew their careers in the IT profession after leaving military service (e.g., Cisco Systems Inc. 2008). Indeed, we identified five subgroups of individuals that clustered along occupational lines: technical administration and support; clerical; craft, production, and service; military service; and one subgroup showing no dominant occupation throughout individuals’ careers. IT jobs appear in the latter portions of these individuals’ work histories. It could be that these individuals are marginal workers in the IT profession with different attitudes and motivation. It is unlikely that these individuals in SLM careers undergo the same cognitive processes with regard to their careers as individuals within IT and PLM careers (Hulin et al. 1985).

Career Mobility

In further analyzing the types and timings of career mobility across careers, we find that the three broad careers are boundaryless in different ways. Individuals in IT careers tend

to move across organizations but stay within the IT profession. This finding suggests that IT professionals are not bounded by their organization but remain relatively bounded within the IT profession. From a skills transferability perspective (Becker 1975), IT professionals seem to have accumulated sufficient IT-specific human capital from the substantial periods within the IT profession to enable them to transfer their skills to other organizations while staying within the IT profession (Mithas and Krishnan 2008).

Interestingly, individuals in both the PLM and SLM careers change occupations within organizations quite frequently. This finding suggests that individuals in PLM and SLM careers are least bounded by occupations but the organization appears to play a large role in their moves across occupations. We suspect, however, that the mechanisms facilitating frequent occupational mobility within organizations for individuals in SLM careers differ from the mechanisms operating for those in PLM careers.

Individuals in PLM careers tend to make occupation-only moves in the early part of their careers, likely as part of an exploration process to find a job with the best fit. IT, therefore, seems to be only one stop in this exploration process, as individuals in PLM careers enter an IT job relatively early in their career and exit after about two years, typically facilitated by their employers. It appears that organizations provide the security and opportunity for these individuals to explore multiple occupations within an organization, perhaps as part of a job rotation process (Ortega 2001). The complicity of employers in facilitating occupational mobility suggests an internal labor market that is not restricted to traditional notions of upward mobility or promotions (Doeringer and Piore 1971; Osterman 1984), but that affords individuals in PLM careers job security and career opportunities to explore multiple occupations within their organizations (Reich and Kaarst-Brown 1999, 2003).

Individuals in SLM careers, on the other hand, make occupation-only moves throughout their career. It is possible that these individuals are attached to their organizations and are willing to take on jobs that their organizations require them to fill. Entry into IT for individuals in SLM careers tends to take place in the latter portion of their career, perhaps due to the increased demand for IT personnel during that period (Hayes 1998; Moore et al. 2001).

Overall, our results point to the need for future research to consider different types of career mobility. Much of the organizational turnover research in the IT and management disciplines assume that individuals turnover to another organization within the same occupation (Kirschenbaum and

Weisberg 2002). In our study, organization only mobility (or organizational turnover) accounts for only a small fraction of the three types of mobility observed, although it is highest for IT professionals.

Individual Profiles

The diverse career paths attract individuals with different profiles. Individuals in the IT career path match the profile of the prototypical IT professional portrayed in the IT literature: male, attained at least a bachelor's degree with a major in an IT-related program, and scores highly on cognitive aptitude tests (Enns et al. 2006; Slaughter and Ang 2004; Slaughter et al. 2007). In contrast, the prototypical individual in a PLM career is one who attended college, majored in a non-IT-related course of study, attained a bachelor's or postgraduate degree, and scores as highly on cognitive ability tests as IT professionals. The prototypical individual in SLM careers, however, tends to hold comparatively lower education level and scores lower on cognitive ability tests compared to the prototypical individuals in IT and PLM careers.

This diversity in the individual profiles in the IT workforce may have its roots in the severe IT labor imbalances experienced over the last three decades (Ang and Slaughter 2000). Pressure to fill IT jobs has translated into less concern for demonstrated experience and more willingness to seek plausible candidates from nontraditional sources (Cisco Systems Inc. 2008; Kanter 1984; Moore et al. 2001). For example, a 2003 ITAA study found only about 50 percent of the IT workforce then held an IT-related degree (Information Technology Association of America 2003a). The multidimensional skill requirements in the IT profession (e.g., knowledge and skills in technology, business operations, and interpersonal skills, Gallivan et al. 2004; Lee et al. 1995) may have led employers to recruit applicants from a wide variety of disciplinary backgrounds to fill IT jobs (National Science Foundation 2002). As a result, the IT workforce includes individuals from a variety of backgrounds.

There is limited IT research that examines how this diversity in individuals' profiles influences the evolution of the career paths of individuals (Ang and Slaughter 2000). Uncovering the PLM and SLM career paths is, therefore, significant because it highlights a long-term implication of the low barriers to entry into the IT profession. The diversity of individuals in the IT workforce has translated into significant heterogeneity in the career paths of individuals who have not been socialized into the IT profession by majoring in an IT-related program in college.

Objective Career Success

The diversity of careers, career mobility, and individual profiles results in differing career success. Consistent with human capital theory, individuals in SLM careers received lower pay because they have not invested as much in education—an important aspect of human capital. IT professionals receive higher pay than those in SLM careers, but equivalent to individuals in PLM careers, due to having invested in education and accumulated occupation-specific human capital. These IT professionals are rewarded for staying within the IT profession because they continue leveraging upon and building their IT-specific human capital (Mithas and Krishnan 2008).

Individuals in PLM careers also receive a similar level of pay, on average, as IT professionals. This finding is consistent with established evidence showing the pay of ex-IT professionals being maintained when ex-IT professionals are moved out to non-IT jobs by their organizations (Reich and Kaarst-Brown 1999, 2003). Thereafter, individuals in PLM careers appear to capitalize on both general and firm-specific human capital to achieve similar levels of career success as IT professionals.

There is, however, significant variance in the pay of individuals in PLM careers. It appears that some individuals in PLM careers pay a penalty because their frequent mobility has not enabled them to build significant firm-specific and occupation-specific human capital. On the other hand, there is a group of individuals in PLM careers who are managers for a large proportion of their careers. It also appears that these individuals are successful in leveraging their general human capital to propel themselves into key managerial positions that pay more.

Limitations

Although the data allowed us to examine careers in a longitudinal fashion, we are constrained to the work histories of one cohort of individuals in the U.S. workforce. Nonetheless, we believe that our findings would be applicable to understanding the careers of other cohorts of individuals currently in the IT workforce. The turbulent IT environment (Hayes 1998; Information Technology Association of America 2003b) and heterogeneity of individuals' backgrounds (Information Technology Association of America 2003a) remain unchanging characteristics of the IT workforce from the past to the present.

The turbulent IT environment arising from the imbalances in the demand and supply of IT labor (Moncarz et al. 2008;

Slaughter and Ang 1996) and from new disruptive technologies (Joseph et al. 2011) may similarly influence individuals in other cohorts (in the U.S. or globally) to leave the IT profession or their organizations. This turbulent environment, at the same time, provides opportunities for individuals with varied backgrounds to enter the IT workforce (e.g., U.S. war veterans; Cisco Systems Inc. 2008). We do acknowledge, however, that examining a single cohort constitutes a limitation, and future research is required to examine if the same findings are applicable to different cohorts of individuals.

Another limitation of our study is that we are unable to examine the reasons why individuals made specific occupational or organizational mobility decisions. We are limited by the missing data on variables in the NLSY79 data set capturing such information. Even though the NLSY79 attempts to collect reasons for career mobility, only about 9.1 percent of respondents had answered this set of questions in the last five waves of data collection (Bureau of Labor Statistics 2008). Future research examining the careers of IT professionals is encouraged to systematically uncover the reasons for undertaking specific career mobility decisions.

Implications for Future Research

This study has several implications for IT and for broader management research. First, expanding the conceptualization and operationalization of boundaryless careers to include both organizational and occupational boundaries enriches the criterion space by identifying a more differentiated set of career mobility. Doing so allows future research to posit more nuanced theories of boundaryless careers. Prior research addresses why individuals develop boundaryless careers through interorganizational mobility (Sullivan and Arthur 2006), but little is known about whether and why individuals develop boundaryless careers both across occupations and organizations (Ang and Slaughter 2000).

Expanding the criterion set of boundaryless career mobility may potentially enrich theories of job and occupation embeddedness (Feldman and Ng 2007; Mitchell et al. 2001; Ng and Feldman 2007). It could be that the fit, links, and sacrifices that one must make to leave an organization are more costly compared to the fit, links, and sacrifices that one must make to leave an occupation. If so, then this line of reasoning may explain why individuals tend to switch into and out of occupations within their organizations more than they enact organizational turnover.

The notion that boundaryless careers are formed by both interorganizational and interoccupational mobility has important

implications for human capital theory. Our finding that more occupational mobility occurs within organizations suggests that organizations value firm-specific human capital over occupation-specific human capital. From a skills transferability perspective (Becker 1975), it appears that firms are protecting their firm-specific human capital investments by providing opportunities for individuals to move between occupations within the organization.

In contrast, IT professionals seem to have accumulated sufficient IT-specific human capital from the substantial periods within the IT profession to enable them to transfer their skills to other organizations while staying within the IT profession (Mithas and Krishnan 2008). Hence, it is not surprising that IT professionals who are 42 to 49 years old (as of 2006) continue to experience organizational mobility where career theories posit more stability. As our data are right censored and these individuals have yet to report retirement, future research could expect to find their careers remain bounded to the IT profession but not to their organization until retirement (Jones and McIntosh 2010) and possibly even after retirement (Maestas 2010).

Second, our study draws attention to previous conceptualizations of turnover as being simplistic. Prior IT research on organizational turnover often does not consider the destinations of individuals after they leave their IT jobs. With this study, we provide new evidence that organizational turnover constitutes only a small proportion of all career mobility. We advocate that prior IT organizational turnover research should be revisited by refining the traditional definition of turnover to examine three conceptually distinct forms of career mobility: *organizational turnover* as mobility to similar jobs across organizational boundaries; *turnaway-within* as mobility to other occupations within organizational boundaries; and *turnaway-between* as mobility to other occupations across organizational boundaries. This refinement in the conceptualization and operationalization of career mobility, we believe, brings this study closer to the spirit of the original meaning of turnover as intended by March and Simon (1958).

Finally, the results from this study imply that prior IT research on career paths (Chesebrough and Davis 1983; Kaiser 1983; Tanniru 1983; Zabusky and Barley 1996) appears to have also held an exclusive definition of *IT professionals* as individuals committed to the IT profession and with significant investments in IT-specific human capital. The newly uncovered careers in this paper draw attention to the heterogeneity of individuals in the IT workforce and imply that researchers should exercise care when selecting IT professionals for future research. To date, cross-sectional research on IT personnel is conducted on samples of IT professionals that

may include individuals who share similar profiles as those in PLM and SLM careers, even though the intended target sample is those in IT careers. But clearly, individuals in PLM and SLM careers are not like individuals in IT careers. Uncovering these previously undocumented groups in the IT workforce underlines the importance for future research to consider individuals' career decisions within the context of a longitudinal work history.

Implications for Practice

Our research has several practical implications. First, this study shows that individuals in the IT workforce are highly heterogeneous, varying in their backgrounds, educational qualifications, and subsequently in the career paths they pursue. It is important, then, for human resource managers not to regard IT professionals as a homogeneous group, but to recognize this heterogeneity in managing and developing their careers.

Second, our research suggests the importance of majoring in IT-related programs in college as a socialization process that binds individuals to the IT profession. Those who chose to major in IT-related programs while in college tended to persist in an IT career, usually pursuing technical IT or managerial IT careers. As such, the choice of IT-related majors as a precursor to a career in the IT profession should not be overlooked. Non-IT-related majors, on the other hand, tend to stay in IT jobs for a short while, but eventually leave IT for other occupations.

Finally, for the individuals in the IT workforce, our findings suggest that IT professionals may have career alternatives that are not constrained to the dual career track as suggested by prior IT careers research (i.e., Chesebrough and Davis 1983; Kaiser 1983; Tanniru 1983). IT professionals and human resource managers, in planning IT professionals' careers, might consider moving IT professionals valued by the organization into managerial positions or into line functions. Nevertheless, our study also suggests that there are differential returns to career paths. In essence, leaving an IT career for a non-IT job function may leave one either well compensated in terms of pay received, or may result in receiving much lower pay than one would otherwise have achieved by staying within the IT profession.

Conclusion

In conclusion, this study contributes to the literature on career paths in several ways. One, our study provides a nuanced

understanding of the careers and career experiences of individuals in the IT workforce. The typology of careers identified in this study enriches our collective understanding of the diversity of career paths in the IT workforce. Two, this study refines the concept of boundaryless careers by uncovering a diverse set of career mobility that crosses occupational and organizational boundaries. The diversity of career mobility types enriches our understanding of how individuals construct a boundaryless career that spans organizations and occupations. Three, this study highlights the diversity of individual profiles in the IT workforce. Finally, our study indicates that career success is associated with the path traveled, the experiences within the path, and individuals' profiles.

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