Turnover of Information Technology Workers: Examining Empirically the Influence of Attitudes, Job Characteristics, and External Markets

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ABSTRACT: This paper presents and tests a conceptual model linking perceptions of the internal work environment and external markets to information technology (IT) worker turnover. The model focuses on organizational commitment (OC) as the primary predictor of turnover intention. We suggest that OC mediates perceptions of the workplace and external environment on turnover intention. Specifically, we hypothesize that OC mediates the influence of (1) job satisfaction, (2) perceived job characteristics, (3) perceived competitiveness of pay, and (4) perceived job alternatives on

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turnover intention. Also, perceived job alternatives are modeled as having a direct effect on turnover intention. Analysis provides moderate empirical support for the research model. OC and perceived job alternatives demonstrated distinct effects on turnover intention. In addition, OC mediated the influence of job satisfaction, perceived job characteristics, and perceived competitiveness of pay on turnover intention. Findings suggest that through cultivating positive beliefs about the job and attitudes toward the employer, managers may counter the influence of external markets on IT workers' turnover intention.

KEY WORDS AND PHRASES: information-technology worker turnover, job characteristics, job satisfaction, organizational commitment.

ESTIMATES SUGGEST THAT UP TO 20 percent of information technology (IT) workers turnover each year [43]. Turnover creates direct recruiting and training costs for organizations. Turnover also creates indirect costs due to disruptions in organizational processes. To replace an IT worker, an organization may spend from one to seven times the employee's annual salary [27]. Due to high rates of turnover and associated costs, employers have shifted from perceiving IT workers as a replaceable commodity to seeing them as a valued asset.

Market conditions contribute to IT worker turnover. Government and industry reports suggest that scarcity characterizes the IT labor market [15]. For example, in a survey of IT managers "56% said the IT skills shortage is serious and 25% called it mildly serious. Only 18% said there is no shortage" [31, p. 32]. Due to tight labor markets, organizations may have driven turnover rates higher by offering higher salaries and incentive packages to lure IT workers away from their current jobs [14].

Although acknowledging the IT labor market's influence, critics assert that the work environment drives turnover. They argue that organizations underappreciate IT work and pay little attention to how it is organized [4, 9]. For example, some IT workers' jobs are segmented into high-pressure deliverables that are poorly integrated into the rest of the organization [28]. Critics contend that low satisfaction with the organization and poor job design drive IT workers' organizational commitment lower, turnover intention higher, and consequently lead to actual turnover.

Relatively little management information system (MIS) research simultaneously examines both indicators of the work environment such as job satisfaction or perceived job characteristics, and market conditions such as perceived job alternatives or pay competitiveness, on IT worker turnover [2]. With few exceptions, prior MIS research has focused on either internal or external antecedents to turnover. To understand the turnover phenomenon, research in organizational behavior suggests linking internal and external factors to employee beliefs and behavior [17]. Hence, this study articulates and tests a conceptual model that links the internal work environment and external labor market to IT worker turnover.

Consistent with organizational behavior research [17], this paper focuses on organizational commitment (OC) and its antecedents as predictors of turnover. Research suggests that OC has a strong effect on turnover intention and actual turnover [17]. We hypothesize that OC mediates the influence of job satisfaction, job characteristics, and perceived competitiveness of pay on turnover intention. In addition, we suggest that perceived job alternatives influence OC and turnover intention.

Theoretical Development

OC IS A STRONG PREDICTOR OF TURNOVER [17]. OC measures the relative strength of an individual's identification or involvement with an organization [35]. It is characterized by: (1) a strong belief in and acceptance of the organization's goals and values (normative commitment), (2) a willingness to exert considerable effort on behalf of the organization (affective commitment), and (3) a strong desire to maintain membership in the organization (continuance commitment) [35]. A review of 16 studies, which used the Organizational Commitment Questionnaire developed and validated by Mowday et al. [35], found a consistent strong relationship ($\rho = -0.27$) between OC and turnover intention [17]. Committed employees report lower turnover intention because they want to remain in a job.

Theory suggests that OC mediates the influence of attitudes, affective beliefs, and job characteristics on turnover intention and actual turnover. This model is based on arguments about the specificity and the stability of job-related attitudes and beliefs. When compared to attitudes such as job satisfaction or beliefs about job characteristics, Porter et al. [36] argue that OC is much less specific and more stable. Where job satisfaction may fluctuate with day-to-day incidents, they assert that OC reflects employees' enduring beliefs about their employer that develop gradually over time. Because of the stability of OC, theorists argue that it is the primary predictor of turnover intention.

Volatile attitudes such as job satisfaction, and perceived job characteristics such as task identity or autonomy, shape the degree of commitment employees feel toward an organization [35]. Steers [38] argues that workers whose needs are satisfied by an organization are likely to develop commitment to this organization. When an organization fails to meet individuals' needs, employees' commitment level decreases. Within the domain of IT, research has confirmed that attitudes such as job satisfaction, and workplace perceptions such as job characteristics, influence OC [8, 13, 23].

External markets may have direct or mediated effects on OC and turnover intention. Expectancy research suggests that attitudes, such as OC, are influenced by an individual's comparisons of their current job with external opportunities. When key indicators such as wages, do not compare favorably, workers may report diminishing job satisfaction and are more likely to turn over [34]. Also, when workers perceive abundant external opportunities, they may report lower levels of organizational commitment and, consequently, pursue opportunities that better satisfy their needs [17]. However, when opportunities are scarce, workers will be less willing to leave

because of their attachment to their current status as well as opportunities for potential advancement within the organization [10]. Thus, comparisons with, and opportunities found in, external markets influence OC and its relationship to turnover intention.

Model and Hypotheses

BASED ON THIS BRIEF REVIEW OF THE LITERATURE, Figure 1 presents a theoretical model of IT worker turnover. The model suggests that OC fully mediates the influence of job satisfaction, job characteristics, and perceived competitiveness of pay on turnover intention. Also, perceived job alternatives are modeled as directly affecting OC and turnover intention. Turnover intention mediates the relationship between OC and actual turnover. The following discussion more fully explains each hypothesis.

Turnover Intention

Turnover intention has been identified as the most immediate cognitive antecedent to turnover. Actual turnover is expected to be a strong positive correlate of turnover intention [34]. Prior IT research has identified turnover intention as an important predictor of turnover; however, relatively few studies have tested the link between turnover intention and actual turnover (see, for example [22]). As a result, we test whether turnover intention is a direct antecedent to actual IT worker turnover. Hence,

> *H1. Turnover intention will demonstrate a positive relationship with actual turnover.*

Attitudes and Job Characteristics

We posit that OC is the most salient attitudinal antecedent to turnover intention. OC reflects enduring feelings about shared norms and individuals' willingness to exert effort on behalf of the organization. Because OC is relatively enduring, it should mediate the influence of less stable attitudes, such as job satisfaction or beliefs about job characteristics, on turnover intention. The following discussion links organizational commitment, job satisfaction, and job characteristics to turnover intention.

Organizational Commitment

Research suggests that OC negatively affects turnover intention [17, 36]. Employees who are highly committed to their organization are less likely to turn over than their less committed peers. Within the domain of IT, research confirms OC has a strong negative influence on turnover intention [22]. Hence,

> *H2a. Organizational commitment will demonstrate a negative relationship with turnover intention.*

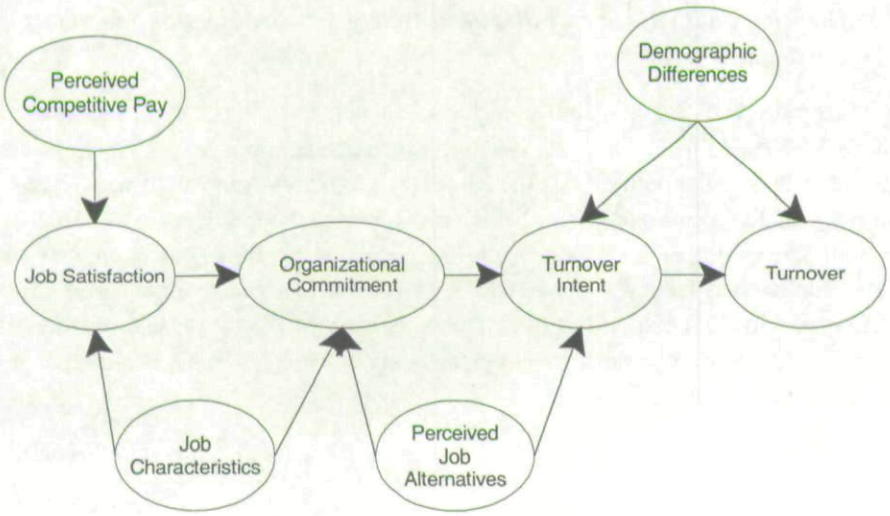

Figure 1. Theoretical Model

Job Satisfaction

Job satisfaction refers to whether employees find their employment sufficiently satisfactory to continue in it, either permanently or until they have prepared for greater responsibilities [19]. There is a substantial literature examining the relationships among job satisfaction, OC, and turnover intention. Theory suggests that job satisfaction may have a direct effect on OC and turnover intention [34]. However, more recent research has shown that job satisfaction predicts OC and has a mediated effect on turnover intention (see, for example [42]). It is reasonable to expect that as workers express greater satisfaction they will express higher levels of organizational commitment. Hence,

> *H2b. Job satisfaction will demonstrate a positive relationship with organizational commitment.*

Perceived Job Characteristics

Critics maintain workers leave because "many IT jobs but especially programming jobs, . . . qualify as lousy jobs" [9, p. 20]. They contend that most management efforts do not focus on creating positive perceptions of job characteristics that influence attitudes such as job satisfaction. Contemporary job design theory assumes that perceived job characteristics are an important contributor to job satisfaction [45]. Prior research has established the relevance of perceived job characteristics [18]; that is, autonomy, identity, variety, significance, and feedback, to understanding IT workers' behaviors in the workplace [8, 13]. These characteristics may be interpreted as cues from the organizational environment about the value placed on work or the worker and have a direct effect on job satisfaction [30]. Hence,

H2c. Job characteristics will demonstrate a positive relationship with job satisfaction.

Theory suggests that the stability and the role of perceived job characteristics varies [46]. Over the course of a week, workers may perceive more or less autonomy or variety in their daily routine. Even though perceived autonomy or variety may change, workers tend to report more stable beliefs about their job's significance [24]. Positive overall perceptions of the importance of their work within the organization may result in individuals feeling a greater need to comply with organizational norms and a willingness to exert extra effort to complete required tasks. As a result, individuals who feel that they are engaged in significant work may express more commitment to their employer. Hence,

H2d. Task significance will demonstrate a positive relationship with organizational commitment.

Perceptions of External Markets

Perceptions of external markets may have direct or indirect effects on employees' turnover intentions. In this study we examine two perceptions of the external environment—perceived competitiveness of pay and perceived job alternatives.

Perceived Competitiveness of Pay

Perceived competitiveness of pay refers to employees' perceptions that salaries are comparable to peers in other organizations or industries. Comparisons of pay with external markets may influence IT workers' job satisfaction. Procedural justice theory suggests that when employees perceive they receive competitive pay they should report greater job satisfaction [29]. In principle, salaries signal to employees that they are valued and important contributors to the organization's success [25]. When employees feel valued, they are more likely to report job satisfaction. Consistent with procedural justice theory, many organizations have turned to raising IT workers' salaries as a means to prevent turnover [1]. When IT employees perceive their pay is competitive with the market rate, they may express more job satisfaction. Hence,

H3a. Perceived competitiveness of pay will demonstrate a positive relationship with job satisfaction.

Perceived Job Alternatives

Perceived job alternatives refer to workers' beliefs that they can find a comparable job in another organization. Theory suggests that perceived job alternatives should have a direct effect on OC and a mediated effect on turnover intention [34]. When employees perceive many employment alternatives, they will express lower levels of OC and, consequently, higher levels of turnover intention. In addition, research in

information systems (IS) and referent fields has found that perceived job alternatives have a direct effect on turnover intention [25, 26]. In an empirical examination of IT workers, Igbaria and Greenhaus [22] reported a small direct effect between awareness of extra-organizational career opportunities and turnover intention. Hence,

H3b. Perceived job alternatives will demonstrate a negative relationship with organizational commitment.

H3c. Perceived job alternatives will demonstrate a positive relationship with turnover intention.

Control Variables

Demographic differences have been identified as potentially important correlates of turnover. Demographic indicators serve as proxies for factors such as family responsibility or willingness to relocate, which may influence IT workers' perceptions of their employer or external opportunities. Within the domain of IS, research suggests that gender and age influence IT workers' turnover intentions. Even when controlling for social capital variables such as education or experience, Igbaria and Baroudi [20] found that female IT workers report higher levels of turnover intention than men. Also, organizational behavior research suggests that older IT workers may report lower turnover intention [17]. It is also important to note that race may impact IT workers' career decisions [5]; however, our research site was reluctant to allow collection of race-related information. Because gender and age may be important negative correlates of turnover intention and turnover, we control for their influence in this study. Hence,

H4a. Female IT workers will report higher levels of turnover intention than male IT workers.

H4b. Female IT workers will be more likely to turn over than male IT workers.

H4c. Age will demonstrate a negative relationship with turnover intention.

H4d. Age will demonstrate a negative relationship with turnover.

Methods

Subjects

PARTICIPANTS WERE IT WORKERS in a southeastern U.S. state government. Seventeen different agencies participated. Job classifications ranged from data center managers to computer operations personnel. Job tenure varied from a low of one month to a high of 40 years. Average job tenure was 16.26 years. The subjects included 63 females and 128 males. Average age was 41.2 years. The educational levels of the

respondents ranged from high school to graduate degrees with the largest percentage of respondents having undergraduate college degrees (30.6 percent).

Procedure

Because we were interested in examining employees with sufficient tenure and experience to have developed OC, a theoretical sampling approach was used to select participants. To control for the potential influence of differences in responsibility by position, efforts were made to use only subjects who worked in professional or supervisory positions. Job classifications were used to select subjects. Subjects were contacted by phone to participate, and surveys were administered at locations away from organizational settings. Because it was a state-sponsored project, subjects completed the survey during regular paid working hours. Of 260 possible potential subjects, 238 (91 percent) participated in the study. Listwise deletion of missing values yielded 193 (74 percent) usable responses.

Measures

Measures were drawn from the human resource management literature and are provided in Appendix A. Items were distributed throughout a larger questionnaire examining IT workers in state government.

Turnover

Turnover data was collected from archival data. In the 24 months following the initial survey administration, 33 of the 193 usable respondents turned over (17.1 percent). Also, one employee died and was dropped from subsequent data analysis.

Turnover Intention

Turnover intention was measured using two items that asked respondents whether they intended to quit and thought about quitting. Measurement of this intention is consistent with common practice in the human resources literature.

Organizational Commitment

OC was measured using the Organizational Commitment Questionnaire [35]. Because items measuring continuance commitment may be highly correlated with turnover intention, they were dropped. This is consistent with prior IT worker research [21].

Job Satisfaction

Job satisfaction was measured using items drawn from the Job Diagnostic Survey (JDS) [18]. To prevent conceptual overlap with other constructs, the item concerning

behavioral intentions was not used. General job satisfaction was measured using two items: "Generally speaking, I am very satisfied with this job" and "I am generally satisfied with the kind of work I do."

Perceived Job Characteristics

Perceived job characteristics were measured with items from the JDS. The specific dimensions measured were variety, autonomy, feedback, task identity, and task significance. Identified by Hackman and Oldham [18], these facets are widely used in organizational behavior and human resources research.

Perceived Job Alternatives

Two items measured perceived job alternatives: "I can find another job doing exactly what I am doing now" and "there are many jobs available similar to mine."

Perceived Competitiveness of Pay

Two items were used to measure perceived competitiveness of pay. Within the public sector, employee salaries are set by broad, statewide compensation systems. As a result, comparisons with peers in other public organizations yield relatively little insight into perceived competitiveness of pay [37]. Hence, items asked respondents to compare their pay to their private sector counterparts.

Demographic Differences

Age was coded in years. Gender was coded 0 = male and 1 = female.

Preliminary Analysis

Preliminary analysis examined descriptive statistics and response distributions for each measure. An inspection of histograms and scatter-plots indicated that item responses were not normally distributed [39]. Formal tests revealed significant departures from normal distributions in the data (see Table 1).

As a result, data analysis was conducted using techniques robust to nonnormality.

Data Analysis

TO ANALYZE THE DATA, THIS STUDY USES partial least squares (PLS), a structural equation modeling (SEM) technique. PLS was used for several reasons. First, like other SEM approaches, PLS allows researchers to integrate measurement and structural models [6]. The measurement model examines hypothesized links between indicators and latent constructs. The structural model estimates hypothesized paths

Table 1. Descriptive Statistics and Tests for Normality

Construct	Number of items	Mean	Standard deviation	Skewedness		Kurtosis	
				Statistic	*z*-score	Statistic	*z*-score
Turnover intention	2	3.98	1.04	0.96	**5.49**	0.32	0.93
Organizational commitment	9	3.25	1.28	1.01	**5.78**	3.03	**8.71**
Job satisfaction	2	2.56	1.16	1.93	**11.00**	5.59	**16.07**
Task variety	3	5.83	0.98	1.38	**7.87**	2.22	**6.38**
Autonomy	3	5.44	0.99	1.14	**6.50**	1.24	**3.55**
Job feedback	3	5.44	1.06	1.00	**5.74**	0.97	**2.78**
Task significance	3	5.68	1.03	0.97	**5.53**	0.93	**2.66**
Task identity	3	5.07	1.30	0.70	**4.02**	0.01	0.04
Perceived job alternatives	3	2.92	0.89	0.12	0.67	−0.26	−0.76
Perceived competitive pay	2	3.45	0.84	0.03	0.19	−0.25	−0.72

Note: Bolded *z*-scores indicate a $p > 0.025$ or greater departure from normality for skewedness or kurtosis.

between exogenous (independent) and endogenous (dependent) latent constructs. By integrating measurement and structural models, PLS permits tests of the influence of latent factors on the formation of turnover intention [11].

Second, PLS is particularly useful for analyzing nonnormal samples. PLS does not assume multivariate normality among sample distributions [44]. It requires few zero correlations between residuals and variables in the model of interest. As a result, PLS may be used to estimate models using ordinal data derived from scales. By doing so, research suggests PLS yields stronger estimates of fit between sampled and "real-world" data [11].

Third, by breaking down models into segments, PLS allows researchers to work with small sample sizes. To determine appropriate sample size, Chin [3] suggests that researchers collect ten times the most complex construct's number of indicators or the largest number of paths leading to a latent construct. Thus, PLS may be used to test complex models using small, nonnormally distributed data sets.

Results

THE MODEL WAS ESTIMATED USING PLS Graph 2.91 [12]. With 193 respondents, the data set's size satisfies the 10:1 observation to indicator (21:1) or path (32:1) ratio required for using PLS [3]. The results are interpreted in two stages—measurement and structural. This sequence allows researchers to ensure they have adequately measured constructs before drawing conclusions on relationships among constructs [6].

Measurement Model

When analyzing the measurement model, researchers evaluate the reliability and validity of each scale. To assess internal consistency, PLS researchers typically calculate a block of indicators' internal composite reliability (ICR) and average variance extracted (AVE) [11]. ICR is calculated by squaring the sum of loadings then dividing it by the sum of squared loadings plus the sum of the error terms [41]. Interpreted like a Cronbach's alpha, an ICR of 0.60 is sufficient for research [16]. The AVE measures the variance captured by the indictors relative to measurement error [16]. To use a construct, AVE should be greater than 0.50 [11]. Values reported in Table 2 demonstrate adequate reliability for indicators of the constructs.

Discriminant and convergent validity suggest that measures of the constructs are distinct and that indicators load on the appropriate construct [33]. To evaluate discriminant validity, the AVE may be compared with the square of the correlations among the latent variables [11]. The correlation among indicators of a construct should be greater than between a construct and any other construct. A second way to evaluate discriminant validity is to examine the factor loadings of each indicator [11]. Each indicator should load higher on the construct of interest than on any other variable. Results presented in Tables 2 and 3 demonstrate that the observed indicators have adequate discriminant and convergent validity.

Table 2. Interconstruct Correlations

Construct	Internal composite reliability	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
(1) Turnover	—	**1.00**										
(2) Turnover intent	0.99	0.37	**0.96**									
(3) Organizational commitment	0.82	0.14	0.41	**0.79**								
(4) Job satisfaction	0.93	0.11	0.43	0.62	**0.87**							
(5) Task variety	0.76	0.06	0.23	0.27	0.38	**0.81**						
(6) Autonomy	0.81	0.12	0.15	0.21	0.24	0.35	**0.79**					
(7) Feedback	0.91	0.00	0.20	0.21	0.24	0.31	0.46	**0.86**				
(8) Task significance	0.79	0.11	0.18	0.30	0.16	0.33	0.16	0.30	**0.78**			
(9) Task identity	0.80	0.02	0.17	0.13	0.16	0.18	0.36	0.38	0.26	**0.78**		
(10) Perceived job alternatives	0.77	0.18	0.39	0.10	0.15	0.09	0.02	0.06	0.01	0.10	**0.77**	
(11) Perceived competitive pay	0.84	0.07	0.21	0.12	0.16	0.13	0.08	0.10	0.07	0.08	0.23	**0.81**

Notes: Bold items are the square root of the average variance extracted. Off-diagonal elements are the correlations among constructs. For discriminant validity, diagonal elements should be larger than off-diagonal elements.

Table 3. Confirmatory Factor Analysis

	Turnover	INT	OC	JS	TV	AU	FB	TI	TS	PJA	PCP
Turnover	**1.00**	0.37	0.14	0.11	0.06	0.12	0.00	0.11	0.02	0.18	0.10
INT1	0.33	**0.96**	0.38	0.41	0.27	0.14	0.19	0.18	0.13	0.38	0.22
INT2	0.38	**0.96**	0.41	0.41	0.17	0.14	0.19	0.16	0.11	0.37	0.19
OC1	0.00	0.20	**0.65**	0.40	0.17	0.09	0.11	0.25	0.04	0.02	0.02
OC2	0.17	0.33	**0.87**	0.55	0.20	0.17	0.12	0.22	0.06	0.06	0.07
OC3	0.04	0.26	**0.63**	0.39	0.20	0.22	0.15	0.11	0.11	0.12	0.08
OC4	0.11	0.31	**0.80**	0.43	0.20	0.18	0.19	0.18	0.09	0.07	0.12
OC5	0.12	0.39	**0.89**	0.55	0.21	0.17	0.19	0.27	0.10	0.07	0.09
OC6	0.17	0.34	**0.85**	0.54	0.30	0.16	0.18	0.33	0.12	0.17	0.07
OC7	0.14	0.33	**0.81**	0.49	0.22	0.15	0.18	0.17	0.10	0.08	0.18
OC8	0.04	0.36	**0.73**	0.49	0.22	0.12	0.15	0.28	0.11	0.12	0.04
OC9	0.15	0.36	**0.83**	0.50	0.21	0.20	0.19	0.27	0.16	0.18	0.08
JS1	0.04	0.19	0.44	**0.83**	0.27	0.17	0.18	0.19	0.13	0.04	0.01
JS1	0.20	0.51	0.53	**0.92**	0.38	0.24	0.24	0.23	0.15	0.19	0.23
TV1	0.06	0.21	0.30	0.40	**0.90**	0.32	0.27	0.33	0.19	0.09	0.04
TV2	0.01	0.01	0.08	0.08	**0.53**	0.25	0.33	0.30	0.23	0.08	0.02
TV3	0.06	0.20	0.15	0.25	**0.80**	0.26	0.21	0.18	0.08	0.09	0.20

(continues)

Table 3. (continued)

	Turnover	INT	OC	JS	TV	AU	FB	TI	TS	PJA	PCP
AU1	0.12	0.14	0.21	0.24	0.29	**0.86**	0.30	0.08	0.32	0.00	0.12
AU2	0.02	0.11	0.19	0.15	0.34	**0.71**	0.45	0.17	0.19	0.08	0.02
AU3	0.14	0.09	0.08	0.16	0.21	**0.74**	0.37	0.15	0.33	0.05	0.06
FB1	0.04	0.11	0.12	0.20	0.20	0.38	**0.86**	0.29	0.37	0.01	0.06
FB2	0.03	0.20	0.20	0.20	0.29	0.36	**0.84**	0.24	0.35	0.09	0.07
FB3	0.06	0.20	0.20	0.22	0.31	0.44	**0.85**	0.24	0.27	0.05	0.14
TI1	0.09	0.15	0.26	0.21	0.30	0.09	0.19	**0.83**	0.21	0.03	0.08
TI2	0.06	0.12	0.12	0.05	0.15	0.13	0.28	**0.63**	0.17	0.02	0.07
TI3	0.09	0.15	0.27	0.24	0.28	0.16	0.28	**0.87**	0.22	0.00	0.07
TS1	0.01	0.06	0.10	0.19	0.20	0.32	0.33	0.23	**0.95**	0.14	0.10
TS2	0.05	0.17	0.08	0.05	0.08	0.26	0.31	0.19	**0.70**	0.01	0.06
TS3	0.07	0.19	0.14	0.06	0.11	0.30	0.32	0.20	**0.67**	0.03	0.03
PJA1	0.15	0.39	0.11	0.16	0.09	0.07	0.11	0.07	0.04	**0.82**	0.23
PJA2	0.18	0.25	0.06	0.12	0.10	0.05	0.03	0.10	0.18	**0.73**	0.19
PJA3	0.07	0.17	0.10	0.01	0.03	0.05	0.01	0.03	0.20	**0.75**	0.13
PCP1	0.15	0.12	0.05	0.02	0.01	0.09	0.07	0.14	0.08	0.21	**0.69**
PCP2	0.06	0.21	0.10	0.17	0.14	0.08	0.10	0.05	0.08	0.22	**0.95**

Notes: INT = turnover intent; OC = organizational commitment; JS = job satisfaction; TV = task variety; AU = job autonomy; FB = job feedback; TI = task identity; TS = task significance; PJA = perceived job alternatives; PCP = perceived competitive pay. The boldface numbers indicate item loadings on the factor of interest.

Structural Model

To evaluate the full model, R^2 values were calculated for each endogenous construct. Interpreted like multiple regression, the R^2 indicates the amount of variance explained by the model [3]. The model demonstrated strong predictive power for OC (R^2 = 0.40) and turnover intention (R^2 = 0.29). It offered less predictive power for job satisfaction (R^2 = 0.19) and actual turnover (R^2 = 0.14). Using a bootstrapping technique, path estimates and *t*-statistics were calculated for hypothesized relationships by construct. PLS results for the structural model are summarized in Figure 2.

Results provide support for many of the hypothesized relationships. Turnover intention (path = 0.38, $p > 0.01$) demonstrated a strong direct effect on actual turnover. OC (path = –0.45, $p > 0.01$) demonstrated a direct negative relationship with turnover intention. Also, job satisfaction and task significance demonstrated significant direct effects on OC. Job satisfaction (path = 0.57, $p > 0.01$) and task significance (path = 0.17, $p > 0.05$) directly influenced organizational commitment. This result suggests that satisfied IT workers, who are entrusted with significant work, feel greater OC.

Mixed support was found for the influence of job characteristics on job satisfaction. Task variety (path = 0.28, $p > 0.01$) and task significance (path = 0.13, $p > 0.05$) have significant direct effects on job satisfaction. Autonomy (path = 0.08, $p > 0.10$) demonstrated a weaker effect. Feedback (path = 0.06, n.s.) and task identity (path = –0.01, n.s.) did not influence job satisfaction. Consistent with prior research, variety and significance are strong predictors of IT workers' satisfaction.

Limited support was found for the influence of perceptions of the external environment on job satisfaction and turnover intention. Perceived competitive pay demonstrated a weak relationship to job satisfaction (path = 0.12, $p > 0.10$). Although perceived job alternatives did not affect OC (path = 0.04, n.s.), it did demonstrate a strong direct influence on turnover intention (path = 0.31, $p > 0.01$). Whereas perceived pay competitiveness may have little effect, findings suggest that perceived job alternatives may influence IT workers' turnover intention [17].

Finally, control variables displayed distinct relationships with turnover intention or actual turnover. Age was not a significant correlate of either variable. Although not directly linked to turnover, gender was a significant positive correlate of turnover intention (path = 0.20, $p > 0.01$).

Conclusion

THIS STUDY WAS MOTIVATED BY a desire to model the influence of the work environment and external markets on IT worker turnover. Results suggest that turnover intention predicted actual turnover, and organizational commitment demonstrated a negative relationship with turnover intention. In addition, job satisfaction and task significance had a positive effect on OC. Also, task significance, task variety, and autonomy positively influenced job satisfaction. Although perceived competitiveness of pay demonstrated a weak relationship with job satisfaction, our analysis indicates that perceptions

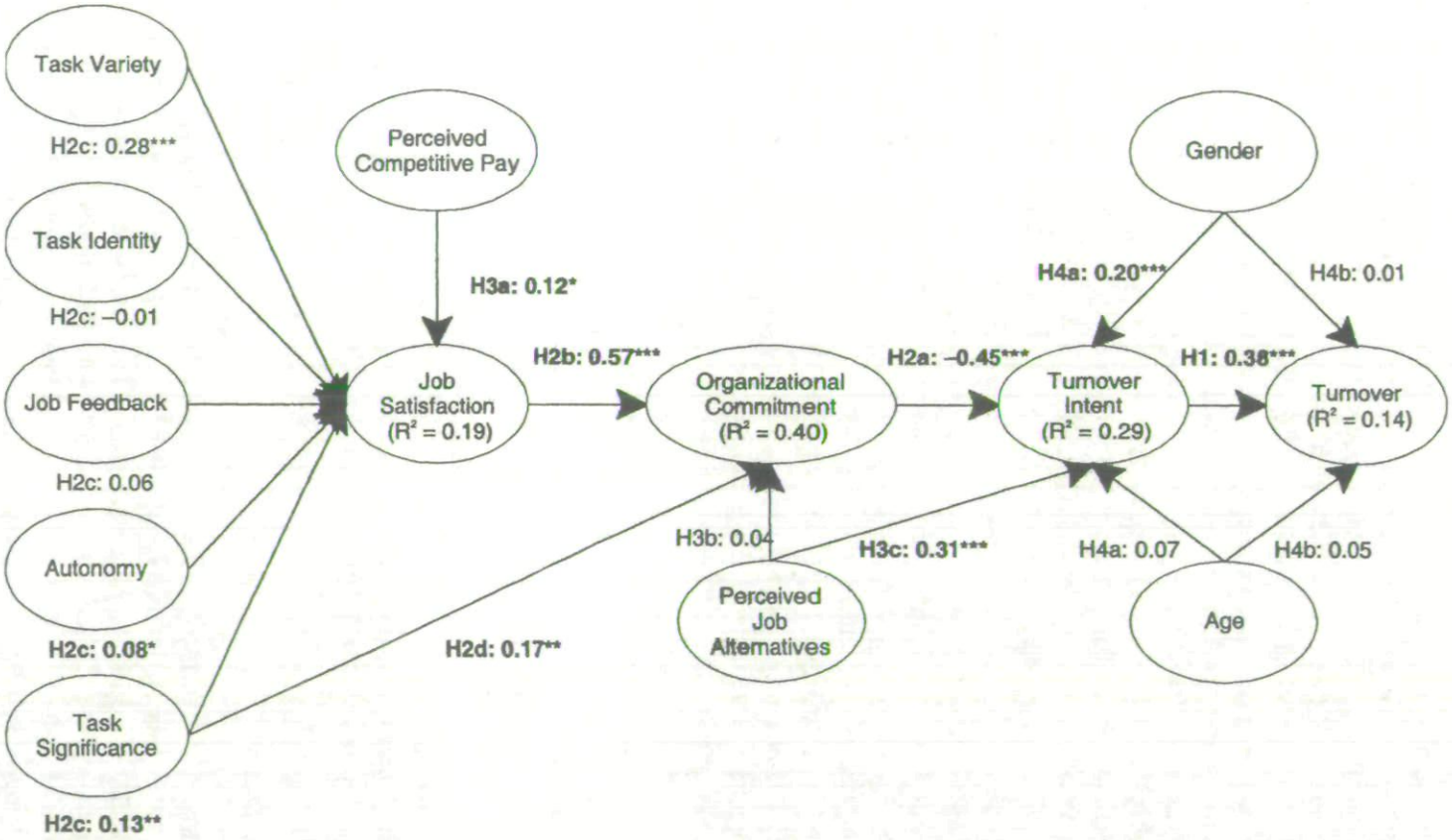

Figure 2. Research Model Results. Significance level of *t*-statistics: * = 0.10; ** = 0.05; *** = 0.01.

of the labor market, operationalized here as perceived job alternatives, have a strong positive influence on turnover intention.

Results provide insight into the relative importance of attitudes and perceptions leading to IT worker turnover. Findings underscore the importance of task significance for retaining IT workers. In the current public sector sample where jobs are underpaid, the idea of significance may be especially important in that higher levels of significance may lead workers to greater job satisfaction and OC because they are providing a more critical public service. Further, our results support the notion that fostering positive beliefs about work and attitudes toward the employer may counter the influence of external markets on turnover intention [32]. Despite perceived job alternatives' influence, OC remained a strong predictor of turnover intention. This finding suggests that managers may cultivate OC as a means to offset the influence of perceived job alternatives. Thus, findings indicate that whereas external markets influence IT worker behavior, managers may take action to mitigate their influence.

Within the IT workforce, results indicate that demographic differences merit further study. Age and gender had mixed effects on turnover intention and actual turnover. Age did not influence turnover intention or turnover. Because profession may serve as an indicator of comparable education or socialization processes, Griffeth et al. [17] suggest that demographic differences such as age influence may be "washed out" when research controls for factors such as profession. However, despite controlling for tenure, gender was a positive predictor of turnover intention. Female IT workers were more likely than their male counterparts to report turnover intention [20]. Given the dearth of gender-based research on IT workers, this finding suggests future studies should examine gender's implications for IT workers' attitudes and behavior.

Prior to discussing implications for practice, it is important to consider limitations on this study's external validity. Sampling was limited to respondents working for public sector organizations in the southeastern United States. Therefore, the results may have limited generalizability to individuals outside of the public sector. However, by drawing managers from diverse public agencies, this study provides a robust test of relationships that may be generalized across public organizations. Given that government agencies consistently report difficulty retaining IT workers [37], we believe this is an appropriate population of organizations from which to sample. Because of consistently high turnover rates in the public sector [37] and increasing competition with the private sector for skilled labor [7], we believe it is of particular interest to examine how perceptions of the internal (that is, job satisfaction, perceived job characteristics, and OC) and the external (that is, perceived competitiveness of pay and perceived job alternatives) environments influence public sector IT worker turnover. Nonetheless, additional studies are needed to assess the extent to which our findings are applicable in diverse organizational and task settings.

This research has important implications for managing IT workers. Since perceived pay competitiveness exerted a weak influence on job satisfaction, our findings underscore the importance of providing significant, interesting work as a means to retain IT workers [32]. Also, this study suggests managers foster OC as a means to mitigate the

influence of robust external labor markets. Through socialization programs such as training or mentoring, organizations may cultivate shared norms and values that promote greater organizational commitment and diminish the relative influence of perceived job alternatives on the turnover intention of IT workers. This finding may be particularly important for organizations that report difficulty retaining female IT workers. Women frequently respond more affirmatively to training programs than men [40]. Hence, managers should consider implementing socialization programs that encourage organizational commitment, reduce the influence of external markets, and, consequently, increase retention of IT workers.

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Appendix A

Construct Measures and Outer Model Loadings

Items	Loadings*
Turnover Intention	
1. I intend to quit.	0.95
2. I am thinking about quitting.	0.96
Organizational Commitment	
1. I am willing to put in a great deal of effort beyond that normally expected in order to help this organization be successful.	0.65
2. I talk up this organization to my friends as a great organization to work for.	0.88
3. I feel very little loyalty to this organization. (r)	0.63
4. I find that my values and the organization's values are very similar.	0.80
5. I am proud to tell others that I am part of this organization.	0.89
6. This organization really inspires the very best in me in the way of job performance.	0.85
7. I am extremely glad that I chose this organization to work for over others I was considering at the time I joined.	0.82
8. I really care about the fate of this organization.	0.73
9. For me this is the best of all possible organizations for which to work.	0.83
Job Satisfaction	
1. Generally speaking, I am very satisfied with this job.	0.83
2. I am generally satisfied with the kind of work I do on this job.	0.92
Perceived Competitive Pay	
1. All things considered, my pay is fair compared to what IT people get in private industry.	0.69
2. I feel that in recent years the state has made my pay rate more fair compared to the private sector.	0.95
Perceived Job Alternatives	
1. I have many alternative job opportunities including some that are different from what I do now.	0.82
2. There are many jobs available similar to mine.	0.73
3. I can find another job doing exactly what I am doing now.	0.75

Items	Loadings
Task Variety	
1. How much variety is their in your job? That is, to what extent does the job require you to do many different things at work, using a variety of skills and talents?	0.91
2. The job requires me to use a number of complex or high-level skills.	0.52
3. The job is quite simple and repetitive. (r)	0.80
Autonomy	
1. How much autonomy is there in your job? That is, to what extent does your job permit you to decide on your own how to go about doing the work?	0.86
2. The job denies me any chance to use my personal initiative or judgment in carrying out the work. (r)	0.72
3. The job gives me considerable opportunity for independence and freedom in how I do the work.	0.74
Job Feedback	
1. To what extent does the job itself provide you with information about your work performance? That is, does the actual work itself provide clues about how well you are doing—aside from any "feedback" coworkers and supervisors may provide?	0.86
2. Just doing the work required by the job provides many chances for me to figure out how well I am doing.	0.85
3. The job itself provides very few clues about whether or not I am performing well. (r)	0.86
Task Significance	
1. In general, how significant or important is your job? That is, are the results of your work likely to significantly affect the lives or well-being of other people.	0.95
2. This job is one where a lot of other people can be affected by how well the work gets done.	0.70
3. The job itself is *not* very significant or important in the broader scheme of things. (r)	0.67

Items	Loadings
Task Identity	
1. To what extent does your job involve a whole and identifiable piece of work? That is, is the job a complete piece of work that has an obvious beginning and end? Or is it a small part of the overall piece of work, which is finished by other people or automatic machines?	0.83
2. The job is arranged so I do *not* have the chance to do an entire piece of work from beginning to end. (r)	0.63
3. The job provides me with a chance to completely finish the pieces of work I begin.	0.87

* All item loadings are significant at 0.01 or greater. (r) Indicates a reverse coded item.

Appendix B

Scales and Scoring Approach for Construct Measures

Turnover Intention

Turnover intention was measured using two items. Respondents evaluated items using a five-item Likert-type scale. Items were anchored with:

Strongly agree	=	SA	(1)
Agree	=	A	(2)
Neither agree nor disagree	=	N	(3)
Disagree	=	D	(4)
Strongly disagree	=	SD	(5)

The number in parentheses indicates how each value was scored in the data set. Although items were scattered throughout a larger portion of the questionnaire, they were presented in the following manner to respondents. Respondents checked boxes related to each point on the scale.

	SA	A	N	D	SD
1. I intend to quit.	□	□	□	□	□
2. I am thinking about quitting.	□	□	□	□	□

Organizational Commitment

Organizational commitment was measured using nine items from the Organizational Commitment Questionnaire. Respondents evaluated a seven-item Likert-type scale. Items were anchored with:

Strongly agree	=	SA	(1)
Moderately agree	=	MA	(2)
Slightly agree	=	sa	(3)
Neutral	=	N	(4)
Slightly disagree	=	sd	(5)
Disagree	=	D	(6)
Strongly disagree	=	SD	(7)

The number in parentheses indicates how each value was scored in the data set. Although items were scattered throughout a larger portion of the questionnaire, they were presented in the following manner to respondents. Respondents checked boxes related to each point on the scale.

	SA	MA	sa	N	sd	D	SD
1. I am willing to put in a great deal of effort beyond that normally expected in order to help this organization be successful.	□	□	□	□	□	□	□

2. I talk up this organization to my friends as a great organization to work for.	□	□	□	□	□	□	□
3. I feel very little loyalty to this organization. (r)	□	□	□	□	□	□	□
4. I find that my values and the organization's values are very similar.	□	□	□	□	□	□	□
5. I am proud to tell others that I am part of this organization.	□	□	□	□	□	□	□
6. This organization really inspires the very best in me in the way of job performance.	□	□	□	□	□	□	□
7. I am extremely glad that I chose this organization to work for over others I was considering at the time I joined.	□	□	□	□	□	□	□
8. I really care about the fate of this organization.	□	□	□	□	□	□	□
9. For me this is the best of all possible organizations for which to work.	□	□	□	□	□	□	□

Job Satisfaction

Job satisfaction was measured using two items. Respondents evaluated a seven-item Likert-type scale anchored with:

Strongly agree	= SA	(1)
Moderately agree	= MA	(2)
Slightly agree	= sa	(3)
Neutral	= N	(4)
Slightly disagree	= sd	(5)
Disagree	= D	(6)
Strongly disagree	= SD	(7)

The number in parentheses indicates how each value was scored in the data set. Although items were scattered throughout a broader section of the questionnaire, they were presented in the following manner to respondents. Respondents checked boxes related to each point on the scale.

	SA	MA	sa	N	sd	D	SD
1. Generally speaking, I am very satisfied with this job.	□	□	□	□	□	□	□
2. I am generally satisfied with the kind of work I do on this job.	□	□	□	□	□	□	□

Perceived Competitive Pay

Perceived competitive pay was measured using two items. Respondents evaluated items using a five-item Likert-type scale. Items were anchored with:

Strongly agree	= SA	(1)
Agree	= A	(2)
Neither agree nor disagree	= N	(3)
Disagree	= D	(4)
Strongly disagree	= SD	(5)

The number in parentheses indicates how each value was scored in the data set. Although items were scattered throughout a larger portion of the questionnaire, they were presented in the following manner to respondents. Respondents checked boxes related to each point on the scale.

	SA	A	N	D	SD
1. All things considered, my pay is fair compared to what IT people get in private industry.	□	□	□	□	□
2. I feel that in recent years the state has made my pay rate more fair compared to the private sector.	□	□	□	□	□

Perceived Job Alternatives

Perceived job alternatives pay was measured using two items. Respondents evaluated items using a five-item Likert-type scale. Items were anchored with:

Strongly agree	= SA	(1)
Agree	= A	(2)
Neither agree nor disagree	= N	(3)
Disagree	= D	(4)
Strongly disagree	= SD	(5)

The number in parentheses indicates how each value was scored in the data set. Although items were scattered throughout a larger portion of the questionnaire, they

were presented in the following manner to respondents. Respondents checked boxes related to each point on the scale.

	SA	A	N	D	SD
1. I have many alternative job opportunities including some that are different from what I do now.	□	□	□	□	□
2. There are many jobs available similar to mine.	□	□	□	□	□
3. I can find another job doing exactly what I am doing now.	□	□	□	□	□

Job Diagnostic Survey Measures—Task Variety, Autonomy, Job Feedback, Task Significance, Task Identify

The JDS measures used two sets of anchors. As suggested by Hackman and Oldham [18], the first item for each JDS measure used a unique anchor. Because of the unique anchors, these items were presented in one section of the survey. The second and third items for each measure were dispersed throughout a broader section of the survey that measured a range of constructs not used in the study. The second and third items used the following anchors:

Very inaccurate	=	VI	(1)
Mildly inaccurate	=	MI	(2)
Slightly inaccurate	=	SI	(3)
Uncertain	=	U	(4)
Slightly accurate	=	SA	(5)
Mildly accurate	=	MA	(6)
Strongly accurate	=	SA	(7)

The following questions present the items and their anchors.

Autonomy

1. How much autonomy is there in your job? That is, to what extent does your job permit you to decide on your own how to go about doing the work?

1	2	3	4	5	6	7
Very little; the job gives me almost no personal "say" about how and when the work is done.			Moderate autonomy; many things are standardized and not under my control, but I can make some decisions about the work.			Very much; the job gives me almost complete responsibility for deciding how and when the work is done.

	VI	MI	SI	U	SA	MA	SA
2. The job denies me any chance to use my personal initiative or judgment in carrying out the work. (r)	□	□	□	□	□	□	□
3. The job gives me considerable opportunity for independence and freedom in how I do the work.	□	□	□	□	□	□	□

Job Feedback

1. To what extent does the job itself provide you with information about your work performance? That is, does the actual work provide clues about how well you are doing—aside from any "feedback" coworkers and supervisors may provide?

1	2	3	4	5	6	7
Very little; the job itself is set up so I could work forever without finding out how well I am doing.			Moderately; sometimes doing the job provides "feedback" to me; sometimes it does not.			Very much; the job is set up so that I get almost constant "feedback" about how well I am doing.

	VI	MI	SI	U	SA	MA	SA
2. Just doing the work required by the job provides many chances for me to figure out how well I am doing.	□	□	□	□	□	□	□
3. The job itself provides very few clues about whether or not I am performing well. (r)	□	□	□	□	□	□	□

Task Variety

1. How much variety is there in your job? That is, to what extent does the job require you to do many different things at work, using a variety of skills and talents?

1	2	3	4	5	6	7
Very little; the job requires me to do the same routine things over and over again.			Moderate variety.			Very much; the job requires me to do many different things, using a number of different skills and talents.

	VI	MI	SI	U	SA	MA	SA
2. The job requires me to use a number of complex or high-level skills.	□	□	□	□	□	□	□
3. The job is quite simple and repetitive. (r)	□	□	□	□	□	□	□

Task Significance

1. In general, how significant or important is your job? That is, are the results of your work likely to significantly affect the lives or well-being of other people.

1	2	3	4	5	6	7
Not very significant; the outcomes of my work are not likely to have important effects on other people.			Moderately significant.			Highly significant; the outcomes of my work can affect other people in very important ways.

	VI	MI	SI	U	SA	MA	SA
2. This job is one where a lot of other people can be affected by how well the work gets done.	□	□	□	□	□	□	□
3. The job itself is *not* very significant or important in the broader scheme of things. (r)	□	□	□	□	□	□	□

Task Identity

1. To what extent does your job involve a whole and identifiable piece of work? That is, is the job a complete piece of work that has an obvious beginning and end? Or is it a small part of the overall piece of work, which is finished by other people or automatic machines?

1	2	3	4	5	6	7
My job is only a tiny part of the overall piece of work; the results of my activities cannot be seen in the final product or service.			My job is a moderate-sized overall piece of work; my own contribution can be seen in the final outcome.			My job involves doing the whole piece of work, from start to finish; the results of my activities are easily seen in the final product or services.

	VI	MI	SI	U	SA	MA	SA
2. The job is arranged so I do *not* have the chance to do an entire piece of work from beginning to end. (r)	□	□	□	□	□	□	□
3. The job provides me with a chance to completely finish the pieces of work I begin.	□	□	□	□	□	□	□

(r) Indicates a reverse coded item.

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