Five Degrees of Separation:
A Human Capital Model of Employment-Related Decisionmaking
in the Information Technology Workforce

Robert A. Josefek, Jr.
Doctoral Candidate, Information Systems
Carlson School of Management
University of Minnesota
Minneapolis, MN  55455
Tel: 612-624-6565; Fax: 612-624-2026
Email: Robert.A.Josefek-1@tc.umn.edu

Robert J. Kauffman
Associate Professor of Information Systems
Carlson School of Management
University of Minnesota
Minneapolis, MN  55455
Tel: 612-624-8562; Fax: 612-626-1316
Email: rkauffman@csom.umn.edu

ABSTRACT

Successfully implementing information technology (IT)-enabled strategy rests on the performance of IT professionals. Consequently, developing and retaining “IT human capital” is critical for many organizations. We introduce human capital theory from economics to the information systems (IS) literature for the study of turnover, present a new model of separation, and provide empirical results based on observed separation from a large diversified firm. We derive five categories of explanatory variables from multiple theoretical bases including IS, organizational studies, industrial psychology, and strategic management. Results indicate ways in which IT human capital differs from that in less knowledge-intensive and less dynamic occupations.

1. Introduction

Since the 1980s, investments in new information technologies (IT) have been recognized as an important element of business strategy. Such investments in information systems (IS) motivate practitioners and researchers alike to study the relationships among various IT investments and firm performance [10,30] including hardware [17], software [29], networks [25], tools [2], and methodologies [1]. Yet in competitive markets, a firm’s ability to successfully implement and earn an adequate return on these strategic IT investments depends heavily on the capability of individual system designers and developers. This capability springs from a different kind of IT asset in which both individuals and firms can invest – human capital.

1.1. Motivation

As firms increasingly rely on the capabilities of IT professionals, labor shortages and unanticipated changes in IT staff have harmful effects: disrupted projects overrun schedules and budgets, important projects are put on hold, system quality falls, and the profitability of the organization is threatened. In the past several years, these conditions have sparked concern and action among U.S. government officials too. The Clinton Administration recently announced it would invest $28 million in new training programs and other initiatives to shore up the supply of talent to the IT industry [18]. The software development industry, now the nation’s largest, had $865 billion in gross revenues last year. The government also announced funding for development of a World Wide Web based system to match employers’ vacancies with people skilled to fill the vacancies.
Meantime, technology-intensive firms suffer. Already short-staffed IT organizations are affected by widely reported annual turnover rates over 20% [15]. Despite this crippling potential in industry, turnover among IT professionals has been the subject of little research [19]. One approach to understanding and managing this turnover is to consider some of the causal factors suggested by existing economics, management, and psychology research on turnover among various kinds of workers. However, much of the prior research fails to portray adequately the turbulent, changing and opportunity-laden world of the IT professional. To understand what is happening, we need to adopt new perspectives about how the nature of IT professionals’ job tasks, skill sets, knowledge, and work environment affect their employment decisionmaking.

Important behavioral perspectives inform much of what we know about employment-related decisionmaking by IT professionals. Industrial psychology and organizational studies, in particular, provide insights into the perceptions and intentions of IT professionals and their relationships with the firm. This research has been valuable for its portrayal of the motivational factors affecting IT professionals. However, it fails to consider the underlying asset – the human capital – that the individual controls, nor does it adequately reflect the special role that such capital plays in an organization.

1.2. The human capital perspective

In the 1960s, Nobel Laureate, Gary Becker formulated a theoretical structure for investment in people as investment in human capital [6,7]. Today we hear business leaders, politicians, educators, and others talk of human capital and its importance to individuals, firms, industries, and nations. For the purposes of this research, we employ the following definition: Human capital is the productive capacity imbedded in an individual that results from natural capability, education, training, and experience.

Thus, when we apply our individual knowledge and skills, we leverage our human capital and create value.

Human capital theory informs our understanding of employment-related decisionmaking throughout an individual’s life: how much education she obtains, when she begins work, what type of work she pursues, when she changes employers, and when she decides to retire. The theory, in our view, implies a utility assessment perspective on the part of the individual that makes decisionmaking rational (in Simon’s sense of bounded rationality), even in the presence of uncertain or incomplete information.

In this paper, we focus on decisionmaking that results in separation and turnover, which we define as follows:

- **Separation** – an event which occurs when an employee acts on a decision to leave a firm.
- **Turnover** – an aggregate firm level measure of separations over a specified period.

1.3. Research questions and approach

We focus on the following questions:

- What are the primary drivers of separation among IT professionals?
- In what way are the primary drivers and their influences different for IT professionals than for the general population of employees?
- Can we leverage human capital theory to specify a robust and inclusive model of turnover among IT professionals?

Prior research related to employment decisionmaking and turnover among IT professionals considers motivational factors. In addition, economic models of turnover have been proposed and tested in other, non-IT specific contexts. However, no single body of theory directly addresses employment-related decisionmaking by IT professionals as an economic phenomenon involving human capital. Since our research focuses on contemporary events that occur in a natural business setting and the theoretical base is not yet fully established, case study methods are appropriate [9,14].

We construct propositions based on our review of the literature, interviews with managers at multiple levels in the organization, and other related observations made during our fieldwork. We also develop a conceptual model that emphasizes five classes of causal factors – the “five degrees of separation model” – that is consistent with human capital theory. We then specify and estimate a related econometric model for this case, using a large data set. The econometric results test our propositions. Estimating the model with a large data set provides considerable power for discovering some of the basic causal relationships. We maximize validity through our choice of the dependent variable – actual separation – which represents an improvement over the more commonly used dependent variable in the literature – intention to separate. The result is a new synthesis that adds value to the IS literature and allows us to understand at a different level the behavior of a critical element of our information systems – the IT professional.

2. Background literature

Three literatures provide theoretical and empirical bases for understanding employment-related decisionmaking and separation.
2.1. IS research perspectives on IT human capital

The existing literature on career decisionmaking among IT professionals builds on theory from psychology and organizational studies. These supporting disciplines interpret the perceptions and Intentions of workers, their relationships with employers, and the factors that affect the separation decision for various kinds of workers.

Much of this literature reports turnover correlates and their relative influence based on path analysis of cross-sectional survey data [4,5,19]. For very practical reasons, the IS research generally employs intention to separate as the standard dependent variable. This choice is similar to what we see in the behavioral research conducted by organizational scholars. Many researchers believe intention to separate is an effective measure because it is correlated with actual separation [23]. Using this dependent variable minimizes the difficulties associated with finding and collecting data from individuals who are no longer with an organization.

However, we view intention to separate as a second best variable to actual separation; a better approach is to distinguish between the drivers of intentions and the drivers of actual separation by examining the drivers of observed separation behavior.

Important explanatory factors in the IT context include individual demographics, job and career satisfaction, job type, task characteristics, attitudes toward the organization, intention to separate and role stressors, such as ambiguity, conflict or boundary spanning [4,20]. Organizations interested in managing turnover can observe and affect some of these underlying variables, but those most highly correlated with separation are problematic. For example, management can control task characteristics through job and organizational design, and by their choice of production tools and technology. Satisfaction and attitudes toward the organization are more problematic because management cannot readily observe or change them. As with research on other groups of employees in other contexts, the IS literature identifies satisfaction and attitude toward the organization as being most correlated with intention to separate.

2.2. Organizational perspectives on IT human capital

Researchers from management, industrial psychology, and other organizational schools have devoted considerable effort to understand employment-related decisions. Theories of the firm explain why employment exists, agency and contract theory consider the structure and performance of employment relationships, and a vast body of literature based on industrial psychology attempts to address turnover [13]. This work broadly concludes that relationships exist between intention to separate and a variety of personal, work-related, and external factors [11] including consistent correlation with overall job satisfaction, age, and tenure. Factors that have weak or inconsistent support include pay, promotion, personality inventories, and task repetitiveness. In general, this body of existing work argues that intention to separate, and thus turnover, is the result of dissatisfaction.

As is the case with published IS research, empirical analysis in this literature generally employs correlation and path analysis of survey data. One difference is that the emphasis is on broad classes of employees. Although, we sometimes see distinctions made between white-collar and blue-collar workers, managers and non-managers, and professionals and non-professionals. While these distinctions acknowledge the important roles that task and environmental characteristics play in individual employment decisionmaking, the classifications are too broad to be useful in the context of IS. While this literature is useful for understanding the motivational factors affecting broad classes of workers, and it supports the argument that turnover is sensitive to the job and work environment. However, we view it only as a starting point for understanding employment decisionmaking among IT professionals.

Theory from another body of organizational literature enables us to establish IT human capital as important to study in its own right. From the firm’s perspective, we can think of a pool of human capital, appropriately deployed, as a resource capable of creating value and delivering competitive advantage. The resource-based theory of the firm argues that firms may derive sustainable competitive advantage only from value-producing resources that are rare, difficult to imitate, and not vulnerable to substitution [3]. When the human capital of individual IT professionals meets these criteria, it becomes a strategic asset capable of enabling competitive advantage (e.g., in financial markets [21]. The mission critical nature of many information systems and the critical roles IT professionals play throughout a system’s life bolster the idea of an IT professional as a strategic resource. Combinations of individual human capital within a firm and other organizational resources may even provide sustainable competitive advantage [27].

2.3. Economic perspectives on IT human capital

Human capital theory assumes that both schooling and on-the-job training enhance our natural abilities and increase individual productive capacity. It also draws on the more general economic theory that firms compensate employees up to their marginal productivity. The result is a strong argument that individual decisions to invest in schooling and on-the-job training are means to acquire productivity-enhancing, work-related skills. This creates
investment in education and experience: specific and general. *Specific human capital* is human capital that is of value to a single employer. Knowledge of program code in an accounts payable application developed in-house is specific human capital; it is unlikely that any other employer can benefit from the person’s knowledge of that code. Specific human capital is usually the result of on-the-job training or experience and, therefore, is a function of tenure with the firm. *General human capital* is human capital that more than one employer can benefit from in an employment relationship, though it may still have some contextual dependencies. Formal training in C++, VisualBasic, PowerBuilder, or Java programming languages creates general human capital. The concepts of general and specific human capital give us a way to think about individual decisionmaking that considers anticipated post-investment productivity, its value to the firm, and the cost of attaining that productivity.

From these definitions we know that regardless of the point in her career that an individual joins a firm, the only human capital she possesses that is of value to the firm is general human capital. Over time, as she builds capital specific to the firm, her individual productivity increases. The firm, continuing to compensate at marginal productivity will pay now her more than what she might be worth to another firm, i.e., more than the market rate for her general human capital. This is a rational outcome because the firm wants to retain individuals with valued specific skills and experience for their specific human capital. Not surprisingly, the same employee will experience reduced returns to employment if she chooses to leave the firm; the specific human capital will lose its value in the marketplace. Thus, we expect to see lower turnover among employees with greater tenure in many job types.

IT professionals are corporate assets, but they are also rational agents who decide among alternate courses of action and seek optimal levels of productivity consistent with their individual goals. As firms and individuals pursue relationships that make them better off than they would be otherwise, each is constrained by a lack of information about the other. Such imperfect and asymmetric information about positions and employees means that good skill-to-position matches will require some degree of experimentation as firms and individuals test the value of specific relationships. This gives rise to the *search* framework [24] in which the individual searches for an appropriate match. This argument lays the groundwork for job matching theory [28] and the theory of occupational choice [22]. These latter theories explain job and occupational changes as a search for a more appropriate match between an individual’s human capital and her occupation or employer. Each of these related theories offers sound economic reasoning for separation behavior as an individual seeks to maximize return on investment in human capital over the course of her working life.

Change is another critical factor. As firms adopt new production technologies, the nature of the work and the skills necessary to achieve individual productivity change. Human capital that was once valued for its productive capacity depreciates and, absent investment in new skills and knowledge, the value of an individual to the firm decreases. A mismatch between the individual and the tasks associated with a changing job description increases the likelihood of separation.

Managerial actions and policy also influence individual employment-related decisionmaking. For example, the nature of a position within a firm constrains the potential value that an individual in the position can create for the firm and therefore places a limit on the return to human capital employed in that position.

IS researchers can benefit from employing human capital and related economic theory in three ways. *First*, an established theory base provides support for human competency as a capital asset with special characteristics. *Second*, we obtain a mechanism for understanding individual employment-related decisionmaking, including the separation decision. *Third*, we see that turnover is a rational economic outcome that occurs as a result of a mix of forces over which firms and managers have varying degrees of influence. Each of these lessons from human capital and related economic theory can enhance our understanding of turnover in an IS context. When combined with grounding evidence and interpretation in an exploratory case study, this theory allows us to begin to specify a new conceptual model of separation and turnover among IT professionals.

3. Making sense of IT human capital turnover

We employ case study analysis to ground our research and support model development and variable specification.

3.1. Turnover demographics at Twin Cities, Inc.

Senior management of Twin Cities Inc. (TCI), a large, diversified services firm, recognizes IT as critical to the firm’s success and is frustrated by the impact of excessive turnover. The decentralized IT organization consists of
approximately 850 people including 250 contractors who support business units operating in five different service industries and several countries. Employees would fill most of the positions held by contractors if the organization was able to hire and retain a sufficient IT professional staff, but they have been unable to do so. IT managers complain about spending 25% of their time recruiting and retaining employees. This occurs despite investment in employee training, career development activities, recruiting, and retention bonuses, and a host of other commonly prescribed activities. For the most recent calendar year, management reports turnover within the IT organization at 19%, a serious threat to the firm’s competitiveness.

![Figure 1. Upturn in IT turnover](image)

The firm consists of separate and highly autonomous divisions that operate in different industries. The IT organizations supporting these divisions vary in size, types of technology employed, reputation, and work environment.

<table>
<thead>
<tr>
<th>Year end</th>
<th>Div. 1</th>
<th>Div. 2</th>
<th>Div. 3</th>
<th>Div. 4</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1996</td>
<td>194</td>
<td>63</td>
<td>176</td>
<td>120</td>
<td>553</td>
</tr>
<tr>
<td>1997</td>
<td>221</td>
<td>63</td>
<td>188</td>
<td>150</td>
<td>622</td>
</tr>
</tbody>
</table>

The nature of technology varies both within and across the operating units. Within Division 4, for example, legacy systems operate in parallel with new technologies. Division 2, by contrast, is more IT intensive, but not so cutting edge; it has a reputation for thorough employment screening, followed by indoctrination of new hires into a strong culture. This division is also known for delivering high quality systems on time and near budget. Division 3, however, takes a “burn ‘em and turn ‘em” approach, often selling IT-enabled products before the IS function can deliver them.

Prior to the year that this study was undertaken, the trend in turnover rates across the divisions was generally downward, even though the level of turnover varied among the IT organization in each division. This year, however, turnover rates in every IT organization turned upward, causing concern across the firm.

3.2. Managerial perspectives and actions relative to IT human capital

IT management recognizes that the performance of the IT organization is largely dependent upon having talented individuals who are well motivated to accomplish the work at hand. They employ a framework of technical, business, and professional competencies that they believe are critical to success within each position. To ensure its people have these skills, the IT organization provided almost 40,000 hours of formal training during the last two years. Approximately 70 people have completed a special series of software design. An actively managed training library of over 60 computer, video, and text based training programs supplements live instruction. All IT employees can also obtain free educational counseling and related services.

To ensure individual needs are meet, management implemented a career development program that helps employees better understand their individual competencies and embark on a plan to reach their goals. The formally defined “skill set” of a position (e.g., Applications or System Operations) helps employees identify jobs that share related competencies or are on similar salary grades in different skill set categories. The combination of skill set and salary grade helps employees map out viable career path options. The program also provides mechanisms for skill assessment, skill gap analysis, and career planning that can incorporate information from others with whom an individual works.

Management believes that the firm must focus its attention and resources on strategies that provide the right mix of skills and motivation. A recent cost study reveals that average direct and indirect costs of IT turnover approach $25,000 per separation, and can be considerably higher for high priced talent or those who possess critical knowledge. Consequently, senior managers believe that focusing resources to retain the right people, skills, and knowledge is a critical success factor for the IT organizations, the divisions, and firm as a whole.

3.3. Case study evidence for drivers of separation

Even with a 19% turnover rate, many individuals remain with the firm for years. Furthermore, separation is sometimes good for both the individual and the firm. What concerns managers is the unwanted and unexpected separation of high performing talent. The challenge is that by the time an individual expresses dissatisfaction with their work situation, it is often too late to do enough to affect the individual’s decision to leave. Through interviews, review of archival records, and other observations made during fieldwork, we identify factors that affect separation decisionmaking among IT
The degree of match among firm, job, and individual employers will result in a net gain because of a better leave an IT organization when she believes that changing employees. Drivers with similar affects among IT and non-IT employees and those that do not. At TCI: those that have similar effects among IT and non-IT workers. Combining these factors result is a parsimonious, powerful model. These observations provide support for a conceptual model and propositions that relate closely to our research questions on human capital and employment decisionmaking in the IT workforce.

4. Modeling turnover behavior at Twin Cities, Inc

Observations made while conducting the case study fieldwork and the literature review suggest to us a number of factors that may be correlated with turnover. These include multiple characteristics of the individual, the job, the division of the firm and the labor market. Human capital theory facilitates identification of a subset of these factors that demonstrate differences between IT professionals and broader classes of workers as well as those which are likely to have similar effects among IT and non-IT workers. Combining these factors result is a parsimonious, powerful model.

4.1. Identifying correlates of turnover

We next analyze two kinds of correlates with turnover at TCI: those that have similar effects among IT and non-IT employees and those that do not. Drivers with similar affects among IT and non-IT employees. As in other professions, an individual will leave an IT organization when she believes that changing employers will result in a net gain because of a better match with her human capital or personal preferences. The degree of match among firm, job, and individual affect the potential benefit the organization and individual will gain from the relationship. An appropriately designed job, within the right organizational environment, yields high productivity when combined with a skilled and motivated individual. Consequently, we expect position structure, the available productivity tools, the organizational environment, and individual skills, knowledge, and ability to affect the value-creating potential of the employment relationship for both the individual and the firm. Similarly, the benefit an individual receives from interacting with others in the organization, the firm’s employment-related policies, and social factors influence individual motivation and decisionmaking.

Individual pursuit of employment that increases human capital will also affect worker behavior. One of the most commonly stated reasons for changing employers is that IT professionals want to gain experience, skills, or knowledge that their current employer cannot or will not accommodate. Like compensation, professional development provides an important return to the IT professional because the resulting increases in human capital facilitate future returns from work. We expect IT professionals to behave in a fashion similar to those in other occupations who leave their employer to build human capital. Drivers with dissimilar affects among IT and non-IT employees. In other ways, the IT professional is unlike other groups of employees. Traditionally we have taken younger workers’ relatively small investment in specific human capital to mean that the cost of separation is less for young workers. The nearly full transferability of their human capital means they experience little loss of earnings on that capital when changing employers. Meanwhile, older workers derive significant benefit from specific skills gained through tenure and are reluctant to abandon this higher return by joining a new employer. However, an employer’s adoption of new technology changes the relative productivity and value of skills; vintage skills, specific to the old technology, lose value while general skills gain relative to the old skills. Consequently, the value of experience drops and more seasoned workers have less to lose when separating. In the IT profession, the combination of high knowledge content and rapid technological change increase the likelihood that we will see non-traditional behavior. Specifically, we expect experience and tenure not have the same effect on IT professionals that they have on others.

4.2. “Five Degrees of Separation”: A descriptive model of IT human capital turnover

A useful model of decisionmaking will capture the most important factors that drive IT professionals'
decisions to separate or stay with TCI and will be sufficiently general that it can span to other organizations and settings that involve IT professionals. The most important factors in this model are the work itself, characteristics of the individual and of the organization, rewards to those involved in the relationship, and characteristics of individual IT human capital. This model, the Five Degrees of Separation Model, is shown in Figure 1. It provides a framework for categorizing relevant variables and the conditions that increase the likelihood of turnover because of an unsatisfactory match.

The firm benefits from an employment relationship with an IT professional because the employee attains some level of performance in a value-creating activity. In exchange for an expected level of value-creating performance, the firm provides compensation. Together, performance and compensation yield some net benefit to the firm. If performance is less than expected given the level of compensation the firm will view the relationship as an unsatisfactory match and seek an appropriate remedy.

Individuals benefit from both financial compensation and non-pecuniary benefits from the relationship. Higher compensation indicates greater financial reward from the relationship while non-pecuniary benefits provide psychic and other rewards. Consider the individual's perspective on compensation and performance. If the benefits from the employment relationship are less than expected, given the level of performance, the individual will view the relationship as an unsatisfactory match and she will seek other opportunities to leverage her investment in human capital.

Although compensation and performance variables give us an indication of individual human capital and its match with a specific position and organization, neither is independently sufficient to determine whether a match is appropriate. For example, an individual who is paid considerably less that her peers may stay with an organization because she knows that her contribution to the organization is also less. Similarly, another individual who earns significantly more than his peers may leave the organization because his performance warrants an even higher level of compensation.

Position characteristics also provide insight into the nature and level of human capital employed by identifying primary skill sets and the level of contribution expected from higher skills in a particular area. Lifecycle factors that reflect the role of specific human capital and the expected period over which an individual can benefit from a change in employers are crucial to the separation decision. Individuals with fewer working years in which to recover the cost of changing employers are less likely to separate than individuals with longer time horizons. In many occupations, as workers gain experience with an employer, they are less inclined to leave because return from specific human capital will vanish. That is, over time a good match is likely to become better, reducing the likelihood of separation. By contrast, we believe the relationship between experience and separation does not hold in an environment characterized by knowledge-work and rapid technological change.

Each of these factors may have a different effect on people who have different skill sets or who are subject to different workplace pressures. We can identify the core skill sets based on position definitions and job family categories suggested to us by managers at TCI Inc. Similarly, identifying the organization allows us to capture the effect of differences in workplace pressure, human resource policy, reputation, and other factors attributable to the specific IT organization.

4.3. Propositions

Differences in the way factors influence IT professionals’ behavior indicate that the decisionmaking model for IT professionals is different from that which is appropriate for broader classes of workers. The human capital perspective can help us better understand these differences and their implications.

Dissimilar effects. Return on human capital investment is a function of the nature of the human capital employed and the employment environment. Consequently, differences in occupation and employment environment will drive different behavior from the same variables. In the case of IT professionals, high knowledge content and rapid technological change means
that lifecycle and specific human capital are less relevant than other factors. Loss of return on specific human capital is insignificant relative to the return on new skill sets valued by many employers. At the same time, however, general human capital gained through greater life experience is not of significant value relative to the value attributable to the new skill sets. As firms increase demand for these new technology skill sets and both age and tenure become less relevant, individuals with the requisite skills have greater opportunity to better their employment situation and the likelihood of separation increases.

Prop. 1. Lifecycle considerations are not an important factor in IT professionals’ separation decisions.

Prop. 2. Firm-specific human capital is not an important factor in IT professionals’ separation decisions.

Prop. 3. As the level of human capital attributable to specific technology increases, the likelihood of separation increases.

Similar effects. Some factors that affect broad classes of employees will have similar effects among IT professionals. For example, characteristics of the organization (e.g., reputation and employment policy) will affect the IT professional’s decisionmaking. Similarly, since one would not expect employees or employers to prefer poor performance, we expect to see turnover increase as performance decreases. Likewise, one would not expect either party to an employment relationship to prefer to be at the disadvantaged end of an inequitable pairing. Consequently, we expect to see turnover increase as the equity of the relationship decreases. Absolute compensation, however, will have no significant effect on separation because, by itself, it indicates nothing about the equity of the relationship.

Prop. 4. As benefits to the firm and individual decrease, the likelihood of separation increases.

Prop. 5. Organization characteristics are an important factor in IT professionals’ separation decisions.

5. An empirical analysis of IT human capital turnover

We model the decision to separate or remain with a firm as a binary decision with several decision factors. We construct an empirical model where separation is a function of variables describing the five degrees of separation that we propose. Estimating the empirical model using binomial regression techniques provides a basis for testing the propositions.

5.1. Variables

We have already identified age, tenure, performance, compensation, organization, primary skill set, and equity of the relationship as the relevant factors to consider for the model. Definitions of all but the last variable, equity of the relationship, are as one expects (see table two).

Equity of the relationship requires an assessment of benefits received from and contributions made to the partnership. We accomplish that by constructing an indicator variable based on an individual’s contribution relative to their position, the expected value of contribution from someone employed in that position, and remuneration to the employee. Salary paid in 1997 reflects remuneration. A regularly scheduled performance rating on a five-point scale by an individual’s manager provides an estimate of individual contribution. Market salaries reflected in salary ranges for each position indicate the expected value of contribution. Recent revisions by TCI give us confidence that range midpoints fairly represent market value of individuals performing at the mean for that position and that the range minimums and maximums are appropriate.

Equity in the relationship therefore requires that individuals who deliver performance at the midpoint for professionals in that position will receive compensation at the midpoint of the salary range for that position. Similarly, compensation above or below midpoint should be consistent with performance above or below the midpoint. We begin constructing the indicator variable by standardizing individual performance ratings (Equation 3) \( \text{StdPerfRating} \). This results in a relative performance measure with mean zero, positive values for performance above the mean, and negative values for performance below the mean. The standardized performance rating provides a basis for determining \( \text{PerformanceAdjSalary} \) (performance adjusted salary, Equation 2) such that the adjusted salary is above or below the midpoint for the position by an amount that is consistent with the individual’s variation from mean performance. Next, we compare an individual’s actual Salary with their \( \text{PerformanceAdjSalary} \). If the actual Salary is lower than the \( \text{PerformanceAdjSalary} \) we consider the individual underpaid given their performance and set the binary variable \( \text{Underpaid} \) equal to 1 (Equation 4) to indicate a lack of equity in the employment relationship from the individual’s perspective.

5.2. Functional form

We model the separation decision as a binary choice in which the dependent variable \( \text{P(Separation)} \) equals one when the individual actually left the firm and zero otherwise. Simple linear regression is known to be inappropriate when the outcome is a binary indicator variable because it results in non-normally distributed error terms and heteroskedasticity (or non-constant error variance). Moreover, the parameter estimates may result
in estimated values of the dependent variable, \( P(\text{Separation}) \), that are greater than 1 or less than 0. To overcome these problems, we employ a simple, additive logit model in which each of the independent variables enters the model as a main effect [16]. The logit model properly constrains the estimated values of the dependent variable. The resulting estimation model yields parameter estimates that equate each combination of variable values present in the data with the probability of separation established by the set of observations.

Equation 1. Logit model

\[
P(\text{Separation} = 1) = \frac{\exp(\alpha + \beta \times X + \gamma D)}{1 + \exp(\alpha + \beta \times X + \gamma D)} + \epsilon
\]

Where: \( X = \) [Continuous Variables] \( D = \) [Binary Variables]

We will identify the specific variables at an appropriate point later in the paper.

<table>
<thead>
<tr>
<th>Variable Name</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \alpha, \beta, \gamma )</td>
<td>Model parameters.</td>
</tr>
<tr>
<td>Age</td>
<td>Age in years.</td>
</tr>
<tr>
<td>Compensation</td>
<td>Annual salary.</td>
</tr>
<tr>
<td>Division1,…,Division4</td>
<td>Binary variables that indicate the division employing the individual, with Division 1 as the base case, and thus not included in the estimation model.</td>
</tr>
<tr>
<td>Performance</td>
<td>Performance rating from manager.</td>
</tr>
<tr>
<td>Performance Adj Salary</td>
<td>Performance Adjusted Salary equals the midpoint of the salary range, adjusted up or down, to reflect performance above or below the mean performance level. The magnitude of adjustment depends upon the magnitude of performance from the mean as reflected in the Std Perf Rate. For individuals performing at the mean performance level Std Perf Rate is zero, so Performance Adj Salary equals the midpoint of the salary range.</td>
</tr>
<tr>
<td>Std Perf Rate</td>
<td>Standardized Performance rate, an intermediate variable used to determine Performance Adj Salary. This variable has mean zero, and is determined for the ( i )th individual with respect to all I individuals in the TCI Inc. sample population.</td>
</tr>
<tr>
<td>Tenure</td>
<td>Tenure in Years.</td>
</tr>
<tr>
<td>Underpaid</td>
<td>Dummy variable indicating whether individual is underpaid given performance adjusted salary (Performance Adj Salary).</td>
</tr>
</tbody>
</table>

Equation 2.

\[
\text{Performance Adj Salary} = \frac{(\text{MaxOfSalaryRange} - \text{MinOfSalaryRange}) \times \text{Std Perf Rate} + \text{MidptOfRange}}{6}
\]

Primary Skill Set

Administration/Strategy, Applications, Architecture, Multiple (principally managerial) and System Operations

Equation 3.

\[
\text{Std Perf Rate}_i = \frac{1}{\sigma_{\text{Std Perf Rate}}} \sum_{i=1}^{I} \text{Performance Rating}_i - \frac{\sum_{i=1}^{I} \text{Performance Rating}_i}{I}
\]

Equation 4.

\[
\text{Underpaid} = \begin{cases} 1, & \text{if } (\text{Salary} - \text{Performance Adj Salary}) > 0 \\ 0, & \text{otherwise} \end{cases}
\]

\( \epsilon \) A randomly distributed error term\(^1\).

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\(^1\) Neter, Kuttner, Nachtsheim, and Wasserman (1996) point out that because the dependent variable can only take on values of 0 or 1, analyzing the residuals is more difficult for binomial logit than for standard linear models. In fact, the authors point out that "the residuals will not be normally distributed and, indeed, their distribution under the assumption that the fitted model is correct is unknown" (p. 595). An attractive feature of the logit...
5.3. Data collection and test methodology

Guided by theory and experience, we probed archival data in payroll records, standardized job descriptions, compensation policy, senior management briefings, and other internal company documents. Interviews with IT management and review of publicly available information from secondary sources provided additional anecdotal and corroborating evidence related to positions, divisions, policy, and the market for IT labor.

The initial data set contained observations on 666 IT professionals hired before 1998 and employed by the firm at some time during 1997. Of these, we excluded 192 individual observations (29%) because they did not include a performance rating. The majority of observations removed for this reason were on individuals who had been with the firm for less than one year.

Except for the exclusion of recent hires from the data set, we do not believe this biases the results in any way. Management concurs with this assessment.

Analysis of the remaining data (summarized in tables 2-5) reveals that the observations are from a reasonably normal distribution of values for age, salary, performance, and tenure with midpoints and ranges consistent with what we expect among IT professionals in this labor market. We find no evidence of collinearity and multicollinearity since no simple correlation between pairs of variables exceeded .60 and the [8] test results indicate an absence of multicollinearity. In the tables, the number of separations gives a sense of the absolute cost of turnover while the turnover rate gives an indication of disruptive effect.

Table 3. Descriptive statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>Median</th>
<th>Standard Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>37</td>
<td>37</td>
<td>7.9</td>
<td>20,600</td>
<td>63,800</td>
</tr>
<tr>
<td>Annual Salary</td>
<td>53,824</td>
<td>50,835</td>
<td>19,884</td>
<td>18,533</td>
<td>136,531</td>
</tr>
<tr>
<td>Performance Rating</td>
<td>3.8</td>
<td>4.0</td>
<td>0.5</td>
<td>1.8</td>
<td>5.0</td>
</tr>
<tr>
<td>Tenure</td>
<td>2253</td>
<td>1856</td>
<td>1840</td>
<td>198</td>
<td>12,929</td>
</tr>
</tbody>
</table>

Table 4. Separation decisions by skill set

<table>
<thead>
<tr>
<th>Skill set</th>
<th>Retained</th>
<th>Separated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Administration/Strategy</td>
<td>20</td>
<td>3</td>
</tr>
<tr>
<td>Applications</td>
<td>81</td>
<td>13</td>
</tr>
<tr>
<td>Architecture</td>
<td>119</td>
<td>23</td>
</tr>
<tr>
<td>Business</td>
<td>81</td>
<td>2</td>
</tr>
<tr>
<td>Multiple</td>
<td>69</td>
<td>10</td>
</tr>
<tr>
<td>System Operations</td>
<td>51</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 5. Separation decisions by division

<table>
<thead>
<tr>
<th>Division</th>
<th>Retained</th>
<th>Separated</th>
</tr>
</thead>
<tbody>
<tr>
<td>Div. 1</td>
<td>133</td>
<td>24</td>
</tr>
<tr>
<td>Div. 2</td>
<td>39</td>
<td>8</td>
</tr>
<tr>
<td>Div. 3</td>
<td>126</td>
<td>17</td>
</tr>
<tr>
<td>Div. 4</td>
<td>123</td>
<td>4</td>
</tr>
</tbody>
</table>

Table 6. Turnover by division & skill set

<table>
<thead>
<tr>
<th>Division</th>
<th>Business</th>
<th>Multiple</th>
<th>Admin/Strategy</th>
<th>Sys. Ops.</th>
<th>Architecture</th>
<th>Applications</th>
<th>Total</th>
<th>Employed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Div. 1</td>
<td>0%</td>
<td>4%</td>
<td>6%</td>
<td>0%</td>
<td>30%</td>
<td>6%</td>
<td>45%</td>
<td>33%</td>
</tr>
<tr>
<td>Div. 2</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>4%</td>
<td>4%</td>
<td>6%</td>
<td>15%</td>
<td>10%</td>
</tr>
<tr>
<td>Div. 3</td>
<td>2%</td>
<td>13%</td>
<td>0%</td>
<td>0%</td>
<td>4%</td>
<td>13%</td>
<td>32%</td>
<td>30%</td>
</tr>
<tr>
<td>Div. 4</td>
<td>0%</td>
<td>2%</td>
<td>0%</td>
<td>0%</td>
<td>6%</td>
<td>0%</td>
<td>8%</td>
<td>27%</td>
</tr>
<tr>
<td>Total</td>
<td>4%</td>
<td>19%</td>
<td>6%</td>
<td>4%</td>
<td>43%</td>
<td>25%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Employed</td>
<td>17%</td>
<td>17%</td>
<td>5%</td>
<td>11%</td>
<td>30%</td>
<td>20%</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Note: Employed = (number of individuals employed by division or skill set) / (total employed)

Table 5, which includes information on turnover by division and skill set, is also revealing. Not surprising, given the preceding analysis, is that 30% of all separations occur among architecture professionals in Division 1. However, Division 3 emerges with a high percentage of total separations among applications professionals and management. Administration/Strategy and Systems Operations personnel exhibit low separation rates and almost no variation in separation among the divisions. IT professionals with a business focus exhibit slightly more separation variation among the divisions but still account for only 4% of all turnover.

model is that, unlike the probit model, it does not assume that the probability distributions for the thresholds for categorizing a specific observation as 0 or 1 are normal.
**5.4. Empirical results**

**Model fit.** We estimated the binomial logit model (Equation 5. Estimation Model) and obtained a deviance-chi-squared of 218.59 with 257 degrees of freedom and a p-value of 0.961. That indicates there is insufficient evidence to reject the null hypothesis that the logistic response model has a good fit. Next, we used the change in deviance-chi-squared statistic that results from dropping variables from the model to indicate whether we can achieve a more parsimonious model without impairing goodness of fit [26]. Our attempt to eliminate variables of secondary importance in that way demonstrated that all variables in the estimation model are significant.

**Equation 5. Estimation Model**

\[
P(\text{Separation}) = \frac{\exp(\alpha + \beta X + \gamma D)}{1 + \exp(\alpha + \beta X + \gamma D)} + \varepsilon
\]

Where: \(X = \{\text{Performance}\}

\(D = \{\text{PrimarySkillSet, Division, Underpaid}\}\)

We also found that adding Age, Annual Salary, and Tenure to our model individually or as a group had no significant affect on goodness of fit. That is, the variables Age, Annual Salary, and Tenure offer no significant explanatory power over the variables contained in the estimation model. This is consistent with Proposition 1 and Proposition 2, and with the contention that salary alone is not important in the separation decision. Lack of a significant coefficient on Age also supports Proposition 1, that lifecycle considerations are not an important factor in IT professionals’ separation decisions. Similarly, an insignificant coefficient on Tenure supports Proposition 2, that firm-specific human capital is not an important factor.

**Main effects.** The main effects and their significance levels are consistent with expected results. In this model, interpretation of the sign and significance of parameter estimates is similar to the interpretation in the simple linear regression context. Parameter estimates (Table 8) and their significance levels reveal that StdPerfRating, Division, SkillSet, and Underpaid each hold explanatory power with respect to variation in individual separation decisions. Significant and positive coefficients on the Skill Set variables, Applications, Architecture, and Multiple, support Proposition 3, that as the level of human capital attributable to specific technology increases, the likelihood of separation increases.

Proposition 4 claims that as the value of the relationship to the firm and individual decreases, separation is more likely. The positive coefficient on Underpaid = 1 support Proposition 4, that separation is more likely when the firm compensates individuals at below their Performance/AdjSalary. Separation is also more likely when the firm believes it is not getting what it needs from the relationship as indicated by the negative coefficient on StdPerfRating.

The significant coefficient on Division 4 supports the final proposition, Proposition 5, that some characteristics of the organization provide explanatory power with respect to separation decisions. Obviously not every division is different in this respect, but evidence that any of them is difference is acceptable support.

To sum up, we found support for all five of our propositions. Our interpretation is that IT professionals are different from other workers in ways that affect their employment decisionmaking. These differences will affect the stability of the IT workforce such that its behavior is not entirely consistent with what we would expect.
expect based upon prior research in ways that may have devastating consequences for organizations and project teams.

5.5. Sensitivity analysis

As in the simple linear regression context, the first partial derivative of the estimated model with respect to the variable in question equals the change in fitted value associated with a unit change in the variable. Once determined, this derivative has the same general interpretation as that in the simple linear regression context. However, in the logit model, a problem arises because the value of the first partial derivative depends upon the observed values of the other variables [16].

The odds ratio gives us a way to deal with that problem [26]. The odds ratio indicates the change in the odds that an event will occur, given a one-unit change in a single variable, with all other variables being held constant. For example, if an individual is underpaid (Underpaid = 1), she is then 2.12 times more likely to leave than she would be otherwise. Similarly, the odds ratio for Performance Rating indicates that the odds of separation increase 33% for a one standard deviation drop in the rating. The odds of separation increase over fivefold for Applications and Architecture professionals compared to the base case, Business-oriented professionals. On the other hand, employment within Division 4, and its mix of legacy and new technology, reduces the odds of separation by 20%.

From this sensitivity analysis, we can see that technical specialists are substantially more likely to leave the organization than others. In addition, inadequate performance or compensation have an important effect on separation. Finally, the organizational context – and all that comes along with it – seems to matter to IT professionals. Each of these can have substantial affects on organizations and IT project team performance.

<table>
<thead>
<tr>
<th>Table 8. MLE results</th>
</tr>
</thead>
<tbody>
<tr>
<td>Variable</td>
</tr>
<tr>
<td><strong>α</strong></td>
</tr>
<tr>
<td>Performance Rate</td>
</tr>
<tr>
<td>Underpaid</td>
</tr>
<tr>
<td>Skill set (Business is the base case)</td>
</tr>
<tr>
<td>Administration/Strategy</td>
</tr>
<tr>
<td>Applications</td>
</tr>
<tr>
<td>Architecture</td>
</tr>
<tr>
<td>Multiple</td>
</tr>
<tr>
<td>System Operations</td>
</tr>
<tr>
<td>Divisions (Division 1 is the base case)</td>
</tr>
<tr>
<td>Division 2</td>
</tr>
<tr>
<td>Division 3</td>
</tr>
<tr>
<td>Division 4</td>
</tr>
</tbody>
</table>

*** Significant at .01 level; ** Significant at .05 level

6. Conclusions

Our exploratory analysis of the applicability of human capital and related economic theory identify important differences in observed behavior among IT professionals versus broader classes of employees. Our empirical results also support the usefulness of our Five Degrees of Separation Model and the five propositions drawn from the IT human capital model of decisionmaking presented in this paper. These results have important implications for theory and practice.

- IT professionals derive less benefit from experience or accumulation of specific capital and their behavior is less affected by traditional lifecycle considerations. The result is that age and tenure become much less valuable as predictors of separation than they are for other workers.
- IT professionals whose human capital is highly technology-intensive have a much higher probability of separation than do those with a greater business focus. This too is consistent with human capital theory: IT professionals with a greater investment in the business processes of an organization are less likely to leave their employer because they will lose the return on valuable firm-specific human capital.
- A one-size-fits-all approach to IT employment policy is too broad to be appropriate. Instead, policy should consider differences among groups of IT professionals who perform similar functions.
- Managers must evaluate the impact technological change has on employment decisionmaking among
IT professionals. Rapid change necessitates continual investment and shortens the duration of skill half-life.

- We find little reason, at least within the context of the sample population of a single firm’s IT workforce, to provide additional incentives to retain experienced IT professionals. Instead, allocating resources to align compensation with performance may increase retention.

Each of these differences means that researchers and managers must work with new rules of employment decisionmaking driven by IT human capital considerations. Additional research in this area will help us to understand better these critical elements of our information systems – the IT professional and IT human capital.

Reference List


