

Turnover and Retention in the Information Technology Workforce



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1. Introduction

During the last two centuries, we have seen tremendous change in Western societies, and more recently also in Eastern societies. Starting with the Industrial Revolution (1780-1840) in the late 18th and early 19th century, major changes in agriculture, manufacturing, and transportation had a profound impact on socioeconomic and cultural conditions in the Western world. A predominantly agricultural society first changed into a manufacturing society, next into a services society and finally into an information society.

With the introduction of steam power and later in the 19th century, the internal combustion engine and electric power generation that dramatically improved productivity, the First Industrial revolution merged into the Second Industrial Revolution (1870-1914). The Second Industrial Revolution was characterized by industrial mass production, improved steel manufacture and steamships, large factories with low skilled labor, the first international corporations and global transport and communications. The third wave of the Industrial Revolution (1896-1947) was characterized by electricity and the motor car, chemical industries, giant factories and deskilling of labor. The fourth wave, also know as the Information Technology Revolution (1948-200?) is characterized by the invention of the transistor and computer, electronics, computer, communications, and a mixture of large multinationals and small firms.

With the development of the digital computer in the late 20th century we entered the period of the Information Technology Revolution. The impact of the IT Revolution on society may be considered as profound as the impact of the Industrial Revolution. Figure 1 shows the impact of these revolutions on employment.

The Changing Workforce in the USA

Source: Dordick and Wang (1993), OECD, 2008

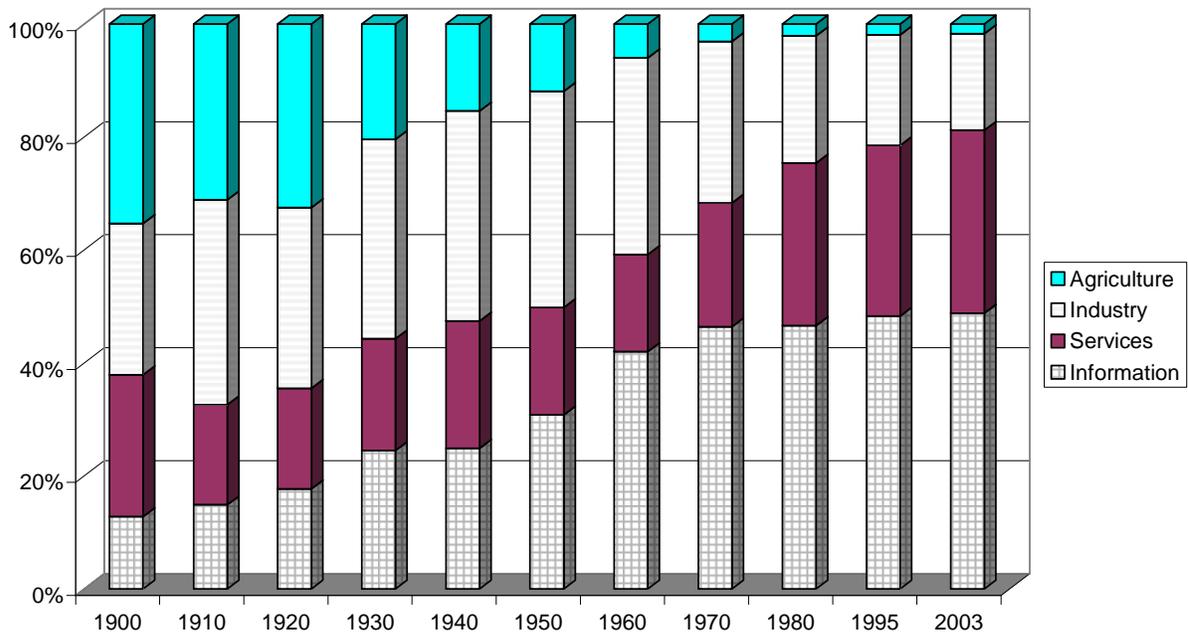


Figure 1 The changing workforce

Figure 1 is adapted from Dordick & Wang (1993). The numbers for 1995 and 2003 are calculated based on statistics of the Organization for Economic Co-operation and Development (2008). The numbers for the agricultural sector and industry are relatively easy to retrieve. But the distinction between the services and the information sector is more difficult to make. For example, Porat & Rubin (Porat & Rubin, 1977) estimated that a physician's work would be 80% information work and 20% non-information work, while a dentist's work would be 20% information work and 80% non-information work (Porat & Rubin, 1977). What matters for this dissertation is the broad picture that this figure represents: the number of employees in agriculture has diminished from more than 35% in 1900 to less than 2% in 2000. After an increase from 27% in 1900 to nearly 40% in 1950, the number of employees working in the production sector was reduced to 17% in 2000. The number of employees in the services sector has increased from a quarter in 1900 to a third of all employees in 2000. The number of employees working in the information (or knowledge) sector has increased from 13% in 1900 to nearly 50% in 2000. A large part of the shift to producing information or knowledge was made possible by information technology.

Information Technology (IT), as defined by the Information Technology Association of America (ITAA), is "the study, design, development, implementation, support or management of computer-based information systems, particularly software applications and computer hardware." IT deals with the use of electronic computers and computer software to convert, store, protect, process, transmit and retrieve information, securely. About 10% of Americans are employed in an IT job, such as application analyst, database administrator, network engineer, network administrator and/or manager, software engineer, etc. Contrary to belief, they do not all work in Silicon Valley, but most of them (about 90%) work in public and private organizations, such as the federal, state and local governments, bank and insurance companies, hospitals and the education sector.

Turnover of personnel in IT has been a major problem for the sector since the early days of computing and continuing to the present. IT personnel have a strong tendency to leave their current employer to work for another organization. Ever since statistics have been kept, IT turnover has been a problem. Studies on turnover in the IT workforce have been conducted since the late 60's and early 70's (Canning, 1977; Lundell, 1970; Stone, 1972; Thompson, 1969; Willoughby, 1972). The first literature review of turnover among IT personnel was already published in 1977 (Willoughby, 1977). Annual turnover in the IT field ranged between 15 percent and 20 percent during the 1960s and the early 1970s (Willoughby, 1977). In the late 1970s, turnover ran as high as 28 percent annually (McLaughlin, 1979) and up to 20 percent in the early 1980s. By the 1990s, the turnover rate reached 25 percent to 33 percent annually (Jiang & Klein, 2002). Many Fortune 500 firms have 25 percent to 33 percent turnover rate among their IT personnel (Hayes, 1998). Turnover of highly skilled employees can be very expensive and disruptive for firms (Reichheld, 1996). Losing highly skilled staff members means that companies incur substantial costs associated with recruiting and re-skilling, and hidden costs associated with difficulties completing projects and disruptions in team-based work environments (Niedermann & Sumner, 2003). Determining the causes of turnover within the IT workforce and controlling it through human resource practices and work system design is imperative for organizations (Igbaria & Siegel, 1992).

Although women have consistently made up nearly 48% of the total workforce in the USA during the last 10 years, the percentage of women in the IT workforce fell from 41% to 29% between 1996 and 2004 (ITAA, 2002; National Center for Woman & Information Technology (NCWIT), 2007; Trauth, Quesenberry, & Huang, 2006). Female scientists and engineers in

industry are more likely to leave their technical occupations and the workforce altogether than women in other fields. Attrition data on female scientists and engineers show that their exit rates are not only double those of men (25% versus 12%), but they are also much higher than those of women in other employment sectors (CAWMSET, 2000). Preliminary research has shown that the key barriers to retention of women in the IT workforce include lack of role models and mentors, exclusion from informal networks, stereotyping and discrimination, unequal pay scales and inadequate work/family balance (CAWMSET, 2000; ITAA, 2000).

There is substantial evidence for a critical shortage of skilled IT workers in the United States (Freeman & Aspray, 1999; ITAA, 1998; Office of Technology Policy, 1997), and a large subset of this problem is the underrepresentation of women and minorities in the IT workforce (ITAA, 2000, 2003). There have been estimates that if women and minorities were represented in the IT workforce in proportion with their representation in the general population, the shortage of IT workers in this country could be largely ameliorated, or perhaps, resolved completely (CAWMSET, 2000; Freeman & Aspray, 1999). Additionally, a larger representation of women and minorities in the IT workforce would contribute to enhanced creativity, knowledge, competencies, performance and markets (CAWMSET, 2000; Panteli, Stack, Atkinson, & Ramsay, 1999).

The goal of this study is to determine the causes of turnover in the IT workforce by developing a turnover model for IT; and to test the model for gender differences. If we know what causes turnover in IT, we know how we can better retain IT personnel, for example by redesigning jobs and organizations. If we know what causes women to leave the IT sector, we can redesign jobs and organizations to better accommodate their specific needs.

Background

Because of its practical and theoretical relevance, employee turnover is a behavior that has been the topic of great interest to researchers in many disciplines (Gallivan, 2003). Few topics in the organizational psychology and human resource management literature have received as much attention as employee turnover (Cotton & Tuttle, 1986). In the past decades several meta-analyses have been conducted to summarize results of research on turnover (Cotton & Tuttle, 1986; Griffeth, Hom, & Gaertner, 2000; Mobley, Griffeth, Hand, & Meglino, 1979; Mowday, Porter, & Steers, 1982; Porter & Steers, 1973). In most of the turnover models that have been used in research, turnover intention has been examined rather than actual turnover; this is based on the argument that intentions to voluntarily leave one's job are consistently correlated with actual turnover (Mobley, Griffeth, Hand, & Meglino, 1979). The focus on intentions rather than behavior is rooted in Fishbein and Ajzen's Theory of Planned Behavior (TPB) (Ajzen, 1985, 1991; Fishbein & Ajzen, 1975), one of the best empirically supported theories of motivation. TPB focuses on behavioral intentions in order to understand the link between attitudes and behavior: an intention is the cognitive representation of a person's readiness to perform a given behavior, and is considered to be the immediate antecedent of behavior (Ajzen, 1991).

In our study we combine the job and organizational design and stress literature and the literature on Human Resources Management (HRM) practices to examine antecedents of turnover intention. The job and organizational design literature shows that the following factors are directly or indirectly associated with turnover: job demands and decision latitude (Beehr, Glaser, Canali, & Wallwey, 2001); role ambiguity (Baroudi & Igarria, 1995; Guimaraes & Igarria, 1992; Igarria & Greenhaus, 1992); challenge (Beehr, Glaser, Canali, & Wallwey, 2001); social support (Jawahar & Hemmasi, 2006; Lee, 2004; Mobley, Griffeth, Hand, & Meglino,

1979; Rhoades & Eisenberger, 2002); person-organization fit (Bretz & Judge, 1994; O'Reilly, Chatman, & Caldwell, 1991; Verquer, Beehr, & Wagner, 2003); and work-family conflict (Greenhaus, Collins, Singh, & Parasuraman, 1997; Netemeyer, Boles, & McMurrian, 1996). The HRM literature and more particularly, the literature on High Involvement Work Processes show that training opportunities (availability and satisfaction with training opportunities at the company), career advancement opportunities (promotional opportunities), development opportunities (e.g. management development programs, coaching from peers and supervisors, mentorship) and fairness of rewards are directly or indirectly related to turnover (Huselid, 1995; Huselid & Day, 1991; Vanderberg, Richardson, & Eastman, 1999).

Although there are some studies that show a direct effect of job and organizational characteristics and HRM practices on turnover intention, most studies assume that the relation between antecedents of turnover intention is mediated by work-related attitudes or quality of working life (QWL) variables such as job satisfaction and organizational commitment (Cotton & Tuttle, 1986; Griffeth, Hom, & Gaertner, 2000; Maertz & Campion, 1998). Research suggests that satisfaction and organizational commitment are related but distinguishable attitudes: commitment is an affective response to the entire organization, whereas job satisfaction represents an affective response to more specific aspects of the job (Porter, Steers, Mowday, & Boulian, 1974). Results of a study by Igarria and Greenhaus (1992) in the IT workforce showed that job satisfaction has a stronger direct effect on turnover intention than organizational commitment. Burnout is another a powerful QWL factor that is significantly correlated with organizational commitment, job satisfaction and turnover intention (Moore, 2000). Emotional exhaustion (the core dimension of burnout) is linked to reduced job satisfaction (Burke & Greenglass, 1995; Maslach & Jackson, 1984; Pines, Aronson, & Kafry, 1981; Wolpin, Burke, & Greenglass, 1991), reduced organizational commitment (Jackson, Turner, & Brief, 1986; Leiter, 1991; Sethi, Barrier, & King, 1999), and high turnover and turnover intention (Jackson, Turner, & Brief, 1986; Moore, 2000; Pines, Aronson, & Kafry, 1981). Results of a meta-analysis by Lee & Ashford (Lee & Ashford, 1996) showed the correlation between emotional exhaustion and turnover intention to be 0.44 (Lee & Ashford, 1996). Technology professionals are particular vulnerable to work exhaustion (Kalimo & Toppinen, 1995; Moore & Burke, 2002).

Research has also shown that several personal characteristics are associated with work-related attitudes and turnover intention. Personal variables have direct effects on work-related attitudes (Arnold & Feldman, 1982; Bluedorn, 1982; Compton, 1987; Cotton & Tuttle, 1986; Igarria & Greenhaus, 1992; Mobley, Griffeth, Hand, & Meglino, 1979). Age and organizational tenure are positively related to satisfaction and commitment (Arnold & Feldman, 1982; Cotton & Tuttle, 1986; Igarria & Greenhaus, 1992) and negatively related to turnover (Cotton & Tuttle, 1986). Education has been found to be negatively related to satisfaction (Igarria & Greenhaus, 1992; Parasuraman, 1982), and organizational commitment (Bluedorn, 1982; Mottaz, 1988) and positively related to turnover (Cotton & Tuttle, 1986). Salary has been found to be negatively related to turnover (Cotton & Tuttle, 1986). Gender has been found to be positively related to turnover in the meta-analytic study by Cotton & Tuttle (1986). Prior research suggests that demographic variables have direct effects on turnover intention over and above their indirect effects on turnover intention through satisfaction and commitment (Igarria & Greenhaus, 1992; Parasuraman, 1982). In a study of 464 IT employees, Igarria, et al. (1992) found age, organizational level, organizational tenure and job tenure to be negatively correlated with turnover propensity and education to be positively related to turnover intention. Therefore, we will control for personal variables in our turnover intention model. The conceptual model of the study is shown in Figure 2.

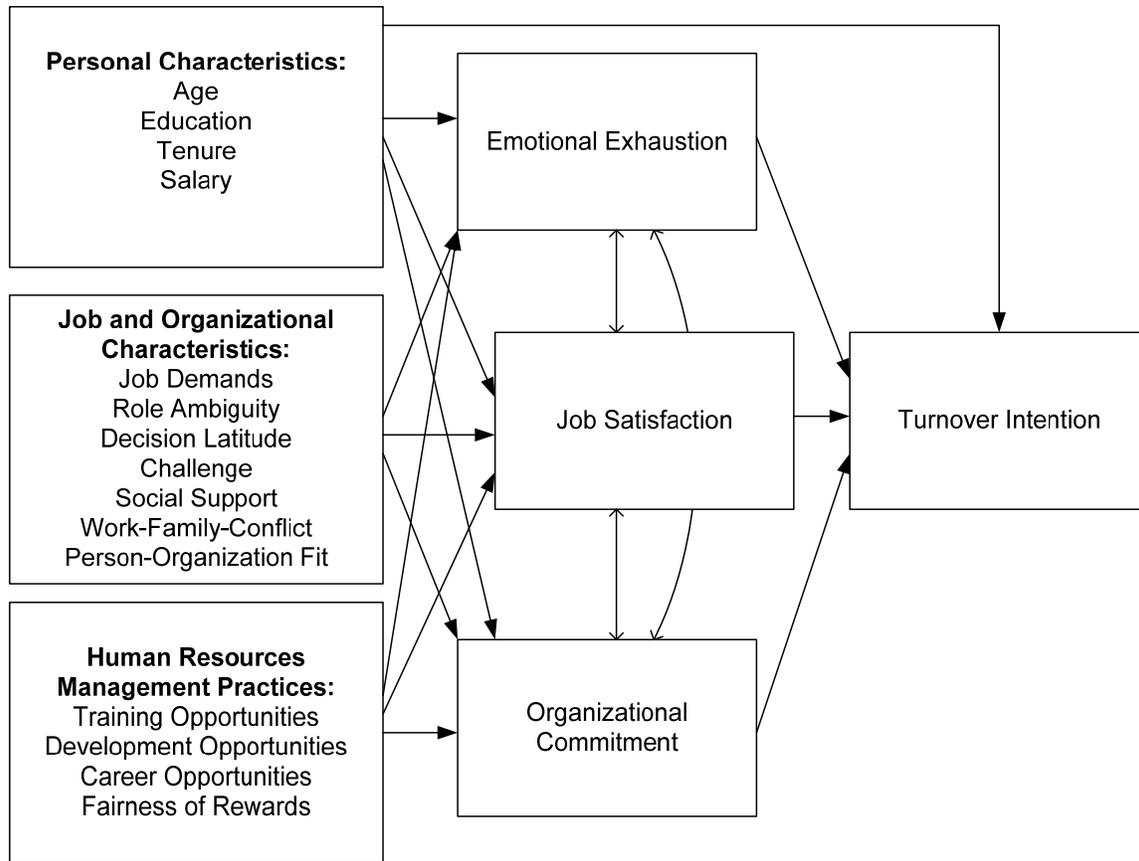


Figure 2 Conceptual Turnover Intention Model

This dissertation combines five articles on turnover and retention in the IT workforce that have been published (1 and 4), are accepted for publication (2 and 5) or submitted for publication (3):

1. Carayon, P., Schoepke, J., Hoonakker, P.L.T., Haims, M. & Brunette, M. (2006). Evaluating Causes and Consequences of Turnover Intention among IT Users: The Development of a Questionnaire Survey. *Behaviour and Information Technology*, 25 (5), 381-397.
2. Hoonakker, P.L.T. & Carayon, P., Non-response in Internet Surveys. Accepted for publication by the *International Journal of Human-Computer Interaction (IJHCI)*.
3. Hoonakker, P.L.T., & Carayon, P. and Korunka, C., (2008). The Relation between Job and Organizational Characteristics, Quality of Working Life and Turnover Intention in the IT Workforce: Are there Differences between Men and Women? Submitted to the *Journal of Management Information Systems*.
4. Korunka, C., Hoonakker, P.L.T. & Carayon, P. (2008). Quality of Working Life and Turnover Intention in Information Technology Work. *Human Factors in Ergonomics in Manufacturing*, 18 (4), 409-423.
5. Hoonakker, P.L.T., Korunka, C. & Carayon, P. (2008). Turnover and Retention of Women and Minorities in IT. Submitted to *Communications of the ACM*, accepted with minor revisions.

1) *In the first paper*, the development of the questionnaire used in the study is described. Great care was taken to develop an instrument that was reliable and valid, and specific for the information technology workforce. Based on a review of the literature, the topics related with turnover were identified and a first version of a questionnaire was developed, using questionnaire scales that were proven to be reliable and valid in previous research. This first version of the questionnaire was tested in 13 interviews with people working in the information technology sector. Based on a qualitative analysis of the interviews, using NVivo©, changes were made to the questionnaire to make it more specific to the IT workforce. The revised version of the questionnaire was transformed into a web-based-survey (WBS) version, using the web survey management system (WSMS) developed by the University of Wisconsin-Madison Center for Quality and Productivity Improvement (Barrios, 2003). The process used to implement the web-based survey questionnaire with the first participating company is described in the first paper. The first paper is published in *Behaviour and Information Technology*, Vol. 25, No 5, pp. 381-397, 2006.

2) WSMS was one of the early web-based survey systems and we had relatively little experience with web-based-surveys and their impact on response rates. Therefore, in *the second paper* we describe the results of a literature review of response rates in postal mail and electronic survey systems. Totally, response rates of 29 studies with nearly 20,000 respondents in which both postal mail and the Internet were used were compared.

Further, we examined survey design factors that influence response rates in both study modes (postal mail and the Internet). Evidently, low response rates can threaten the validity of a survey and the conclusions reached, because it makes it very difficult to generalize the results to the larger population. Surprisingly, there is relatively little literature on adequate response rates for questionnaire surveys. Reviews of the literature showed that after an initial increase of response rates using the Internet as a medium, response rates, in particular for questionnaires sent by e-mail, have started to drop. Results of our own analysis show that response rates for *e-mail questionnaires* have indeed dropped in the last decade compared to response rates of paper & pencil version of questionnaires. But results also show that response rates of *web-based surveys* are comparable to response rates of paper & pencil questionnaires.

Our examination of survey design factors shows that many factors that can increase response rates in postal mail questionnaires (saliency of the topic, understanding the targeted population, pre-notification, personalized cover letter, sponsorship, incentives, and reminders) can also increase response rates in web-based surveys.

We conclude the second paper with recommendations for web-based survey design and for future research. We may know *what* survey design factors increase response rates, but we still know relatively little about *why* they work, especially in web-based surveys. The web survey process has several distinct stages where nonresponse occurs: cooperation rate in the pre-recruitment stage; failure rate (percentage of undeliverable mail); click-through rate (percentage of potential participants accessing the web questionnaire); overall completion rate (the percentage of partial and complete surveys submitted); and drop-out rate (the percentage of respondents prematurely abandoning the web survey). It may well be that different survey design factors may have an impact at different stages. We know little about the different stages and more research is needed focusing on the underlying psychological processes explaining the effectiveness of the design factors in the different survey stages. The second paper was submitted to the *International Journal of Human Computer Interaction* and has been accepted for publication.

3) *In the third paper*, we examine causes of turnover in the Information Technology (IT) workforce. Turnover has been a major issue in the IT workforce since the very early days of computing and continuing in the present. Turnover rates in the IT workforce can be as high as 30% annually and can be very expensive and disruptive for firms. Losing highly skilled staff members means that companies incur substantial costs associated with recruiting and re-skilling, and hidden costs associated with difficulties completing projects and disruptions in team-based work environments. Determining the causes of turnover within the IT workforce and controlling it through human resource practices and work system design is imperative for organizations. Interestingly, turnover rates of women can be twice as high as those of men (CAWMSET, 2000). Therefore, we also examined gender differences in turnover intention. Path analysis with AMOS© was used to determine the relationships between job and organizational characteristics, human resource management (HRM) practices, quality of working life and turnover intention. Results of our analysis show that there are a number of job and organizational characteristics and HRM practices associated with turnover intention. Most of these relations are mediated by quality of working life (job satisfaction and burnout). Results show further that there are very few differences in how men and women in the IT workforce perceive their jobs. However, results of our analysis also show that gender *moderates* the relationship between job and organizational factors, HRM practices and turnover intention. This means that the relationship between the different factors and turnover intention has different meaning for men and women. Obviously, these results have implications for retention of men and women in the IT workforce. This paper has been submitted to the *Journal of Management Information Systems*.

4) The Center for Quality and Productivity Improvement (CQPI) at the University of Wisconsin-Madison has a history of cooperating with the Psychology Department at the University of Vienna. Over the years we have conducted several, transnational studies ranging from quality improvement in the public sector (Korunka, Carayon, Sainfort, Scharitzer, & Hoonakker, 2003), turnover and retention of IT personnel (Korunka, Hoonakker, & Carayon, 2008), to studies on the aging working population and early retirement (Kubicek, Korunka, Hoonakker, & Raymo, submitted). Obviously, repeating the same study, while using the same survey questionnaire, in another country, can add to the external validity of the results. The project on turnover and retention of IT personnel was no exception. We used the same questionnaire that was developed in the USA, had it carefully translated into German and conducted a “replication” study with a large IT organization in Austria. The results of this study, as well as the results of a comparison between the USA and Austria, are reported in the *fourth paper*. Results showed that the model developed to explain turnover intention in the IT workforce in the USA can be used to explain turnover intention in Austria. This provides support for an external validation of the turnover model. This paper has been published in *Human Factors in Ergonomics in Manufacturing*, Vol. 18, No 4, pp. 409-423, 2008.

5) Finally, in the *fifth paper*, we describe options for retention of IT employees. Employers have several options to retain their personnel. For example, they can offer financial incentives, including a higher salary, more extensive health insurance or better pension plans; career incentives such as training and mentoring; and family-friendly programs. In this paper we focus on family friendly programs. The challenge of balancing work and family life is one of today’s concerns for both individuals and organizations, especially in industries like IT that are characterized by high job demands. Offering family-friendly programs can help to restore the work-family balance. In this paper, we describe reasons for turnover of men, women and

minorities in the IT workforce, and we examine the family friendly programs that are used to retain employees in the IT sector. We analyze the efficiency of family friendly programs in retaining IT personnel. Results show that reasons to leave one's job are different for men, women and minorities. Results also show significant differences in the availability of family-friendly programs for men, women and minorities. Finally, results of our study show that offering family-friendly arrangements is not a "one size fits all" solution for retaining IT personnel. Different groups (white men, white women, and underrepresented minority men and women) benefit from different family-friendly arrangements, depending on their family situation (having children or not, the age of the children, etc.). The fifth paper has been submitted to *Communications of the ACM* and is conditionally accepted for publication, pending revisions.

The NSF-ITWF project was a successful project. Great care was taken to ensure the reliability and validity of the measures. As described above, we used scales and items that were proven to be reliable and valid in previous research, and pilot-tested the first draft of our questionnaire in interviews with 13 people working in IT, carefully analyzed the data using qualitative analysis software (NVivo©), and made changes to the questionnaire to make it more specific to IT. Then we developed our own web-based survey management system, using open source software, which was very interesting but at the same time demanding: the system was tested several times. We conducted a literature review to examine the questionnaire design factors that affect response rates. The questionnaire survey itself was conducted among 5 different companies, one large one, one medium sized and three small sized companies. The results were analyzed using quantitative analysis software (SPSS© and AMOS©). The validity of the turnover model developed in the USA was tested in a transnational study, and the results showed that the model can indeed be used to predict turnover intention in another organization, in another country. Obviously, this shows the robustness and external validity of the model. Finally, we not only analyzed causes of turnover in the IT workforce, but also made recommendations for retention of key personnel.

The project was also very successful as measured by the number of publications. Totally, 25 publications (including this dissertation) were written on the topic of turnover in the Information Technology workforce (see appendix 1). The questionnaire that we developed has been used in several other studies.

Many colleagues and students took part in the NSF-ITWF project: first of all, Pascale Carayon, the principal investigator, Marla Haims, who was very instrumental in writing the proposal for the National Science Foundation (NSF) and conducting the pilot study, Maria Julia Brunette, Segolene Marchand, Alexander Marian, Jen Schoepke, and last but not least: Ernesto Barrios, who developed the web survey system used in the project and was always open to suggestions to improve the system. In Austria, the study was led by Christian Korunka. Data were collected by Claudia Konrad. Many thanks to my colleagues and the students who participated in the project, as well to the organizations and their employees for participating in the study!

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2. Paper 1

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Evaluating causes and consequences of turnover intention among IT workers: the development of a questionnaire survey

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In this paper we describe the process of developing a questionnaire survey that evaluates the causes and consequences of turnover intention among information technology (IT) workers, with specific attention to issues of importance to women and minorities within the IT workforce. The questionnaire development process consisted of four steps:

1. Creation of the initial questionnaire from a literature review of existing scales
2. Pilot study using interviews to test the questionnaire
3. Modifications to the questionnaire based on feedback from the pilot study
4. Implementation of the revised questionnaire survey.

The process used for the development of the questionnaire survey is systematic and addresses issues specific to the IT workforce, in particular the underrepresentation of women and minorities in the IT workforce. The questionnaire survey allows the collection of reliable and valid data on causes and effects of retention and intention to turnover, thus making it possible to better understand the reasons for the underrepresentation of women and minorities in the IT workforce.

Keywords: Questionnaire survey; IT workforce; Turnover; Working conditions; Job satisfaction; Job stress

1. Introduction

Turnover and retention of skilled information technology (IT) personnel are major issues for employers and recruiters of the IT workforce: the departure of a company's IT employees not only means the loss of personnel, knowledge and skills, but also the loss of business opportunities (Moore and Burke 2002). In 2001, Information Technology Association of America (ITAA) reported that IT firms lost 15% of their IT workers while non-IT companies lost 4% (2002). With 92% of IT workers employed by non-IT companies (ITAA 2002), the issue of retention and turnover of IT workers is a problem for both IT and non-IT firms.

Projections from the US Bureau of Labor Statistics estimate that between 2000 and 2010, 2.5 million new IT jobs will be available, which will result from the growth in IT occupations (2.2 million) and the need to replace those leaving the workforce (331,000) (U.S. Department of Commerce 2003). Thus, a high demand for skilled IT workers is predicted for the next decade (U.S. Department of Commerce 2003). A large subset of this demand could be fulfilled if women and people of minority status are represented in the IT workforce as they are in the total workforce. According to statistics from the Bureau of Labor Statistics (2003), women represent 47% of the total workforce, but only 35% of the IT workforce. Similarly,

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Afro-Americans make up 11% of the total workforce, yet hold only 8% of IT workforce jobs (Bureau of Labor Statistics 2003). Hispanics make up 12% of the total workforce, but hold 6% of IT workforce jobs (Bureau of Labor Statistics 2003). Native Americans make up 1% of the total workforce, but hold less than 0.6% of the IT workforce jobs (Bureau of Labor Statistics 2003). Unfortunately, similar data is not available for Alaskan Natives, but they are a group that is underrepresented in all science and engineering fields (ITAA 2000).

Compared to women in other fields, female scientists and engineers are more likely to leave their jobs and the workforce altogether. Attrition data shows that female scientists and engineers have exit rates almost double those of men (25% versus 12%), and exit rates for women in the technical fields are much higher than those of women in other fields (CAWMSET 2000).

Previous studies on intention to turnover, in particular the IT workforce, leave gaps in our understanding of the phenomenon of turnover intention. We need to look more closely at the causes and effects of retention and intention to turnover in order to better understand the reasons for the underrepresentation of women and minorities in the IT workforce. In this paper, we describe the development of a questionnaire survey aimed at assessing the causes and effects of retention and turnover intention in the IT workforce, with special emphasis on issues relevant to women and minorities that are underrepresented in the IT workforce.

2. Turnover in the IT workforce

Numerous studies of the IT workforce have looked at intention to turnover as a result of job satisfaction and organisational commitment. Igarria and Greenhaus (1992) used questionnaire data to test a model of turnover intention among 464 management information systems (MIS) employees. The model consisted of five sets of variables:

1. demographic variables
2. role stressors
3. career experiences
4. work-related attitudes
5. turnover intention.

Turnover intention was strongly influenced by job satisfaction and organisational commitment. The impact of other variables, such as demographics, role stressors and career experiences, on turnover intention was mediated by job satisfaction and organisational commitment. Role stressors had a positive, indirect effect on turnover intention through low job and career satisfaction and organisational commitment. Organisational commitment had a strong, negative effect on turnover intention, but inconsistent with prior research, job satisfaction had stronger effects than organi-

sational commitment on turnover intention (Igarria and Greenhaus 1992).

Many factors influence an employee's commitment to the organisation and satisfaction with his or her job. One particular powerful factor that prior research has repeatedly shown to be significantly correlated to the job attitudes of interest (namely organisational commitment, job satisfaction and turnover intention) is work exhaustion, or burnout (Moore 2000, Moore and Burke 2002). The research literature in IT and the popular press suggest that technology professionals are particularly vulnerable to work exhaustion and stress (Kalimo and Toppinen 1995, McGee 1996).

In the management and organisational design literature, turnover has traditionally been thought of as coming from a perceived ease of movement (extent to which one can find alternative jobs) and a perceived desirability of movement (related to job satisfaction). Empirical studies have demonstrated a relationship between job satisfaction and turnover. Levy (2003) cites Hom and Griffeth's (1991) Modified Model of Turnover as an example of a model that uses job satisfaction as a key element in the decision-making process of staying with or leaving a job. Levy also points out that individual circumstances may impact one's decision to leave a job, such as relocating because of a spouse or to be near a sick relative (Levy 2003).

The models of turnover described above point to the importance of the relationship between job and organisational factors and quality of working life (QWL).[†] For example, Igarria and Greenhaus's study (1992) confirmed that a range of job factors and role stressors can influence QWL (job satisfaction and organisational commitment), which in turn, can influence turnover intention. Moore and Burke (2002) stressed that job and organisational factors influence the turnover culture found in the IT workforce. However, in most turnover models the concept of what happens *after* one leaves a job is missing. Further, very little research focused on issues specifically relevant to the underrepresentation of women and minorities within the IT workforce. Therefore, we need to develop a better understanding of the job and organisational factors that contribute to turnover intention among IT professionals and to assess the role of gender and minority status.

The main method used for evaluating job and organisational factors, QWL, and turnover is questionnaire survey. Thus there is a need to adapt existing surveys that measure intention to turnover and include the causes and consequences of intention to turnover of the populations underrepresented in the IT workforce. In

[†]Quality of working life (QWL) is defined as the employee reactions to the outcomes of the complex interactions of the different elements in the work system. Various outcomes can result from these interactions. In this paper, the main areas of interest are job satisfaction, organisational involvement and health outcomes, such as fatigue and tension (Carayon 1997).

this paper, we report results on the development of a questionnaire survey to assess turnover intention among IT professionals, with specific attention to the role of gender and minority status. The survey was specifically designed to evaluate job and organisational factors, QWL and turnover in the IT workforce. While some of the job and organisational factors of importance to IT workers may be similar to other job categories, IT workers experience some unique job and organisational factors, such as the need to continuously update one's skills and knowledge. This survey is based on a conceptual framework that links job and organisational factors to QWL and turnover intention (Carayon *et al.* 2001).

The questionnaire survey was specifically developed to collect data from IT workers in order to test models of how job and organisational factors affect QWL and turnover, and the role of gender and ethnic/racial background in those relationships (Carayon *et al.* 2001). The survey can also be used for other purposes:

- evaluating the job and organisational factors that predict QWL and turnover
- comparing IT workers' perceptions and attitudes of different companies or different groups (e.g. benchmarking different divisions within a single organisation, comparing responses of men versus women)
- identifying those job and organisational factors in need of redesign in order to improve QWL and reduce turnover.

The quality of a questionnaire survey can be assessed by examining its validity and reliability. Validity refers to the content of measurement: are we measuring what we think we are measuring? There are several methods to evaluate reliability and validity (Carmines and Zeller 1990, Carayon and Hoonakker 2001). We can evaluate reliability by measuring a concept at two different times (test–retest–reliability), by looking at the internal consistency (of the answers) of questions that are supposed to measure the same concept, and by comparing with other methods of measurement of equal or higher level, for example standardised (and validated) questionnaires. A measure that is often used to evaluate internal consistency is the Cronbach's alpha: it is a measure of the homogeneity of a group of items in a survey or questionnaire. The Cronbach alpha scores of our scales are calculated in order to evaluate the reliability of our measures.

Three forms of validity can be distinguished (Nunnally 1978): predictive validity, content validity and construct validity. In this study, we examine only content validity and construct validity. The content validity of a measurement instrument can be established by examining the domain represented by the questions very carefully. For developing the domain of questions of our questionnaire survey, we chose our topics/issues to be measured from a

review of the literature and from our conceptual framework (Carayon *et al.* 2001). We also conducted interviews with IT professionals to make sure the IT professionals interpreted the questions as we wanted them to be interpreted. Further, the process of asking subject-matter experts (IT professionals) about the clarity and completeness of a questionnaire is an often-used method for establishing the content validity of a questionnaire (McDowell and Newell 1987). Thus, interviewing IT professionals, analysing the data collected, and revising the questionnaire were all steps that provided a method for ensuring the content validity of the questionnaire. The construct validity of a measurement instrument can be established by statistically analysing the measures. The abstract concept (the construct) is typically operationalised by several questions. When results of statistical analyses show that the questionnaire items show a high degree of internal consistency, one can conclude that the different questions do indeed refer to one (underlying) construct. Structural equation modelling with primary and secondary confirmatory factor analysis of the scales in a questionnaire survey is a statistical method used to evaluate construct validity.

3. Methods

3.1 Overall process

The overall process used to develop the questionnaire is depicted in figure 1. The process consisted of four steps:

1. creating the initial questionnaire from a literature review of existing scales
2. conducting a pilot study with interviews to test the questionnaire
3. modifying the questionnaire based on feedback from the pilot study
4. implementing the revised questionnaire survey.

In this section, we describe the content of the initial questionnaire survey, the methods used for conducting the pilot study and the methods used to implement the final version of the questionnaire survey in one company.

3.2 Initial questionnaire survey

In order to assure reliability and validity, it is recommended to use established scales as much as possible (Carmines and Zeller 1990). Based on our conceptual framework (Carayon *et al.* 2001) and existing research literature, the initial questionnaire had the following structure:

- demographic and background information
- job information

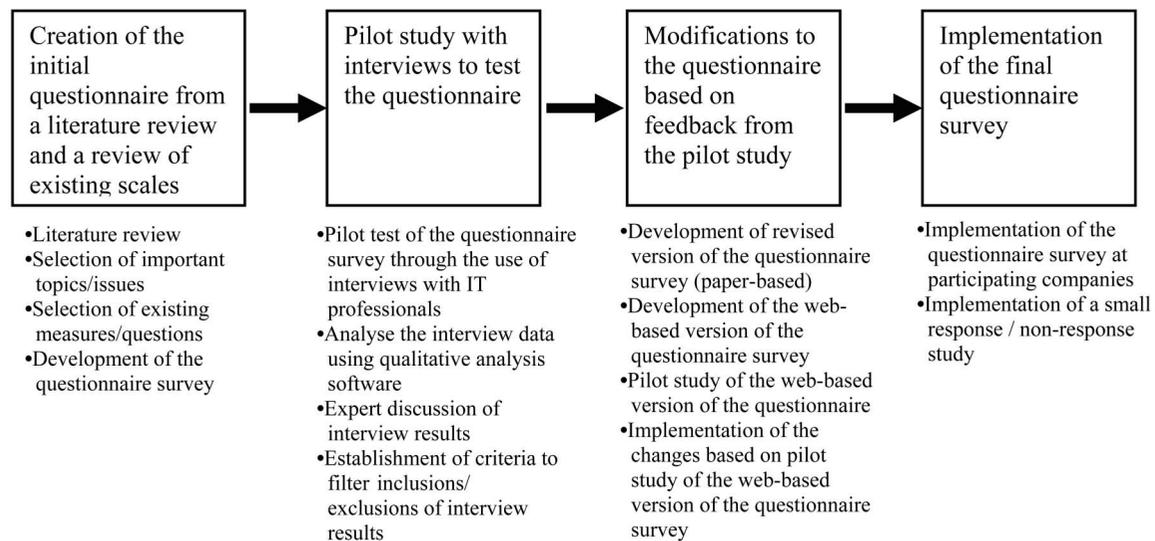


Figure 1. Process of developing questionnaire survey.

- job factors
- organisational factors
- QWL and intention to turnover.

Refer to table 1 for the sources of measures and data on reliability for the last three categories of variable, i.e. job factors, organisational factors and QWL, and intention to turnover. The section on demographic and background information includes the following measures: gender, minority status, marital status, parental status, age, number of children living at home, number of children under the age of six, level of education and IT education. The section on job information includes the following measures: organisational tenure, job tenure, job title (job title was not an existing scale; the measure was specifically developed for this project through extensive review of IT jobs), job type (e.g. professional or managerial) and current salary range. The section on job factors includes the following measures: job demands, role conflict, role ambiguity, decision control, challenge, supervisor social support and co-worker social support. The section on organisational factors includes the following measures: training opportunities, development activities, career advancement, discrimination (general and ethnicity), corporate fit, rewards, flexible work practices and work/family conflict. The section on QWL factors includes the following measures: job satisfaction, organisational involvement and perceived stress (fatigue, tension and burnout). In the initial questionnaire survey, intention to turnover was measured using a 3-item scale from the Michigan Organizational Assessment Questionnaire (MOAQ) from the Seashore *et al.* (1982) study with a reliability coefficient of 0.87 (Siegall and McDonald 1995). All measures have been used extensively in research concerning job design, occupa-

tional stress and QWL (Carayon 1993, Carayon 1994, Carayon *et al.* 2000, Carayon and Karsh 2000, Carayon and Smith 2000).

3.3 Pilot study – interviews

To test the initial version of the questionnaire, interviews with IT professionals (i.e. content experts) were conducted. An interview guide was developed to obtain feedback on the initial questionnaire survey, in particular those questionnaire items most relevant to and likely to be affected by gender and minority status. A total of 14 topics were addressed by the interview. Initially, the following 10 topics were identified by the researchers as important for obtaining feedback from the interviewees:

1. work/family conflict
2. training opportunities
3. development activities
4. career advancement
5. discrimination in general
6. discrimination based on ethnicity
7. corporate fit
8. flexible work practices
9. rewards
10. intention to turnover.

In the context of the extensive research conducted by our research group on IT work (Carayon and Haims 2001), we specifically selected those 10 topics because of our lack of experience with these constructs and those measures. These 10 topics represented the 10 categories of organisational factors assessed in the survey (see table 1). Another set of three topics was added later on

Table 1. Measures in the initial questionnaire.

Scale name	Source	# items	α^*	Example question
Job Factors				
Job demands	Quinn et al. (1971)	4	.84	How often does your job require you to work very hard?
Role conflict	Caplan, Cobb, French, Harrison and Pinneau, (1975)	3	.80	People in a good position to see if you do what they ask give you things to do which conflict with one another.
Role ambiguity	Caplan et al. (1975)	4	.91	How often are you clear about what others expect of you on the job?
Decision control	McLaney and Hurrell (1988)	4	.90	How much influence do you have over the policies, procedures and performance in your work unit?
Challenge	Seashore et al (1982)	4	.81	On my job, I seldom get a chance to use my special skills and abilities.
Supervisor social support	Caplan et al. (1975)	4	.90	How much can your immediate supervisor (boss) be relied on when things get tough at work?
Co-worker social support	Caplan et al. (1975)	4	.85	How much can other people at work be relied on when things get tough at work?
Organisational Factors				
Training opportunities	Lehto and Sutela (1999)	3	—	What is the total number of days (in full days) you have attended training courses in the last 12 months?
	Igbaria and Wormley (1992)	2	—	Technical Training: Programs designed to teach specific job-related information and skills (rank usefulness).
Development activities	Igbaria and Wormley (1992)	7	—	Mentor: A relationship with a more experienced colleague in order to provide you with increased opportunities for advancement, corporate visibility, guidance and advice, and 'running interference' (rank usefulness or no existence).
Career advancement	Nixon (1985b)	13	.89	There is no promotional ceiling for me in my company.
Discrimination	Lehto and Sutela (1999)	8	—	Do you believe that unequal treatment or discrimination occurs at your workplace on the basis of sex?
	Sanchez and Brock (1996)	10	.87	At work, I feel that others exclude me from their activities because of my ethnic background.
Corporate fit	Nixon (1985a)	12	.88	The longer I work for my company, the more I feel I belong.
Rewards	Vandenberg et al. (1999)	7	.86	There is a strong link between how well I perform in my job and the likelihood of my receiving high performance appraisal ratings.
Flexible work practices	Vandenberg et al. (1999)	11	.80	To help employees balance work and family/home responsibilities, which of these options are offered at your company: Flextime? Telecommuting? etc. . .
Work/family interface	Wortman, Biernat and Lang (1991)	5	.61	Because of the requirements of your job, you have to miss out on home or family activities that you would prefer to participate in.
Quality of Working Life (QWL)				
Job satisfaction	Quinn et al. (1971)	5	.80	Knowing what you know now, if you had to decide all over again whether to take the job you now have, what would you decide?
Organisational involvement	Cook and Wall (1980)	3	.68	In my work, I like to feel I am making some effort, not just for myself but for the organisation as well.
Fatigue	Grove and Prapavessis (1992)	3	.95	How have you been feeling during the last week, including today?: Fatigued? Exhausted? Bushed?
Tension	Swanson (1997, unpublished data)	3	.73	How have you been feeling during the last week, including today?: Nervous? Tense? Shaky?

*Cronbach-alpha reliability scores

because of their importance and relevance specifically to IT work. Those additional three topics were also addressed in the pilot study:

1. job demands
2. IT/computer education/training
3. IT job title.

We also allowed interviewees to provide any additional comments. The interview guide, therefore, tackled a total of 14 major topics.

The target sample for the pilot study was 15 women and minorities across three participating companies. The goal was to interview five non-minority women, five minority women and five minority men. All potential participants were recruited through a recruitment letter that asked people interested in volunteering to contact the researcher. When the researcher received an email or phone call from a volunteer, the first step was to determine the volunteers' eligibility for participation. Eligibility was determined by asking a series of questions including job type, gender and minority status, and a number of similar volunteers already participating (i.e. if there were already five volunteers from that company or in their demographic category, the volunteer was politely turned down for an interview). After eligibility criteria were applied, our final sample included a total of 13 interviewees: five from Company A, five from Company B and three from Company C. There were five female non-minorities interviewed, five male minorities and three female minorities. Interviewee job types included programmers, systems analysts, network engineers and software, testing and technical support engineers.

All 13 telephone interviews were conducted between mid-January and mid-February 2002. All interviews began with the researcher reading a consent form to the pilot study volunteer to ensure informed consent for participation in general, to verify acceptance of the tape recording of the interview, and to ensure the interviewee was in a private room where no-one at work could overhear their responses. Each interview was tape-recorded using a speakerphone, while the researcher was in a private office with the door shut. Although the interview tapes were to be transcribed, the researcher did take some handwritten notes during each of the interviews to highlight the key points of the discussion. Interview length varied from 45 minutes to 1 hour and 15 minutes.

The interview data was transcribed and formatted for entry into the NVivo[®] qualitative data analysis software. All interview data was coded into NVivo[®]. The coding was based on a node structure that was developed on the basis of the 14 major interview topics. For each topic, the major nodes were:

- (1) additions (i.e. additional questions to add to what already exists in the initial questionnaire survey)
- (2) changes/edits (i.e. suggestions for modifying existing questions)
- (3) interviewee positive comments.

The major nodes were then divided into subnodes, leading to a final node structure containing 307 nodes. A total of 532 pieces of interview data were coded. The result of the

coding was itemised lists of the additions, deletions and modifications for each topic area.

A set of criteria was developed to filter the itemised lists of interview data. The selected recommendations were then applied to make revisions to the initial questionnaire (see section 4.2 for further explanation of the criteria and process used for the modifications).

3.4 Implementation of the revised questionnaire survey

The last step of the development of the questionnaire survey was the implementation of the survey. We described the process used to implement the questionnaire for one of the participating companies in our study (Company 1). The same process was used for all participating companies. Our contact persons at Company 1 were given the questionnaire in order to verify its content and suggest additional questions specific to their company, thus adding to the content validity. In addition, they were also asked to verify the list of IT job titles and edit the list according to the job categories and job titles used in their company. Once the changes to the IT job title list and any additional survey questions were agreed upon by the company's representatives and the researchers, changes were made to the questionnaire.

The revised version of the questionnaire was transformed into a web-based questionnaire using the web survey mailing system (WSMS) developed by the University of Wisconsin-Madison Center for Quality and Productivity Improvement (Barrios 2003). This involves the questionnaire being posted on a secure password-protected website where each potential participant has his or her unique link to gain access to the questionnaire. An informed consent procedure is part of WSMS. Participants then go to the website to fill out the questionnaire online and submit it online. The system is designed such that the questionnaire can only be filled out and submitted *once* per unique link. Once the data is submitted, it goes directly to a secure server, where it is stored and accessed and analysed by the researchers.

Company 1 is a medium-sized IT company located in the Midwest of the US. The researchers asked the company's contact person to send an email to notify potential participants and express the company's support for the project. This was done two days before the researchers sent out the invitation to potential participants via email in order to achieve a high response rate (Dillman 2000). The initial invitation to participate was sent out to potential participants on 26 February 2003. The first reminder email was sent out five days after the first invitation to participate. The second reminder email was sent out 14 days after the initial invitation. After achieving a response rate of 66%, we decided to stop the data collection. The data collection period ended 23 days after it began. A total of 190 people were invited to participate, of which 125 responded to the questionnaire and 65 did not. Of the 65

who did not participate, 71% were non-responses, 23% said yes to the consent form but did not submit a completed survey, and 6% asked to be removed from the list of possible participants.

Following the end of the data collection period, a short response/non-response survey was conducted. All 190 employees were emailed two questions. Depending on whether the employee responded or did not respond to the previous questionnaire, the wording of the questions varied. The questions were:

1. Why did you choose to (not) participate in our web-based survey on retention and turnover in the IT workforce?
2. Do you have any suggestions on how to improve our web-based survey?

4. Results

4.1 Pilot study – interview data

This section presents the major findings from the phone interviews for each of the 14 topic areas. Table 2 contains a summary of the results of the 14 topic areas (nodes), their

level-one subnodes and the frequency for each subnode. The five subnodes with the highest frequencies were:

1. intention to turnover additions (n = 77)
2. training opportunities additions (n = 30)
3. work/family conflict additions (n = 29)
4. flexible work practices additions (n = 26)
5. job demands additions (n = 23).

The subnode of intention to turnover additions had the highest frequency of comments from the interviewees. Many pieces of interview data concerned dissatisfaction as a reason to leave (n = 39). One interviewee stated s/he would leave, ‘...because it [management policies and practices] is something that affects how people stay in their jobs. Places that ask you to do a lot of overtime with no compensation...’. Another interviewee stated that lack of challenge could be a source of dissatisfaction and a reason to leave: ‘...I recently talked to one of my colleague[s] and... she told me that she wants to leave because she feel[s] that she [is] never given an important job or something that she liked really well to do.’ The many comments that we obtained on intention to turnover additions prompted us to add two questions (see the

Table 2. Pilot study – Aggregated results from phone interviews.

Node	Subnode	Frequency of comments
Job Demands	Additions	23
	Changes and Edits	9
Work/Family Conflict	Additions	29
	Changes and Edits	9
Training Opportunities	Additions	30
	Changes and Edits	5
Development Activities	Additions	8
	Changes and Edits	12
Career Advancement	Additions	6
	Changes and Edits	13
Discrimination (General)	Additions	16
	Changes and Edits	10
Discrimination (Ethnicity)	Additions	9
	Changes and Edits	19
Corporate Fit	Additions	20
	Changes and Edits	10
Flexible Work Practices	Additions	26
	Changes and Edits	8
Rewards	Additions	20
	Changes and Edits	5
Intention to Turnover	Additions	77
	Changes and Edits	14
Training and Education in IT	Additions	21
	Changes and Edits	15
Job Title	Additions	0
	Changes and Edits	20
Additional Comments	Overall Additions	10
	Overall Changes and Edits	11

Intention to Turnover Additions section in the table[†] on the comparison of initial questionnaire and revised questionnaire): one question on reasons for leaving one's job with 20 possible reasons, such as high job demands, lack of social support and want more challenge in my job; and a second question on intentions after leaving one's job with six options, such as different job in the same company, same job in a different company and leaving the IT field.

Training opportunities additions had the second highest frequency of comments from the interviewees. Many pieces of interview data were about the need to differentiate where training was conducted and who sponsored it (n = 5). One interviewee stated that, '...some of the training that our job requires can't happen on the job, because it's more of a classroom setup. So I think the question to ask is, "Does your company offer... to pay for your studies."' The many comments that we obtained on training opportunities additions prompted us to add four questions (see the Training Opportunities Additions section in the table[†] comparing the initial questionnaire to the revised questionnaire) on how many days of training were received within the last 12 months for several scenarios:

1. company sponsored/on company time
2. company sponsored/on own time
3. self-sponsored/on company time
4. self-sponsored/on own time.

In addition, a series of eight questions, each with response categories from strongly agree to strongly disagree, was added to measure availability of and satisfaction with training.

Work/family conflict additions had the third highest frequency of comments from the interviewees. Many pieces of interview data address work opportunities as conflicting with family (n = 6). One interviewee stated, 'If I had to go to [large city in neighboring state] and it was required that I be there Monday through Friday to do my work... and I have a family, and I would refuse to do that, I would turn down that, that would not be, ah, looked upon as good. And yes, it... I could see that, where it would be a problem with a promotion.' The many comments that we obtained on work/family conflict additions prompted us to add a question (see the Work / Family Conflict Additions section in the table[†] comparing the initial questionnaire to the revised questionnaire) asking if one had ever turned down one of the following because of family obligations:

1. an assignment
2. a promotion
3. a relocation.

A series of eight questions were either reworded or added to measure the spillover of work into family and of family into work, with response categories ranging from strongly disagree to strongly agree.

Flexible work practices additions had the fourth highest frequency of comments from the interviewees. Many pieces of interview data referred to telecommuting as a specific type of flexible work practice (n = 6). One interviewee stated, '...how easy is it to get flex time or telecommuting or job sharing? Because if... if your company does not have, they are going to say that it's impossible. Or if they have and the manager doesn't encourage everybody to do it, it is going to be... it's kind of hard.' This led us to adding a question on telecommuting in the job information section. The many comments that we obtained on flexible work practices additions prompted us to modify the question that we asked on whether one takes advantage of flexible work options to whether a company offers 11 different flexible work options (e.g. job sharing, maternal or paternal leave and elder care) and an option to write in other options (see the Flexible Work Practices Modifications section in the table[†] comparing the initial questionnaire to the revised questionnaire). Two other questions were added (see the Flexible Work Practices Additions section in the table[†] comparing the initial questionnaire to the revised questionnaire). One question asked if the flexible work practices offered by one's company were *sufficient* to fit one's needs with a scale of 1 = no, not at all to 7 = yes, most definitely. The second question asked if one *feels discouraged* from taking advantage of these flexible work options, with the same scale as the first question.

Job demands additions had the fifth highest frequency of comments from the interviewees. Many pieces of interview data were about keeping up with new technology as a job demand in IT work. One interviewee stated, '...one of the things that we thought of that's a special job demand, perhaps, for people in IT as opposed to other types of work, is that you're constantly having to keep up with new developments. So technology is always changing...'. The many comments that we obtained on job demands additions prompted us to add three questions, all on a scale of 1 = rarely to 5 = very often (see the Job Demands Additions section in the table[†] comparing the initial questionnaire to the revised questionnaire). The first question asked how often one has problems keeping up with new technology. The second question asked how often one has to stay at work because of customer demands. The third question asked how often one is overwhelmed by workload.

The remaining nine topic areas and their respective subnodes contained various comments that lead to minor changes in wording, scales and formatting. For example, comments were made by interviewees on the need to clarify the various activities listed under the topic area of development activities and to distinguish between listing

[†]Due to its length, this table is available at the following website: <http://cqi2.engr.wisc.edu/itwf/docs/Questionnaire%20Comparison.pdf>.

responsibilities versus listing IT jobs for the question on IT job titles.

4.2 Process of revising questionnaire

In developing our criteria for determining which interviewee suggestions would be retained for consideration in the survey edits, we chose to include both quantitative and qualitative criteria. The quantitative aspect is important for ensuring that issues raised by multiple people are included for consideration (frequency), while the qualitative aspect is important for ensuring that highly relevant issues are also included for consideration, regardless of the number of coded data on this topic. This also compensates for the inherent limitations within the interview coding process, such as missed coding and several issues being coded under a single node.

Our criterion of relevance is defined by:

1. the issue's relationship to the key factors being examined in the larger study (e.g. work/family conflict, different types of discrimination at work and turnover)
2. the probability of the issue having an impact on the quality of the final survey data.

A criterion for further filtering the issues or topics for consideration for survey revisions was feasibility. One major feasibility issue was survey length. Other important feasibility issues included not losing important issues and not 'breaking up' scales and factors as much as possible. The five researchers read through the topic areas and independently rated recommendations for each topic area. The researchers then met and discussed their ratings. After this discussion, final decisions for revisions in each topic area were made and applied to the questionnaire. The results of this process are described in the table[†] comparing the initial questionnaire to the revised questionnaire. The questionnaire was then reviewed one more time and final changes were made, which included minor wording changes and formatting.

In summary, the revised questionnaire survey contained the scales of the initial questionnaire with some additions, deletions, and modifications to the measures. In the revised version of the questionnaire survey, the section on demographic and background information was unchanged, except for a more precise question on IT education. In the section on job information we added a question on telecommuting. In the sections on job factors and on organisational factors, we made significant changes to several of the scales. In the section on QWL and intention to turnover, we made significant changes, in particular to the questions on intention to turnover.

[†]Due to its length, this table is available at the following website: <http://cqi2.engr.wisc.edu/itwf/docs/Questionnaire%20Comparison.pdf>.

4.3 Adminstrating the revised questionnaire

The revised questionnaire was imported into a web-based format using web creation software, Dreamweaver[®] and our web survey mailing system software (WSMS) (Barrios 2003). The format of the web-based questionnaire differed from that of the paper-based questionnaire. Dillman's (2000) criteria were used in the transfer of the questionnaire from paper to web-based: the web-based questionnaire was kept as clean and simple as possible, with a white background, black lettering and *no* use of frills (multitudes of color and colorful backgrounds). The researchers then tested the web-based survey extensively under various web applications (i.e. Netscape Navigator, Internet Explorer, etc.), computer systems (e.g. Windows versus Macintosh platforms, various physical screen sizes), and scenarios (e.g. methods of accessing the web-based questionnaire, submitting the questionnaire without data and granting access to an individual ID to re-access the questionnaire, complete it and resubmit it). The web-based questionnaire was then tested on a group of 10 graduate students in the Industrial Engineering department at the University of Wisconsin-Madison. Based on students' feedback, minor changes were made to the layout and format of the web-based questionnaire.

4.4 Implementation of the revised questionnaire survey

The web-based questionnaire was administered at Company 1 during February 2003. Table 3 describes the results from the questionnaire for the measures of job and organisational factors, quality of working life and turnover, including the source of the measure, number of items per measure, Cronbach-alpha score, mean, standard deviation, minimum and maximum scores, and example of questions. The Cronbach-alpha scores for job and organisational factors are all above 0.70 (Nunnally 1978), except for the job spills over into family measure (0.68). The Cronbach-alpha scores for the quality of working life measures are all above 0.70 (Nunnally, 1978). All the measures had varying response categories. In order to compare the measures, we decided to recode the measures into 0–100 scores. For each scale, we computed the mean scores of the measures, subtracted one, which shifted the response scale to include zero, then divided by one minus the number of response categories, and multiplied by 100. This resulted in a possible score range of 0–100 for each of the measures. Data shows that all measures have adequate range and standard deviation, given their ranges (see table 3).

The quality of the responses to the revised questionnaire was excellent in spite of the ample opportunities respondents had to skip whole parts of the questionnaire survey. Totally, on most questions, we had no missing values at all, with an exception for some questions where there were one

Table 3. Revised questionnaire (n = 125).

Scale name	Source	# items	α for sample and (original α) reported*	Mean (SD)	Min/Max	Example question
1 Demands	(Quinn <i>et al.</i> 1971)	7	0.87 (0.81)	71.75 (19.57)	0–100	How often does your job require you to work very hard?
2 Role ambiguity	(Caplan <i>et al.</i> 1975)	4	0.87 (0.91)	68.3 (19.30)	0–100	How often are you clear on what your job responsibilities are?
3 Decision control	(McLaney and Hurrell 1988)	4	0.89 (0.90)	40.05 (25.83)	0–100	How much influence do you have over the decisions as to when things will be done in your work unit?
4 Challenge	(Seashore <i>et al.</i> 1982)	4	0.82 (0.81)	75.23 (19.55)	17–100	On my job, I seldom get a chance to use my special skills and abilities.
5 a -Supervisor support	(Caplan <i>et al.</i> 1975)	4	0.83 (0.90)	63.67 (25.32)	0–100	How much does your immediate supervisor (boss) go out of his/her way to do things to make your life easier for you?
5 b -Colleagues support	(Caplan <i>et al.</i> 1975)	4	0.79 (0.85)	68.27 (19.79)	0–100	How easy is it to talk with other people at work?
5 c -Home support	Adapted from (Caplan <i>et al.</i> 1975)	4	0.76	84.68 (16.95)	17–100	How much can your spouse, friends and relatives be relied on when things get tough at work?
6 a -Family spills over into job	(Grzywacz and Marks 2000)	4	0.70 (0.81)	47.88 (18.13)	0–87	Family matters reduce the time I can devote to my job.
6 b -Job spills over into family	(Grzywacz and Marks 2000)	4	0.68 (0.84)	53.67 (20.62)	6–100	My job reduces the amount of time I can spend with my family.
7 Training opportunities	Developed in pilot study (Carayon, Brunette, Schwarz, Hoonakker and Haims 2003)	12	0.92	47.16 (20.59)	0–100	I am given a real opportunity to improve my skills at this company through education and training programs.
8 Development activities	Adapted from (Igarria and Wormley 1992)	5	0.85	72.69 (21.74)	0–100	Management development: Programs or activities designed to teach managerial skills, such as supervision, coaching, recruiting, management decision-making, strategic policy making.
9 Career advancement	Adapted from (Nixon 1985b)	10	0.81 (0.89)	47.89 (15.86)	10–80	My opportunities for advancement in this company are somewhat limited.
10 General discrimination	Adapted from (Lehto and Sutela 1999)	34	n/a	n/a	n/a	Do you believe that unequal treatment or discrimination occurs at your workplace on the basis of sex?
11 Ethnic discrimination	Adapted from (Sanchez and Brock 1996)	10	.96 (0.87)	20.01 (17.84)	0–100	At work, I feel that others exclude me from their activities because of my ethnic background.
12 Corporate fit	Adapted from (Nixon 1985a)	13	0.86 (0.88)	74.54 (13.10)	29–100	I understand my company's principles and goals and support them.
13 Flexible work practices	Adapted from (Vandenberg, Richardson and Eastman 1999)	14	n/a	n/a	n/a	To help employees balance work and family/home responsibilities, which of these options are offered at your company: Flextime? Telecommuting? etc. . .
14 Rewards	Adapted from (Vandenberg <i>et al.</i> 1999)	8	0.84 (0.86)	50.84 (17.95)	4–100	My performance evaluations within the past few years have been helpful to me in my professional development.
15 Future job uncertainty	(Carayon 1994)	4	0.71 (0.79)	23.12 (17.39)	0–100	How often are you concerned or bothered about losing your job or being laid off?
16 Job satisfaction	(Quinn <i>et al.</i> 1971)	5	0.78 (0.80)	72.44 (22.60)	10–100	Knowing what you know now, if you had to decide all over again whether to take the job you now have, what would you decide?

(continued)

Table 3. (continued)

Scale name	Source	# items	α for sample and (original α) reported*	Mean (SD)	Min/Max	Example question
17 Organisational involvement	(Cook and Wall 1980)	3	0.72 (0.68)	80.24 (15.43)	17–100	In my work, I like to feel I am making some effort, not just for myself but for the organisation as well.
18 a -Fatigue	(Grove and Prapavessis 1992)	3	0.91 (0.95)	37.70 (27.33)	0–100	How have you been feeling during the last week, including today?: Fatigued? Exhausted? Bushed?
18 b -Tension	(Swanson, 1997, unpublished data)	3	0.73 (0.86)	22.58 (23.83)	0–100	How have you been feeling during the last week, including today?: Nervous? Tense? Shaky?
19 Emotional exhaustion	(Maslach and Jackson 1986) and (Geurts, Schaufeli and De Jonge 1998)	6	0.87	41.04 (22.51)	0–100	I feel emotional drained from my work.
20 a Intention to turnover	Michigan Organisational Assessment Scale (MOAQ) (Seashore, Lawler, Mirvis and Cammann 1982)	1	n/a	2.87 (1.83)	1–7	How likely is it that you will actively look for a new job in the next year?
20 b Reasons for turnover	Developed in pilot study (Carayon <i>et al.</i> 2003)	1	n/a	n/a	n/a	If you'd consider leaving your current job, please check all the reasons that apply: (% (n)) <ul style="list-style-type: none"> ● High job demands (26% (32)) ● Long working hours (28% (35)) ● Lack of challenge or boredom (29% (36)) ● Lack of social support (4% (5)) ● Inadequate flexible work practices / options (12% (15)) ● Conflicts between work and family (26% (32)) ● Ineffective management (34% (43)) ● Feeling discriminated against (6% (8)) ● Feeling of not fitting in (10% (13)) ● Lack of training (34% (42)) ● Lack of development opportunities (38% (48)) ● Inadequate rewards / reviews / raises (51% (64)) ● Inadequate opportunities for career advancement (37% (46)) ● Want a higher job status (18% (22)) ● Want to advance my career (39% (49)) ● Want a higher salary (49% (61)) ● Want a better compensation plan (30% (38)) ● Want to obtain more or different expertise (33% (41)) ● Want the opportunity to learn new things (43% (54)) ● Want more challenge in my job (20% (25)) ● Other (please specify): (14% (17))
20 c Intention after turnover	Developed in pilot study (Carayon <i>et al.</i> 2003)	1	n/a	n/a	n/a	If you'd decide to leave your current job, what would be your intentions? Please check all the intentions that apply: (% (n))

(continued)

Table 3. (continued)

Scale name	Source	# items	α for sample and (original α) reported*	Mean (SD)	Min/Max	Example question
						<ul style="list-style-type: none"> ● I would intend to look for a different type of job in my same company. (21% (26)) ● I would intend to stay in a similar type of job, but move to a different company. (52% (65)) ● I would intend to be in a different IT job in a different company. (31% (39)) ● I would intend to no longer work in the IT field. (30% (38)) ● I would intend not to look for another job at all. (2% (3)) ● Other (please specify): (7% (9))

*Cronbach-alpha reliability scores.

n/a Not applicable.

or two missing values for measures such as gender and minority/majority status.

To establish the construct validity of the scales used in the questionnaire we performed a series of confirmatory factor analysis, using structural equation modelling (AMOS[®]) with a maximum likelihood procedure. In the first step, the factor structure of the various scales was confirmed. In the second step, a second order factor analysis was performed on the factor structure of the scales within their 'constructs' (e.g. job demands as part of the job characteristics 'construct' and job satisfaction as part of the quality of working life 'construct'). The results are summarised in table 4. Results of the confirmatory factor analysis of the individual scales demonstrate satisfactory construct validity, especially after allowing for covariance between items that belong to the same scale. In general, results of the (second order) confirmatory factor analysis on the various constructs also demonstrate satisfactory construct validity, although the fit for the job and organisational characteristics models and the QWL model are not optimal. However, we have to consider the complexity of the models and the relative small sample size ($N = 124$), which is expressed in the Comparative Fit Index (CFI) (see notes of table 4). Furthermore, the models can be improved by allowing for more covariance **within** the various scales. It is important to note that none of the constructs (with an exception for the cross-loading between burnout and job satisfaction in the QWL construct) can be significantly improved by allowing for covariance **between** (the items in) the scales (also known as cross-loadings), which is an indication of the construct validity of the items and the scales.

The short response/non-response survey conducted one month after the main data collection period closed was replied by 35 employees of Company 1, with no reminder

emails sent. The response rate was 18%: six non-respondents and 30 respondents. The results of the response/non-response survey showed that non-respondents mainly did not respond because they were too busy at work (e.g. '...too busy working on other things.'). Sixteen out of 30 respondents filled out the survey because of the salience of the topic (e.g. 'I felt that this was an important topic, plus I hope that the information gathered by this study will improve the working conditions for all IT workers.'). and eight out of 30 respondents filled out the survey because management supported it (e.g. '...because it is important and I was encouraged to participate by my company.'). Most of the respondents had no suggestions on how to improve the survey other than the fact that it was too long (11 out of 30) and the fact that the follow-up survey took place too long after the original survey (4 out of 30) (e.g. 'I thought it was laid out well. I thought it may have been a little long but I am sure you needed that for the information you need to gather.').

5. Discussion

The IT workforce is distinctive as a field because of its recent growth, demand for skilled IT workers and unique labour force makeup. To gather information on what makes the IT workforce distinct, we decided to gather data on the job and organisational factors, QWL and turnover within the IT workforce, with a special emphasis on the makeup of the labour force.

Literature shows that women and minorities are more likely to be underrepresented in the IT workforce as opposed to their representation in the general workforce population (Bureau of Labor Statistics 2003). Further, attrition rates in engineering and sciences, as opposed to other fields, have shown women to have higher attrition

rates than men (CAWMSET 2000). Therefore, it was concluded that the information used to evaluate job and organisational factors, QWL and turnover within the IT workforce needed to have a special emphasis on underrepresented populations. The special emphasis on underrepresented populations in the IT workforce desired in the questionnaire was confirmed in our questionnaire development process. During the interview process where the initial version of the questionnaire survey was tested, the interviewed IT professionals (considered experts in job and organisational factors, QWL and turnover within the IT workforce) expressed the need to focus questions on women and minorities. For instance, the question on general discrimination was expanded to include a wide range of possible types of discrimination. The question on flexible work practices was also expanded to represent the range of practices important to IT workers, in particular women and minorities.

Whereas some of the job and organisational factors of importance to IT workers may also be relevant to other professional groups, we cannot say with any confidence that the survey we developed can be applied to other professional jobs. In addition, some of the issues evaluated in the survey are very specific to IT work. For instance, the scale of job demands is based on the Caplan *et al.* (1975) scale of quantitative workload, but includes three additional questions on: problems keeping up with new technology; having to stay at work because of customer demands; and feeling overwhelmed by workload. The first item is specific to IT work, and not applicable to many other professional jobs. Many of the questions on training are very specific to IT-related training, such as training opportunities provided by IT vendors. It is also important to recognise that the questionnaire survey was designed to address some issues specific to the US, such as the underrepresentation of 'minority' in the American IT workforce. The definition of 'minority' in the IT workforce is borrowed from the American National Science Foundation that is funding this study (www.nsf.gov/sbe/srs/nsf00327/start.htm).

To understand the attrition of underrepresented populations in the IT workforce, we looked at turnover literature. The literature pointed to a need to adapt existing surveys that measure intention to turnover and include the causes and consequences of intention to turnover of the populations underrepresented in the IT workforce. Thus our questionnaire survey is based on a conceptual framework that links job and organisational factors to QWL and turnover intention (Carayon *et al.* 2001). The interview process proved valuable in the creation of two new questions on the reasons (causes) for turnover and the outcomes (consequences) of turnover. Interviewees provided expert knowledge as to the positive reasons (e.g. want more challenge on my job) and negative reasons (e.g. long working hours) they may leave their current job within the

next year, as well as the career path they may take (e.g. I would intend to be in a similar type of job, but move to a different company) if they did choose to leave their current job within the next year.

There are many strengths in the process we developed and used to create the web-based questionnaire survey. The most evident strength is the *systematic* method in which the questionnaire was developed. By using literature we were able to create an initial questionnaire using known measures and then to tailor the questionnaire to issues specific to the IT workforce, in particular related to the underrepresentation of women and minorities in the IT workforce. We believe that this particular process could be generalised to the development of other questionnaire surveys.

The pilot study with the interviews proved important in the revision of the initial version of the questionnaire survey. The interviewees provided insight into the interpretation of questions and served as a resource for suggestions to modify and add questions. Many modifications to the instructions, scales and wording choices were made to questions based on the comments of interviewees, thus producing a questionnaire better adapted for gathering information specifically about women and minorities within the IT workforce. This part of the questionnaire development process helped us ensure to some extent the content validity of our measures.

The implementation of the questionnaire into a web-based version for data collection proved to be quite valuable for three reasons. First, the mode of delivery of the questionnaire to potential participants was aligned with the computer-proficient IT workforce. Second, the ability to collect data via the Internet eliminated the need for data entry, and thus eliminated possible errors that occur during data entry. Finally, it gave the researchers very quick access to the data, therefore speeding up the data-analysis process.

One limitation of the overall process used to revise the questionnaire survey was the number of interviewees in the pilot study of the initial version of the questionnaire. We strived for a total of 15 interviewees, but stopped at 13 interviewees. This may be seen as a drawback. The rationale for stopping at 13 interviews rather than conducting 15 interviews was based on saturation (Sandelowski 1995). After 13 interviews, we had much repetition in the interviewees' comments and decided to stop the recruitment of interview participants. Another factor that contributed to our decision was our belief that we should not appear too demanding to participating companies at the beginning of the three-year project.

Another limitation of the questionnaire survey development process was the method used to code the interview data into the qualitative analysis software. After all researchers coded data of one interview and met to discuss

Table 4. Results of the confirmatory factor analysis (construct validity).

		χ^2 *	df*	GFI*	AGFI*	CFI*	RSMEA*	RMR*
Job characteristics	IT Job Demands (JD)	32	14	0.93	0.86	0.95	0.10	0.05
	After allowing for covariance ^a	19	13	0.96	0.91	0.98	0.06	0.04
	Role Ambiguity (RA)	25	2	0.91	0.55	0.91	0.31	0.05
	After allowing for covariance ^b	3.6	1	0.99	0.86	0.99	0.14	0.02
	Decision Control (DC)	8.5	2	0.97	0.84	0.98	0.16	0.03
	After allowing for covariance ^c	2.1	1	0.99	0.91	1.00	0.09	0.01
	Challenge (CH)	2.3	2	0.99	0.96	1.00	0.03	0.02
Model with all four job characteristics		213.8	149	0.85	0.81	0.95	0.06	0.10
Model with all four job characteristics after allowing for covariance		174.1	146	0.88	0.84	0.98	0.04	0.08
Social Support	Supervisory support (SS)	1.5	2	0.99	0.97	1.00	0.00	0.01
	Colleague Support (CS)	0.2	2	1.00	1.00	1.00	0.00	0.00
	Home Support (HS)	5.7	2	0.98	0.88	0.95	0.12	0.02
Model with all three social support scales		137	51	0.86	0.78	0.85	0.12	0.05
Model with three scales after allowing for covariance ^d		66.6	47	0.92	0.87	0.96	0.04	0.06
Organisational characteristics	Corporate Integration (CI)	150.6	65	0.86	0.80	0.84	0.10	0.05
	After allowing for covariance ^e	99.7	62	0.90	0.85	0.93	0.07	0.04
	Career Opportunities (CO)	46.7	35	0.93	0.88	0.97	0.05	0.06
	After allowing for covariance ^f	37.5	34	0.94	0.91	0.99	0.03	0.06
	Satisfaction with training opportunities (TR)	81.7	20	0.84	0.71	0.92	0.16	0.03
	After allowing for covariance ^g	31.6	17	0.93	0.86	0.98	0.08	0.02
	Rewards (RE)	40.8	20	0.92	0.86	0.94	0.09	0.03
	After allowing for covariance ^h	23.6	18	0.95	0.91	0.98	0.05	0.03
	Development opportunities (DO) ⁺	Na	Na	Na	Na	Na	Na	Na
	Model with all four organisational characteristics		1085.2	697	0.70	0.67	0.83	0.07
After allowing for covariance ⁱ		925.0	682	0.75	0.71	0.90	0.05	0.06
Quality of Working Life (QWL)	Job Satisfaction (JS)	10.6	5	0.97	0.90	0.97	0.09	0.02
	Organisational Involvement (OI)	Na	Na	Na	Na	Na	Na	Na
	Fatigue (FA)	Na	Na	Na	Na	Na	Na	Na
	Tension (TE)	Na	Na	Na	Na	Na	Na	Na
	Emotional Exhaustion (EEX)	61.6	9	0.87	0.70	0.89	0.22	0.14
	After allowing for covariance ^j	19.0	8	0.96	0.89	0.98	0.11	0.07
Model with all five QWL scales		270.4	164	0.82	0.77	0.93	0.07	0.10

(continued)

Table 4. (continued)

		χ^2 *	df*	GFI*	AGFI*	CFI*	RSMEA*	RMR*
After allowing for covariance ^k		220.8	163	0.85	0.80	0.96	0.05	0.08
Other scales used in the questionnaire								
Work Family Balance	Family spills over into Work	8.1	2	0.97	0.84	0.92	0.16	0.02
	Work spills over into Family	5.1	2	0.98	0.89	0.96	0.11	0.06
Work Family Balance Model		63.1	19	0.90	0.81	0.80	0.14	0.12
After allowing for covariance		43.3	17	0.92	0.84	0.88	0.11	0.09
Discrimination/ethnicity		191.9	35	0.74	0.59	0.85	0.19	0.04
After allowing for covariance ^l		66.2	29	0.90	0.82	0.96	0.10	0.02

* χ^2 (Chi Square) = difference between model and data; df = degrees of freedom (indicator of the model complexity); GFI = Goodness of Fit Index; AGFI = Adjusted Goodness of Fit Index: Fit Index that takes model complexity into account; CFI = Comparative Fit Index: Fit Index adjusted for sample size; RMSEA: Root Mean Square Error of Approximation: takes the error of approximation in the population into account; (standardised) Root Mean Square Residual (RMR): represents the average value across all standardised residuals. Non-significant (χ^2 , and Goodness of Fit Indices in the 0.90's, accompanied by parsimonious fit indices in the 0.50's are not unexpected (Mulaik *et al.* 1989).

^k Goodness of Fit of the model can not be computed because the model is just identified.

⁺ Only 25% of the sample (N = 32) had participated in management development programs. Therefore we have not analysed the construct validity of this scale.

^aAfter allowing for co-variance between JD1 ('How often does your job require you to work very fast?') and JD2 ('How often does your job require you to work very hard?').

^bAfter allowing for covariance between RA3: 'How much of the time are your work objectives well-defined?' and RA4: 'How often are you clear about what others expect of you on the job?'

^cAfter allowing for covariance between DC3: 'How much influence do you have over the policies, procedures, and performance in your work unit?' and DC4RA4: 'How much influence do you have over the training of other workers in your work unit?'

^dAfter allowing for covariance between SS1 and CS1 ('How much does each of these people go out of their way to do things to make life easier for you?': your immediate supervisor/other people at work); SS2 and CS2 ('How easy is it to talk with each of the following people?': your immediate supervisor/other people at work); SS3 and CS3 ('How much can each of these people be relied on when things get tough at work?': your immediate supervisor/other people at work) and SS4 and CS4 ('How much is each of the following people willing to listen to your personal problems?': your immediate supervisor/other people at work).

^eAfter allowing for covariance between CI7 and CI8: 'I feel isolated from others in my work group' and 'My work associates do not regard me as an equal' (two out of the three negatively worded questions in the scale and both referring to group work); CI6: 'I am accepted in informal business activities with my company peers' and CI8: 'I am accepted in informal business activities with my company subordinates' and CI6: 'I am accepted in informal business activities with my company peers' and CI7: 'I feel isolated from others in my work group'.

^fAfter allowing for covariance between CO1 and CO3 ('My opportunities for advancement in this company are somewhat limited' and 'I have a dead-end job').

^gAfter allowing for covariance between TR1: 'I am given a real opportunity to improve my skills at this company through training and education' and TR3: 'My supervisor helped me acquire additional job-related training when I needed it'; TR6: 'The training and educational activities I have received enabled me to perform my job more effectively' and TR8: 'I am satisfied with the training opportunities offered to me to keep up with the latest technologies' and TR4: 'I receive ongoing training, which enables me to do my job better.' and TR8.

^hAfter allowing for covariance between RE2 ('There is a strong link between how well I perform my job and the likelihood of my receiving recognition and praise') and RE4 ('There is a strong link between how well I perform my job and the likelihood of my receiving high performance appraisal ratings') and between RE3 ('There is a strong link between how well I perform my job and the likelihood of my receiving a raise in pay/salary') and RE6 ('I am satisfied with the amount of recognition I receive when I do a good job').

ⁱAfter allowing for covariance between DO1 ('Management development: programs or activities designed to teach managerial skills, such as supervision, coaching, recruiting, management decision-making, strategic policy making') and DO4 ('Mentorship: a relationship between a more experienced colleague in order to provide you with increased opportunities for advancement, corporate visibility, guidance and advice').

^jAfter allowing for covariance between EEX1 ('I feel emotionally drained from my work') and EEX2 ('I feel used up at the end of the work day').

^kAfter allowing for covariance and for a cross-loading between EEX6 ('I feel frustrated by my job') and job satisfaction.

^lAfter allowing for covariance between D2 and D3: 'At work, I sometimes feel that my ethnicity is a limitation' and 'At work, many people have stereotypes about my culture or ethnic group and treat me as if they were true'; D4 and D8: 'At work, people think I am unsociable, when in fact I have trouble communicating in English' and 'My accent is a limitation at work' (English speaking ability); D9 and D10: 'At work, I feel others exclude me from their activities because of my ethnic or cultural background' and 'At work, people look down upon me if I practice customs of my culture'; D8 and D10; D6: 'At work, it bothers me when people pressure me to assimilate' and D7: 'At work, I do not get enough recognition because I am different' and D3 and D10.

and agree on the coding procedures, only one researcher performed the coding for the remaining 12 interviews. One may argue that involving a second researcher in coding may have increased the accuracy of the coding process.

6. Conclusion

The systematic process used for the development of the questionnaire survey created a tool specific to the IT workforce that demonstrates evidence of reliability and (content and construct) validity. The questionnaire survey addresses the causes and effects of retention and intention to turnover, thus making it possible to better understand the reasons for the underrepresentation of women and minorities in the IT workforce. The revised version of the questionnaire is available at <http://cqp2.engr.wisc.edu/itwf/index.html>.

The questionnaire survey was specifically developed to test models of the impact of work on IT workers, with specific consideration of gender and ethnic/racial background (Carayon *et al.* 2001). This research can produce important information regarding those work factors that specifically affect IT workers, their perceptions and attitudes, and their turnover intention. In addition, we will examine how men and women, and minorities and majorities in the IT workforce experience their work environment. This information can lead to the identification of work factors of need of redesign for the IT workforce in general, and for specific subgroups (men versus women, minorities versus majorities). The questionnaire survey is widely available and can be used by researchers all over the world who are specifically interested in the work environment of IT workers.

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3. Paper 2

Hoonakker, P.L.T. & Carayon, P. (2008). Non-response in Internet surveys. Accepted for publication by the *International Journal of Human-Computer Interaction*.

Questionnaire Survey Nonresponse:

A comparison of postal mail and Internet surveys

Abstract

Rapid advances in computer technology and more specifically, the Internet, have spurred the use of the Internet surveys for data collection. However, there are some concerns about low response rates in studies that use the Internet as a medium. The question is if we can apply the lessons learned in conducting postal mail surveys to increase response rates to Internet surveys. After all, the Internet is a completely new medium with its own “rules” and even its own (n)etiquette. In this paper we examine 29 studies that directly compared different survey modes (postal mail, fax, e-mail, and web-based surveys) with a total of more than 15,000 respondents. We discuss factors that can increase response rates and response quality when using Internet surveys, compared to mail surveys. Finally, we examine what research can contribute to increase response rates in Internet surveys.

Keywords: survey research, Internet research, web-based surveys, response rates, response quality, survey design factors

1. Introduction

Literally, millions of survey questionnaires are sent out each year to assess respondents' opinions about a variety of different topics ranging from satisfaction with one's health care provider to the kind of car or computer to purchase; from career aspirations to the value of the national plumbing standards based on a nationwide survey of water supply utilities. It is hard to estimate how many surveys are sent out exactly each year, but to give just one example: the Canadian Bureau of Statistics alone sends out 768 different surveys on an annual basis.

Before the late 1990's, there were basically two mediums to conduct a survey: either by telephone (an interview) or by mail (a questionnaire), but only recently has it become possible to conduct surveys using the Internet¹. Already in the 1960's researchers succeeded to connect several computers to each other, and thus established the so called ARPANET. It would take time to develop the protocols needed for the computers to properly "communicate" to each other and even longer before this "service" became available to the general public. The breakthrough occurred in the mid 1990's: with the introduction of HyperText Markup Language (HTML), the Web became an interactive medium. The very first web browser (1989) was written by Tim Berners-Lee while at CERN (a European center for physics research). The year 1991 meant the birth of what we now know as the World Wide Web (WWW). In 1993 the WWW opened to non-technical users. After 1993, the situation changed dramatically as Figure 1 shows.

¹ We will use the term Internet surveys for all surveys that use the Internet as a medium to conduct a survey. The term web-based surveys (WBS) will be reserved for surveys that use a web-server to conduct surveys.

Estimation of Internet users worldwide, in millions
 (Sources: ClickZ, Computer Industry Almanac, Global Research, Internet World Stats, NUA)

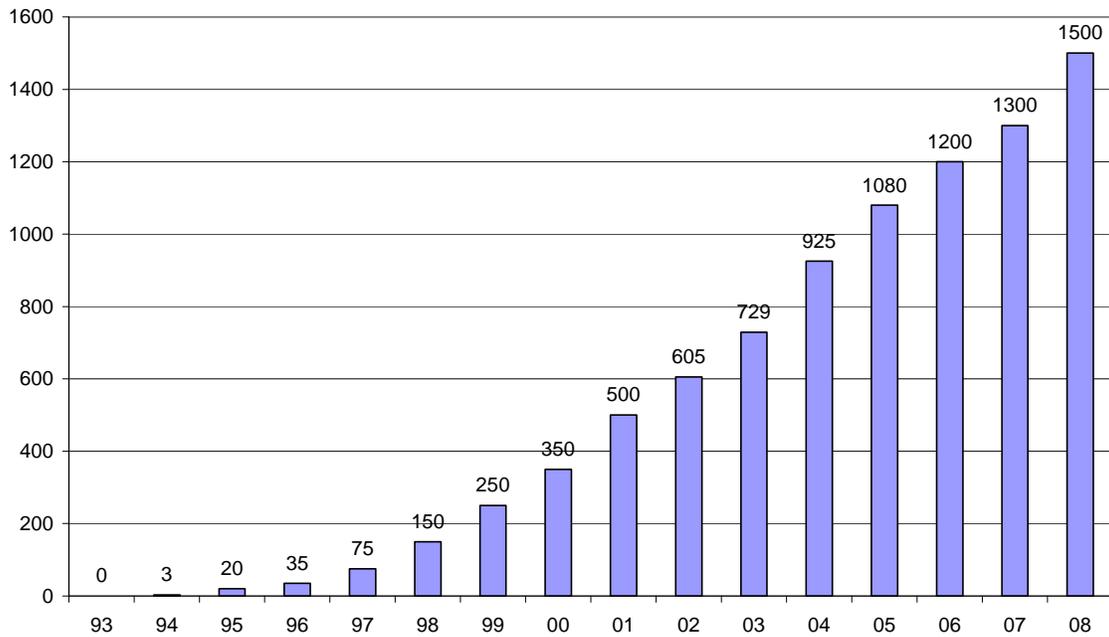


Figure 1: Estimation of Internet users worldwide

While in 1994 only 3 million people had access to the World Wide Web, this number had increased to 605 million users in 2002 (NUA, 2002), 925 million users in 2004 (ClickZ Networks, 2005) and the latest estimates show that –as of August 2008—there were 1,463,632,361 people connected to the Internet (Internet World Stats, 2008). To give another example of the tremendous growth of the Internet: in 1995 100 billion e-mails were sent annually; in 2002 this number had increased to 5.5 trillion e-mails, spam not included (PCWorld, 2003).

The large number of people connected to the Internet also means an enormous potential pool of survey respondents. If it was possible to contact all people with an Internet connection, a response rate of 1% would be enough to get over 10 million responses. However, we can question the reliability and validity of the data collected using this method. For example, would we be able to generalize the results to the general (world) population? In this paper we begin with a brief introduction on Internet surveys and discuss advantages and disadvantages of the use of Internet surveys. Second, we

focus on nonresponse error. We will briefly discuss response rates and response quality and compare these topics in postal mail surveys and Internet surveys. Third, we describe the factors that impact response and nonresponse in postal mail surveys. Fourth, we examine these factors in the context of Internet surveys. We conclude with a set of recommendations for conducting Internet surveys.

2. Internet surveys

Opening up the World Wide Web to the general public has impacted virtually every aspect of society. It also created new opportunities for researchers and marketing professionals who now have access to millions of potential respondents. In 1998, in an informal search of Yahoo, Kaye and Johnson (1999) identified over 2,000 online surveys in 59 areas². The interest in Internet surveying is not surprising as it offers a number of distinct advantages over more traditional mail and phone techniques. There are four methods for conducting an Internet survey:

- Survey questionnaire embedded in an e-mail message
- Survey questionnaire attached as a text document (e.g. MS Word document) to an e-mail message
- Survey questionnaire attached as a self executing (.EXE) program to an e-mail message
- Web-based surveys (WBS). Web based surveys are surveys that are (physically) placed on the web, primarily on a server. Participants are provided with a link to the website and are asked to fill out the survey and submit the data. The data is then stored on the server.

² Nowadays, entering the keyword “survey” (as Kaye & Johnson did in 1998) in a Google search results in 251,000,000 hits; entering the keywords: Internet (and) survey results in 164,000,000 hits and entering: “Internet surveys” results in 736,000 hits.

Advantages and disadvantages of Internet surveys

Table 1 summarizes the advantages and disadvantages of Internet surveys

Table 1 Advantages and disadvantages of Internet surveys

<i>Advantages</i>	<i>Disadvantages</i>
• Easy access to large (worldwide) populations	• Coverage error
• Speed:	• Sampling error
• Reduced costs	• Measurement error
• Reduced time and error in data entry	• Nonresponse error
• Ease of administration	• Lack of anonymity
• Higher flexibility	• Computer security
• More possibilities for design	• Computer illiteracy
• Higher response quality	• Non-deliverability

Most of the advantages are specific for Internet surveys, but most of the disadvantages, such as coverage error, sampling error, measurement error and nonresponse error, and to a lesser extent, lack of anonymity, illiteracy and non-deliverability play a role in postal mail surveys as well. Most of the advantages are obvious: using the Internet gives researchers easier and cheaper access to large samples; the speed of the response is in general much faster and the quality of the data (less item omissions and more written, additional comments) is better (Bachmann, Elfrink, & Vazzana, 1996). Costs are lower and –basically- there are fewer errors, due for example to the fact that the data need not be entered (manually) into a database. Administration is easier: databases can be used to keep track of who responded and who has not (yet), which allows the researcher to send reminders. Various formats can be used (backgrounds, colors, sounds, images, skip patterns etc). One of the benefits of skip patterns (e.g. If yes, go to question 5; If no, go to

question 17) may be fewer missing data. However, there are also some disadvantages to the use of the Internet for surveys. Using Internet surveys, researcher can reach out to a large population (possibly millions of respondents). However, Internet users are still a very biased population: predominantly male, white, and highly educated and thus not representative of the general population (Dommeyer & Moriarty, 2000; Kaye & Johnson, 1999; Zhang, 2000). Therefore, coverage error (part of the population of interest cannot become part of the sample) may occur. Other errors that can occur are: sampling error (only a subset of the target population is surveyed, yet inference is made about the whole population); measurement error (a respondent's answer to a survey question is inaccurate, imprecise, or cannot be compared in any useful way to other respondents' answers), and nonresponse error (respondents do not participate in any part of the survey (unit nonresponse) or individuals do not answer individual questions (item nonresponse)). These errors may be related to computer illiteracy (respondents do have to know how to connect to the Internet, how to set up an e-mail account, how to use an e-mail-account, how to open and respond to e-mail messages, how to open possible attachments and how to submit their response) or respondents who fill out multiple copies of a survey. Other disadvantages of using the Internet to conduct surveys are: non deliverability, lack of anonymity and computer security issues. Bachman et al. (1996; 2000) estimated that 20% of Internet surveys could not be delivered because e-mail addresses were wrong or no longer existed. Weible & Wallace (1998) estimated the non deliverability to be nearly 25%. Kim et al. (2001) estimated the non deliverability in their study to be higher than 50%. Furthermore, lack of anonymity can be a problem with Internet surveys. For example, if respondents respond to a survey and send their responses by e-mail, their return address will be known. Last but not least, there are vast computer security risks. Computer users have learned to be suspicious of e-mails sent by people they do not know. These e-mails can cause all kinds of computer security risks such as viruses, Trojan horses and worms. E-mails that contain an attachment are suspicious, especially when the attachment contains an executable file.

3. Nonresponse and nonresponse rates

In this paper we focus on nonresponse error. “Nonresponse occurs when a sampled unit does not respond to the request to be surveyed or to particular surveys questions. Error caused by nonresponse is only one of several sources of potential error in surveys – others include coverage, measurement and sampling error (Groves, 1989) – but it is one that has attracted much interest in recent years, as response rates to certain surveys appear to have been declining, and this is of much concern to social sciences and statisticians throughout the world.” (Dillman, Eltinge, Groves, & Little, 2002, p.3). For example, results of a study by Connelly, Brown & Decker (2003) showed that postal mail survey response rates decreased an average 0.77% per year from 1971 to 2000. Nonresponse makes it very difficult for researchers to generalize the results to the larger population. Surveys are usually designed to allow for formal statistical inference about some larger population using information collected from a subset of that population. Nonresponse threatens the validity of a survey and the conclusions reached. Research results can be biased if nonresponse is nonrandom or somehow correlated with the variables measured in the survey. “Thus, a high response rate is not only desirable, but also an important criterion by which the quality of the survey is judged” (Hox & deLeeuw, 1994 p. 330).

Several studies have compared response rates from e-mail studies to those from mail surveys of the same population. These studies are summarized in Couper, Blair and Triplett (1999); Dommeyer & Moriarty (2000); Schaefer and Dillman (1998) and Schonlau, Fricker and Elliott (2002). In many of these studies, the e-mail surveys failed to reach the response rate levels of the mail survey. In a meta-analysis of 49 electronic studies, Cook, Heath and Thompson (2000) revealed an average response rate of 39.6% which is much lower than the response rate reported for mail surveys in studies by Heberlein and Baumgartner (1978: 60.6%) and Baruch (1999: 55.6%). However, most of the studies quoted above summarized studies that examined differences in response rate between mail surveys and *e-mail surveys* and failed to distinguish e-mail surveys from *web based surveys*. In the last couple of years we have seen a tremendous growth in the number of web based surveys. The results of a comparison between postal mail surveys, e-mail surveys and web based surveys shows that web based surveys generate much

better results than e-mail surveys (see 3.1). In a study that compared web based surveys with traditional mail surveys among populations with little coverage errors, Guterbock, Meekins, Weaver & Fries (2000) came to the same conclusion: they found higher response rates for web based surveys than for postal mail surveys.

Response rates

Surprisingly, relatively few studies have examined reasonable response rates³ for research studies. Asch, Jedrziwski & Christakis (1997) analyzed 187 manuscripts published in medical journals in 1991: those manuscripts represent 321 distinct mail surveys. Results show that the mean response rate among those mail surveys published is approximately 60%. However, response rates vary according to the subject studied and techniques used. For example, published surveys of physicians have a mean response rate of only 54%, and those of non-physicians have a mean response rate of 68% (Asch et al., 1997).

In a comparative analysis, Baruch (1999) examined 141 scientific papers that included 175 different studies and were published in *Academy Journal of Management*, *Human Relations*, *Journal of Applied Psychology*, *Organizational Behavior and Human Decision Processes*, and *Journal of International Business Studies* in respectively 1975, 1985 and 1995: those studies represent over 200,000 respondents. The average response rate was 55.6% with a standard deviation of 19.7. One of the most notable results of the study was the decline in response rates over the years: the average response rate had declined to 48.4% in 1995, the last year used for the comparison. Cook, Heath and Thompson (2000) conducted a meta-analysis of response rates in Internet surveys. They found an average response rate of 36.9% for 68 surveys reported in 49 studies. According

³ One of the reasons that there are few studies on response rates is that it is difficult to compare studies that have different topics, different samples, and different methods of surveying. Apart from that, there are also substantial differences in the method used to calculate the response rate. Most studies report the unit response rate and fail to report the item response rate. An interview or questionnaire is rarely fully completed. According to some systems (e.g. the American Association for Public Opinion Research (AAPOR) system) an interview is completed if the respondent was cooperative and at least 80% of the questions have been reliably and validly answered. Other systems to calculate response rates (e.g. SISA) would prefer 90%. For an overview of methods to calculate response rates, see the Simple Interactive Statistical Analysis (SISA) website at <http://home.clara.net/sisa/resprhlp.htm>

to some researchers (Babbie, 1990, 1992) a 50% response rate is considered minimally adequate for research.

Response quality

Less attention is given to the response quality in the literature. Response quality refers to the number of questions answered, item omissions and quality of responses for open-ended questions. When the average number of questions respondents leave unanswered is small, this is regarded as an indicator of good survey quality (Couper et al., 1999; Kwak & Radler, 2002; Schaefer & Dillman, 1998; Stanton, 1998). Schaefer & Dillman (1998) assumed that longer responses to open-ended questions would indicate detailed responses, which contributes to the quality of a survey method. Relatively few scientific publications discuss these aspects, even if one can doubt the reliability and validity of data with a high item nonresponse.

Comparison of response rates and response quality in postal mail and Internet surveys

Table 2 shows results of studies that compare response rates; response time and response quality of (postal) mail, fax, e-mail and web based surveys addressing the same topic and sent to the same population. We have limited the results to studies conducted in the USA. Furthermore, we have limited our analysis to studies that use a *single mode* design: potential postal mail respondents receive the survey by postal mail and potential Internet survey respondents receive the survey by e-mail. In recent years, researchers have experimented with using *multi-mode or mixed designs*: for example, potential respondents receive the letter of invitation and the survey by postal mail, but the letter of invitation contains a link to a web based survey. Clearly, that makes it difficult to compare response rates between different modes of survey administration.

Table 2: Comparison of different modes of surveying: postal mail, fax, e-mail and web-based surveys

Author(s)	Sample	Survey Topic	Method	Sample Size	Response Rate	Response Time (days)	Response quality
(Kiesler & Sproull, 1986)	Employees of a Fortune 500 company	Corporate communication	Mail E-mail ⁴	115 115	67% 75%	10.8 9.6	E-mail had fewer mistakes and a higher completion rate
(Parker, 1992)	Employees of AT&T	Internal communication	Mail E-mail	70 70	38% 68%	NA NA	NA NA
(Schuldt & Totten, 1994)	Marketing and MIS professors	Shareware copying	Mail E-mail	200 218	56.5% 19.3%	NA NA	NA NA
(Mehta & Sivadas, 1995)	Usenet users	Internet communication	Mail E-mail	309 182	56.5% 54.3%	NA NA	Both groups had similar number of item omissions, but e-mail respondents wrote more
(Tse et al., 1995)	University population	Business ethics	Mail E-mail	200 200	27% 6%	9.8 8.1	No significant difference in number of item omissions
(Bachmann et al., 1996)	Business school deans	Total Quality Management (TQM)	Mail E-mail	224 224	65.6% 52.5%	11.2 4.7	E-mail respondents were more willing to answer open-ended questions
(Mavis & Brocato, 1998)	Registered subscribers to a listserv	The quality of information received from the listserv	Mail E-mail	100 100	77% 56%	18.8 8.1	86% of the e-mail surveys were complete and 84% of the mail surveys. Of the e-mail respondents 63% provided additional written comments compared to 58% among

⁴ Mail = postal mail; E-mail, unless defined otherwise = questionnaire embedded in the E-mail, WBS=web based survey

Author(s)	Sample	Survey Topic	Method	Sample Size	Response Rate	Response Time (days)	Response quality
							postal survey respondents. Differences are not statistically significant.
(Schaefer & Dillman, 1998)	University faculty	Unknown	Mail E-mail	226 226	57.5% 58.0%	14.4 9.2	E-mail surveys had fewer item omissions and longer answers to open-ended questions
(Weible & Wallace, 1998)	MIS professors	Internet use	Mail Fax E-mail Web form	200 200 200 200	35.7% 20.9% 29.8% 32.7%	12.9 8.8 6.1 7.4	NA
(Couper et al., 1999)	Employees in several government statistical agencies	Organization climate	Agency A: mail	2,699	68%	NA	E-mail response rate was much lower, mostly due to technical problems (different e-mail software). No significant difference in number of item omissions
			Agency A: e-mail	2,699	37%		
			Agency B: mail	790	76%	NA	
			Agency B: e-mail	396	63%		
Agency C: mail	266	74%	NA				
Agency C: e-mail	265	60%					
Agency D: mail	216	75%	NA				
Agency D: e-mail	221	53%					

Author(s)	Sample	Survey Topic	Method	Sample Size	Response Rate	Response Time (days)	Response quality
			Agency E: mail	216	76%	NA	
			Agency E: e-mail	215	55%		
			Mail overall	4,187	70.7%	NA	
			E-mail overall	3,796	42.6%		
(Sheehan & McMillan, 1999)	Creators of health related web sites	Values of site creators, site purpose and funding	E-mail ⁵ (individual)	834	47%	5.0	
	Faculty, staff and students	Attitudes toward on-line privacy	E-mail (batch ⁶)	580	47%	4.6	
	Individuals with personal e-mail accounts	Attitudes and behaviors associated with on-line privacy	E-mail (merge ⁷)	3,724	24%	3.6	
(Bachmann, Elfrink, & Vazzana, 2000)	Business school deans and division chair persons	TQM	Mail E-mail	250 250	66.0% 19.1%	18.3 4.3	No differences in response patterns. E-mail respondents were more willing to answer open-ended questions.
(Dommeyer & Moriarty,	Students	Attitudes towards binge drinking	E-mail (embedded)	150	37%	4.3	No significant difference in number of item omissions.

⁵ Respondent were given the option to return a paper copy. Three percent made use of this option.

⁶ Batch: the (same) message was sent to all of the subjects in one message, thus creating multiple recipients.

⁷ Merge: a program was written to merge a list of e-mail addresses with the survey and the surveys were sent by e-mail, thus eliminating the problem of multiple recipients.

Author(s)	Sample	Survey Topic	Method	Sample Size	Response Rate	Response Time (days)	Response quality
2000)			E-mail (attached)	150	8%	5.7	
(Paolo, Bonaminio, Gibson, Partridge, & Kallail, 2000)	Medical students	Feedback on their clerkship experiences as part of the curriculum evaluation process	Mail E-mail	83 81	41% 24%	The turnaround time for e-mail was faster than mailed surveys	No significant differences were found in the comments made. The number of students who omitted items was larger for the e-mail group (27% vs. 9%) but not statistically significant.
(Cobanoglu, Warde, & Moreo, 2001)	Hospitality professors	Hospitality education	Mail Fax WBS	100 100 100	26% 17% 44%	16.5 4.0 6.0	80.7% completed mail surveys; 76.4% completed fax surveys; 81.4% completed web surveys
(Harewood, Yacavone, Locke, & Wiersema, 2001)	Patients	Patients experience after routine outpatient endoscopy	Mail E-mail	20 23	85% 70%	33 18	NA
(Kim et al., 2001)	Members of the American Urological Association (N=2502)	Practice patterns in the treatment of urinary incontinence	Mail E-mail	1000 1502	42% 11%	NA	NA
(Raziano et al., 2001)	Geriatric division chiefs (N=114)	Existence of acute care for elders	Mail E-mail	57 57	77% 58%	33 18	NA
(Kwak &	University	Use of computing	Mail	1000	43%	9.0	Item non response was

Author(s)	Sample	Survey Topic	Method	Sample Size	Response Rate	Response Time (days)	Response quality
Radler, 2002)	students	and Internet technology	WBS	1000	27%	2.2	significantly lower for the WBS version. WBS respondents were more willing to answer open-ended questions.
(McAbe, Boyd, Couper, Crawford, & D'Arcy, 2002)	Undergraduate students	Alcohol and other drug use	Mail WBS	3,500 3,500	40% 63%*	NA	Slightly more partly completed surveys in the web version. Marginally lower missing data rate in web version
(McMahon et al., 2003)	Pediatricians	Knowledge and attitudes regarding rotavirus vaccine	Mail Fax WBS	150 150 150	55% 57% 47%	NA	Seventy-eight of 3713 (2.1%) questions were not answered by those who responded by postal mail, 94 of 3384 (2.8%) for those who responded by fax, and 6 of 1410 (0.4%) for those who responded by e-mail ($p = .001$).
(Leece et al., 2004)	Surgeons	Treatment of femoral neck fractures	Mail WBS	221 221	45% 58%	NA	NA
(Ritter et al., 2004)	People with a chronic disease	Information was collected on 16 self-report instruments and well as on demographic	Mail WBS	231 231	83% 87%	NA	The instruments administered via the Internet appear to be reliable, and to be answered similarly to the way they are answered when they are administered via traditional

Author(s)	Sample	Survey Topic	Method	Sample Size	Response Rate	Response Time (days)	Response quality
		variables and types of disease conditions.					mailed paper questionnaires.
(Kiernan, Kiernan, Oyler, & Gilles, 2005)	Community- and university-based educators	Educators' use of communication tools	Mail WBS	137 137	79% 95%	NA	No significant difference in number of item omissions. WBS respondents provided longer and more substantive responses to qualitative questions
TOTAL			Mail Fax E-mail WBS Total	14,346 450 12,782 7,292 38,870	52.4% 32.1% 32.8% 50.5% 44.6%	16.1 6.4 7.7 6.7 9.2	Overall, 6 studies found no differences in response quality (number of item omissions and quality of open-ended questions) between postal mail and E-mail. In 6 studies response quality was better in studies using E-mail vs. postal mail. One study reported no differences between mail and web-based surveys in response quality. Five studies reported that response quality was better in WBS than in postal mail surveys.

Although it is very difficult to compare surveys, especially when they address different topics, use different methods and different samples, the studies summarized above have the advantage that the study topic and the study sample are similar and only the survey method is different. Results show that, in general, postal mail surveys generate a higher response rate than e-mail surveys: 52% vs. 33%. Fax surveys result in the lowest response rate (32%). Web based surveys have similar response rate to postal mail surveys: 52% vs. 51%.

E-mail (7.7 days) and web based surveys (6.7 days) have a much shorter response time than postal mail surveys (16.1 days). E-mails and web based surveys also seem to elicit a better response quality. Although in general there are only slight differences in the number of item omissions (Mehta & Sivadas, 1995; Tse et al., 1995; Bachman et al., 1999; Dommeyer & Moriarty, 2000; Couper, Blair & Triplett, 2000), Internet respondents are more willing to give extra information (Mehta & Sivadas, 1995) and to answer open-ended questions (Bachman et al., 1996, 1999; Schaefer & Dillman, 1998) than postal mail respondents.

There seems to be a trend over time that respondents are less willing to respond to surveys by e-mail. The most striking example of this trend are the studies conducted by Bachman et al. (1996 and 1999). Both studies had the same topic and the same (target) population in 1996 and 1999 (see Table 2): the surveys asked Business school deans about their attitude towards Total Quality Management (TQM). In 1996 the response rate for the Internet survey was 52.5%; in 1999 it dropped to 19.1%. This could be explained by the saliency of the topic (respondents less interested in TQM in 1999). However, the response rate for the postal mail survey was the same in both years: 66%. Thus, a more plausible reason for the decline could be the subjects' increased reluctance to respond by e-mail (Bachman et al., 2000).

4. Factors that influence (non)response in postal mail surveys

In a review of the postal mail survey literature on nonresponse, Bosnjak, Tuten, & Wittman (2005) distinguish between three lines of research: research on psychological

processes leading to (non)participation; research on respondents factors and research on design factors.

Psychological processes

The first line of research focuses on an integrative conceptual model to predict and explain (non)participation in self-administrated surveys, describing the psychological processes leading to survey (non)participation (Albaum, Evangelista, & Medina, 1998; Helgeson, Voss, & Terpening, 2002). Several theories have been used to describe these psychological processes: social exchange theory (Blau, 1964; Homans, 1961; Thibaut & Kelley, 1959), cognitive dissonance theory (Festinger, 1954, 1957), self-perception theory (Bem, 1972), the theory of commitment or involvement (Becker, 1960), Cialdini's persuasion principles (Groves, Cialdini, & Couper, 1992) and the theory of reasoned action (Ajzen & Fishbein, 1980; Fishbein & Ajzen, 1975).

The core of the underlying processes is formed by social exchange theory. Social exchange theory postulates that human behavior is in essence an exchange, particularly of rewards (Homans, 1961) or resources of primarily material character (wealth) (K. S. Cook & Whitmeyer, 1992; Stolte, Fine, & Cook, 2001) and secondarily of symbolic attributes. Responding to a questionnaire is viewed as social exchange and the assumption is that people are seen as more likely to complete and return self-administered questionnaires if they trust that the rewards of doing so will, in the long run, outweigh the costs they expect to incur (Dillman, 2000, p. 26). For example, Dillman (2000) developed the Tailored Design Method (TDM) on the basis of social exchange theory. However, in Dillman's TDM, social exchange theory is used as the theoretical umbrella to integrate recommendations for increasing response rates, but the theory itself has not been tested to predict survey (non)response (Bosnjak et al., 2005; Dillman, 2000).

Respondent factors

The second line of research focuses on *respondents factors* such as age, education, social economic status (SES) and personality characteristics associated with (non)response (Heberlein & Baumgartner, 1978; Lubin, Levitt, & Zuckerman, 1962; Rogelberg et al., 2003). Results show that people with higher education or a higher SES respond more

often (Clausen & Ford, 1947; Vincent, 1964; Wallace, 1954), but this literature is old. Personality factors have been found to have only a small predictive power (Rogelberg et al., 2003).

Survey design factors

The third line of research focuses on *survey design factors* influencing response rates (Claycomb, Porter, & Martin, 2000; Dillman, 1978; Kanuk & Berenson, 1975; Yammarino, Skinner, & Childers, 1991). This line of research is mainly data-driven and aimed at finding the factors that improve response rates but is limited in helping to theoretically understand the antecedent psychological processes resulting in (non)compliance to survey request (Bosnjak et al., 2005). Results of this line of research show that the following survey design factors have a consistent and significant effect on observed response rates. *Saliency* is of course one of the most predominant factors when it comes to conducting surveys and achieving high response rates. In a quantitative analysis of the literature, Heberlein and Baumgartner (1978) were able to explain 51% of the variance in final response rate with two variables: salience of the topic to the respondent and number of contacts. Robertson and Sundstrom (1990) and Martin (1995) found that salience was a key predictor of response for postal mail surveys. *Pre-notification* (Cook et al., 2000; Fox, Crask, & Kim, 1988) –preferably by the organization the respondents work for- and personalized cover letters help as well (Cook et al., 2000; Dillman, 1978, 1991). Fox et al. (1988) compared fifteen studies to examine the impact of (monetary) *incentives*. In all but two of the 30 experiments reported in the studies, incentives increased the response rate (Fox et al., 1988). *Length* of the survey is obviously an important factor: the shorter the survey, the higher the response rate (Groves, Singer, Corning, & Bowers, 1999; Heberlein & Baumgartner, 1978; Steele, Schwendig, & Kilpatrick, 1992; Yammarino et al., 1991). *Sponsorship* (for example the survey originates from a university instead of a marketing company) is also an important factor: association with governments produces higher response rates (Fox et al., 1988; Heberlein & Baumgartner, 1978). Last but not least, *follow up* (sending out reminders) increases response rates (Mavis & Brocato, 1998; Mehta & Sivadas, 1995; Yammarino et al., 1991).

5. Can we apply lessons learned about postal mail surveys to Internet surveys?

Several decades of research on response rates in postal mail surveys have provided insight about the underlying psychological processes of (non)response behavior, the role of personality characteristics and the effects of survey design factors. The question, however, is: can we apply the lessons learned about postal mail surveys to Internet surveys?

Psychological processes

There are no obvious reasons why the psychological processes that explain response behavior in postal mail surveys cannot be applied to Internet surveys. However, there have been very few studies on the psychological processes underlying response and nonresponse in Internet surveys. A study by Bosnjak et al. (2005) attempted to predict and explain the number of participants in a five-wave web-based panel study, testing Azjen's (1991) theory of planned behavior. According to this theory, a central determinant of behavior is the individual's intention to perform the behavior in question. The behavioral intention is influenced by three concepts: first, one's belief about the likely consequences, which results in a positive or negative attitude towards performing the behavior; second the perceived social pressure to perform or not perform the behavior in question (subjective norm); and third consideration of factors that may further or hinder one's ability to perform the behavior (control beliefs). These control beliefs lead to the formation of perceived behavioral control, which refers to the perceived ease or difficulty of performing the behavior (Bosnjak et al., 2005). Added to the theory was the construct of moral obligation. According to an earlier study by Bosnjak & Batinic (2002) the extent to which an individual feels morally obliged to participate in a web-based survey plays an important role in predicting their willingness to participate. The results of the web based study show that the 4 concepts (attitudes, subjective norm, perceived behavioral control and moral obligation) predict intention to participate (explained variance 69%), but are less successful in predicting actual participation (explained

variance 17%). Still, the study by Bosnjak et al. (2005) is the only study based on a theory that is actually applied to and tested with web-based surveys.

Respondent characteristics

We could not find any literature that compares respondent's characteristics, such as personality, among respondents and non-respondents of Internet surveys. Most of the literature has focused on socio-economic status characteristics of the respondents. However in recent years, studies have been conducted that compare respondent characteristics in postal mail surveys and Internet surveys. In general, results show that there are few differences in respondent characteristics between postal mail surveys respondents and Internet surveys respondents. Ritter et al. (2004) summarized some of the results. For example, in a study of a 13-item quality of life scale, the Foundation for Accountability (Lansky, Whitworth, & Meyers, 2002) found that while there was some variation in individual items, the mean scores for mail and Internet surveys were similar. Buchanan & Smith (1999) compared a Web-based personality assessment to a paper-and-pencil version. Using confirmatory factor analyses, they found similar psychometric properties in the two different modes of administration. Davis (1999) compared Web and paper-and-pencil versions of a personality measure (rumination), and concluded that "findings from Web-based questionnaire research are comparable with results obtained using standard procedures." Riva, Teruzzi, & Anolli (2003) compared attitudes and behaviors with regard to the Internet, using a mail survey and a web based survey. They concluded that if sampling control and validity assessment is provided, the Internet is a suitable alternative to traditional paper-based methods. However, there are some studies that have found differences in respondent characteristics. Joinson (1999) reported that a Web survey resulted in lower scores on a social desirability measure as compared to a paper-and-pencil survey. Buchanan (2003) reported that even when Internet-based versions of instruments are reliable and valid, normative data from paper-and-pencil versions may not always compare directly with Internet-mediated psychological testing. Based on their review of the literature Ritter et al. (2004) conclude: "Although progress is being made, there remains a need to evaluate Internet versions of most of the health-behavior and outcome instruments useful to researchers evaluating patient intervention

programs”. Ritter et al. (2004) collected information on 16 self-report instruments measuring health as well as on demographic variables and types of disease conditions. The results showed few differences between Internet-based and mailed paper questionnaires. However, results of a recent study by Kwak & Radler (2002) show that respondents of a web based survey are more likely to be young and male and to spend more time on the Internet as compared to respondents of a postal mail survey.

Survey design factors

Most of the research on nonresponse in Internet surveys has focused on survey design factors. Much of the research has focused on technical issues and the graphical user interface (GUI). There is well documented research on the requirements of the interface. For an excellent overview see Best & Krueger (2004) who summarize the findings on display configuration, color, text appearance, item style, alignment, item delivery and length.

Table 3: Survey design factors that influence response rates in Internet surveys

Positive impact	Negative impact
• Saliency	• Lack of anonymity
• Understanding the targeted population	• E-mail is easy to ignore and discard
• Pre-notification	• Confusion related to computer illiteracy
• Personalized cover letter	• Less incentives to respond
• Incentives	• Design/connection speed
• Sponsorship	• Non deliverable mail
• Reminders	

There is evidence that survey design factors that enhance response rates in postal mail surveys also enhance response rates in Internet surveys. Sheenan and McMillan (1999) found that *saliency* was –in addition to being a predictor of response rates in postal mail surveys- also a predictor of response rate for e-mail surveys. If potential respondents are not interested in the topic of the survey, it is easy for them to discard the Internet survey because they only need to push one button (delete). Understanding the *targeted population* is another important factor, especially when using Internet surveys (Sheehan

& McMillan, 1999). Design may interact with the type of web survey being conducted and the population targeted by the survey (Couper, Traugott, & Lamias, 2001). In other words, the design of a survey targeted at students would likely have different design requirements than one aimed at older persons. *Sponsorship* (the “From” part in the e-mail header) has also proven to have a positive impact on participation (Lozar Manfreda & Vehovar, 2002; Tuten, 1997; Woodall, 1998). Mehta and Sivadas (1995) found e-mail response rates of 40% for e-mail alone and 64% for e-mail with *pre-notification*. *Reminders* improve response to Internet surveys, just as they do for postal mail surveys (Kittleson, 1997; Mavis & Brocato, 1998; Mehta & Sivadas, 1995; Schaefer & Dillman, 1998; Sheehan & McMillan, 1999; Vehovar, Batagelj, Lozar, & Zaletel, 2002). Sheenan and McMillan (1999) were able to increase the response rate from 23% to 48% by sending a reminder e-mail. Kittleson (1997) claimed that “one can expect between a 25 and 30% response rate from an e-mail survey when no follow-up takes place. Follow-up reminders will approximately double the response rate for e-mail surveys” (p. 196). The majority of responses in Internet surveys are received within the first few days of data collection period (Vehovar et al., 2002). This suggests that, in comparison to postal mail surveys, the time intervals between follow-up strategies should be shortened. Cook et al. (2000) conducted a meta-analysis of response rates in web- or internet-based surveys, and found that the number of contacts, personalized contacts, and pre-contacts are the factors most associated with high response rates.

There is also some literature on factors that can negatively influence response rate using Internet surveys. A major problem of Internet surveys is the lack of *anonymity* (Couper, 2000; 2001). If one sends out an e-mail asking people to fill out a survey (whether the survey is embedded, attached as a document or an executive file, or linked to a web based survey), in most cases it is possible to trace back the return address; therefore, the survey is not anonymous. However, there are means to circumvent this, especially when using web based surveys. The responses that are submitted can be stripped of all personal identifiers before storing the data on a server. However, even if the researchers can guarantee confidentiality, *confidentiality* may be a concern to the respondents. An increasing number of organizations keep records of all incoming and outgoing messages,

and if the topic of the survey is particularly sensitive, this may discourage employees from completing surveys at the office (Couper, 2000). Therefore, it is essential that precautions be taken to protect the confidentiality and privacy of respondents (Shannon & Bradshaw, 2002).

Another problem with Internet surveys is that they are *easily discarded*. It will only take the push of one button to delete the e-mail. Therefore, the subject line or subject header in e-mails can have an impact on response rate of Internet surveys. An e-mail invitation is less noticeable and can be perceived as commercial spam, particularly when the information in the head of the message (“From”; “To” and “Subject”) is unclear (Vehovar et al., 2002). The e-mail subject line is therefore extremely important to catch the attention of respondents and encourage their participation (Coomber, 1997; Tuten, 1997; Vehovar et al., 2002). The study by Tuten (1997) focused on the decision process involved in determining whether to open an e-mail. Twenty faculty members in sociology departments in Germany were invited by e-mail to participate in the study. Eleven persons who responded to the e-mail were interviewed. Nine respondents stated that they deleted messages at times without reading them for the following reasons: the subject was not interesting (7), the message appeared to be an advertisement (6), the message appeared to be sent to a mass mailing list (2), the message appeared to be “rubbish” (1), the message was too long (1), and the message was not from a colleague (2). Everyone interviewed described looking at the subject line and then to the name of the sender when deciding whether or not to read an e-mail message (Tuten, 1997). This topic is of great importance because if a potential respondent does not even open the mail, incentives such as monetary rewards, appeal and sponsorship are irrelevant.

Another matter that can have an impact on response is that it can be *difficult to give respondents incentives*. Using a mail survey, it is possible to enclose for example \$5 or \$10 as an incentive for respondents to complete the survey. Evidently this is not possible with Internet surveys, although there is some evidence that monetary incentives such as electronic vouchers can increase response rates in Internet surveys as well (Downes-Le Guin, Janowitz, Stone, & Khorram, 2002; Frick, Bachtiger, & Reips, 1999; MacElroy, 2003; Woodall, 1998).

Another problem is related to *computer illiteracy*: respondents need certain knowledge of Internet use. An Internet survey assumes that the respondent has the ability to retrieve and send e-mail attachments, etc. An example is provided by Raziano et al. (2001) who compared an e-mail survey to a postal mail survey of chiefs of geriatric units. Following the completion of the study, the e-mail nonresponders were contacted to better understand the nonresponder behavior and the factors that influenced that behavior. Individuals who did not respond to all three e-mail attempts (N=6), but who completed a conventional postal mail survey, were contacted personally by telephone and asked why they did not respond to the e-mail survey. The reasons reported included a higher level of comfort with the conventional mail survey, unavailability of e-mail accounts, and lack of technical knowledge with the Internet and with e-mail attachments (Raziano et al., 2001). Other researchers have also suggested that potential respondents' technology related uneasiness or perceived difficulty in completing an online questionnaire may be responsible for lower response rates in electronic surveys (Kittleson, 1997; Kwak & Radler, 2002; Zhang, 2000).

The design of an Internet survey has a limited impact on the initial decision to participate, but is strongly related to partial nonresponse, item nonresponse, and data quality. For example, edit control (forcing respondents to answer questions properly) is an important design issue that has not been examined yet (Vehovar et al., 2002). In principle, edit control can prevent any item nonresponse or inconsistent response. However, the respondent's frustration associated with these requirements can lead to premature termination (Dillman, 2000; Dillman, Tortora, & Bowker, 1998).

Non-deliverable mail is another problem of Internet surveys. Internet users often change from one Internet provider to another, and therefore may change their e-mail-address. Some studies have shown that the percentage of non-deliverable mail can be as high as 25%.

6. Conclusion and recommendations

Evidently there are advantages and disadvantages to using the Internet for surveys. The advantages and disadvantages are summarized in Table 1. The advantages are obvious

and do not need further explanation. However, how can we deal with the disadvantages? These disadvantages can be a serious threat to the validity of Internet surveys. Research on the use of the Internet for conducting surveys is still in its infancy. However, we can draw some conclusions based on our review of the literature and our own experience with web based surveys and make recommendations for Internet surveys.

The greatest threats to the *validity* of Internet surveys are coverage error (part of the population of interest cannot become part of the sample because they simply do not have access to the Internet) and sampling error (only a subset of the target population is surveyed yet inference is made about the whole population). Coverage error and sampling error will become less important as the gap between Internet users and the general public is beginning to close. As the Internet becomes increasingly accessible to a greater segment of the population, sampling will become less restrictive. However, until that time has come, we recommend to randomly drawing samples from populations where everybody has access to the Internet, such as people employed in information technology jobs, companies or universities.

The third disadvantage of conducting Internet surveys is nonresponse error especially because response rates to Internet surveys appear to have been declining (Dommeyer & Moriarty, 2000; Sheehan, 2001). Nonresponse error is important because nonresponse will make it very difficult to generalize the results to the larger population. Results of our own analysis of American studies that compare single mode surveys show that the average response rate is 52.4% for postal mail surveys, 32.1% for fax surveys, 32.8% for e-mail surveys and 50.5% for web based surveys. The response rates for postal mail and web based surveys are close to the average response rate (56%) found by Baruch (1999) in his review of 20 years of scientific literature. Furthermore, the response rates for postal mail and web based surveys in our study do not appear to be declining. If we use Babbie's (1990; 1992) criterion, postulating that a 50% response rate is considered minimally adequate for research, fax surveys and e-mail surveys should not be used anymore. Apart from the low response rate, there are also other reasons why we should not use e-mail (and fax) surveys. The most important one is the lack of anonymity. If the survey is embedded in or attached to an e-mail and the participant responds by returning the mail to the sender, the researcher will know who sent the e-

mail. Furthermore, more and more organizations keep records of all incoming and outgoing messages, and if the topic of the survey is particularly sensitive, this may discourage employees from completing surveys at the office. Another reason not to use surveys embedded or attached in an e-mail is that it does not take full advantage of the benefit of automated administration. Last but not least, when using embedded or attached questionnaires in e-mail it is difficult to prevent potential respondents either to submit multiple questionnaires themselves, or forward the e-mail to other Internet users who in turn can submit their responses (multiple responses). With a username/password protected web based survey these problems can be prevented.

The most important other disadvantages of Internet surveys that may increase nonresponse are lack of anonymity, computer security, computer illiteracy and non-deliverability. The lack of anonymity has been explained above. This is more an issue when using embedded or attached e-mail surveys than using a web based survey. Computer security poses a problem for all Internet surveys. Because of problems with spam and viruses, Internet users have grown suspicious of receiving e-mails from strangers. Computer security systems have been set up to prevent these problems and may cause the e-mail inviting the potential respondents to participate in the survey never to reach the potential participants⁸. Computer illiteracy is another problem. The literature has shown that many users still feel more confident with postal mail surveys and that they not always know how to respond to the invitation to participate. Research has also suggested that potential respondents' technology-related uneasiness or perceived difficulty in completing an online questionnaire may be responsible for lower response rates in Internet surveys. Finally, non-deliverability is becoming a serious problem. People may have an e-mail address but do not know how to use it, change e-mails address without a follow-up or have several e-mail addresses, and not all of the mail is checked on a regular basis. The literature shows that the percentage of non-deliverable mail can be as high as 50% (Kim et al., 2001).

⁸ Deliverability is the top concern for 68 percent of IT and e-mail marketers according to an online survey conducted by Socketware (Burns, 2005). Deliverability concerns center on a few key barriers. The biggest barriers are e-mail filters (92%); ISP Blocking (73%); blacklisting (69%); commercial e-mail laws (65%); whitelisting (58%); authentication (39%); accreditation and reputation services (31%); and feedback loop processing (27%). Only 4 percent of respondents say they are not concerned with deliverability.

However, our review of the literature and our own experiences have shown that well designed web based surveys can generate response rates that are equal to or even better than response rates found in postal mail surveys if the issues mentioned above are properly addressed. Our review of the literature has shown that the same survey design factors that improve response rates in postal mail surveys are also important or possibly even more important in Internet surveys. They are: saliency of the topic, understanding the targeted population and related to that the survey design, personalized contacts, sponsorship (e.g., university vs. marketing company), incentives, pre-notification, and reminders.

In summary, we make the following recommendations to increase response rates in Internet surveys:

- Use a web based survey system;
- Notify the organization involved that you are conducting a web based survey;
- Take precautions to protect confidentiality and privacy of respondents;
- Use password protected web based surveys;
- Apply all of the survey design factors that increase response rates in postal mail surveys:
 - o Pre-notification, preferably by the organization the respondents belong to
 - o Personalized contacts
 - o Incentives: give respondents something in return, whether it is a electronic gift certificate or a summary of the results
 - o Reminders
- With regard to the web based survey system:
 - o Automatically validate input
 - o Use skip patterns
 - o Force errors only on rare occasions
 - o Provide some indication of survey progress
 - o Allow respondents to interrupt and then re-enter the survey
 - o Take advantage of the ability to track respondent's behavior
- Thoroughly pretest the survey and the technology involved;
- Enable respondents to report problems.

Nowadays, it is nearly impossible to conduct a web based survey without notifying the organization where the study is conducted and asking for their cooperation. Otherwise the computer security systems at the organizational level will prevent the e-mail messages inviting the persons to participate in the survey to reach the potential participants. We further recommend that the organization itself pre-notifies their members/employees of the survey. Members or employees probably will read e-mail originating from their own organization, which will increase the chance that they open and read the letter of invitation sent by the researcher(s) or research institute, who may be unknown to them. It is important is to enable the respondents to report problems, whether it are problems caused by computer illiteracy or technical problems. One can test a web based system as often as possible, but that does not mean that Internet users, with their individual set up (e.g., type and version of the browser, settings that will or not allow cookies; java script, or software used) will not experience problems.

With regard to the reminders, research has shown that most of the response in web based surveys occurs within three days after sending out the letter of invitation. Therefore we recommend sending at least three reminders in three-day intervals. Results of a study by Crawford, Couper & Lamias (2001) show that an experimental group that received a reminder two days after the initial invitation demonstrated a higher response rate than the group that received a reminder five days after the invitation. Although some researchers warn against using too many reminders, we think that using the Internet to conduct surveys and the problems associated with it, the benefits of sending at least three reminders outweigh the risks.

Finally, one of the problems with research on nonresponse in Internet surveys is that it is mostly data driven. Experiments are conducted to study the effect of different survey design factors that can improve the response rates, but we do not *why* these factors have an effect. In other words, we lack a theory of nonresponse. Although the literature on postal mail surveys has the same problems (much data driven research and relatively little theory), there are theories available to explain and sometimes even predict why some factors are effective in increasing response rates. A major problems with Internet surveys is that not only we do not know why people decide to participate or not, but we do not even know why they decide to open an e-mail or completely ignore it. Once

potential participants have opened the e-mail and the researcher has been able to explain the purpose of the study and appeal to potential participant, the theories that explain participation in postal mails probably work as well. Internet survey respondents probably participate in a survey as part of a social exchange (they expect something in return), or want to reduce cognitive dissonance. But research should focus on the first step of the survey process: why do potential participants open their e-mail or discard it? In reality, the researcher has about 10 cm² (1.5 inch²), depending on the size of the screen, the e-mail program used, and whether the reader uses a preview pane or not, to convey his or her message: the subject line. In the subject line, the researcher has about 30-40 characters to convey his message, his appeal to participate, hoping that this will be enough for the social exchange theory, cognitive dissonance theory or one of the other theories mentioned to do its work. Future research should also focus on signal-detection theory (Green & Swets, 1966), because the message inviting people to participate in a survey is not the only message on the screen. Messages get lost in the enormous amount of information that is being sent to us every day⁹. That is if they do not get lost in spam folders or are blocked altogether by the system.

The web survey process has several distinct stages where nonresponse occurs: cooperation rate in the pre-recruitment stage, failure rate (percentage of undeliverable mail), click-through rate (percentage of potential participants accessing the web questionnaire), overall completion rate (the percentage of partial and complete surveys submitted) and drop-out rate (the percentage of respondents prematurely abandoning the web survey) (Lozar Manfreda & Vehovar, 2002). Different survey design factors may have an impact at different stages. For example, pre-notification seems to be associated with click-through rates, whereas the length of the questionnaire, the number of open ended questions and the use of incentives are associated with drop-out rates (Lozar Manfreda & Vehovar, 2002). Therefore, future research should focus on nonresponse in the different stages in the web survey process and the underlying psychological processes

⁹ Results of the Pew Internet & American Life Project Study (Fallows, 2005; Rainie & Fallows, 2004) on the effects of the CAN SPAM Act in the USA on January 1, 2004, show that 60% of employees mailers receive 10 or fewer e-mail messages on an average day; 23% receive more than 20 and only 6% more than 50. With regard to users experiences with spam after the introduction of the SPAM-CAN Act, the study found the following results: users who say they have ever received porn spam have decreased from 71% in 2004 to 63% in 2005; 52% of internet users consider spam a big problem; 22% of e-mail users say that spam has reduced their overall use of e-mail; 53% of e-mail users say spam has made them less trusting of e-mail, compared to 62% a year ago; 67% of e-mail users say spam has made being online unpleasant or annoying, compared to 77% a year ago. The spam filtering company MessageLabs has reported that in an average month during 2004, spam constituted 73% of e-mail.

involved in these different stages. For example, Bosnjak et al. (2005), based on the Azjen's theory of planned behavior, were able to predict the intention to participate in a web based survey, but were less successful in predicting actual participation. To summarize, the first steps toward understanding the different stages in the Internet survey process have been taken (Bosnjak & Batinic, 2002; Bosnjak & Tuten, 2001; Lozar Manfreda & Vehovar, 2002; Tuten, 1997; Vehovar et al., 2002), but more research is needed focusing on the underlying psychological processes explaining the effectiveness of the design factors in the different survey stages.

7. References

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4. Paper 3

Hoonakker, P.L.T., & Carayon, P. and Korunka, C., (2008). The relation between job and organizational characteristics, quality of working life and turnover intention in the IT workforce: Are there differences between men and women? Submitted to the *Journal of Management Information Systems*.

Title: The Effect of Job and Organizational Characteristics, Human Resources Management Practices and Quality of Working Life on Turnover Intention in the IT Workforce: Are There Differences Between Men and Women?

Abstract

Turnover has been a major issue for Information Technology (IT) personnel since the very early days of computing and continues to be a problem. Research has shown that female scientists and engineers in industry are more likely to leave their technical occupations and the workforce altogether than women in other fields. In this study we reviewed the literature on the relationship between certain factors (job and organizational characteristics, human resource management practices, and quality of working life) and turnover. Then we developed and tested two research models of the relationship between gender, these factors, and turnover intention. Results of our study show that women do not perceive job and organizational characteristics, human resource management practices or quality of working life differently than men, but they perceive *the relationships between those concepts* differently, which in turn can explain differences in turnover intention. The results of our study have consequences for the retention of men and women in the IT work force.

Keywords

Job and organizational characteristics, human resource management practices, quality of working life, turnover intention, gender

INTRODUCTION

Turnover has been a major issue for Information Technology (IT) personnel since the very early days of computing and continues to be a problem [1, 2]. IT personnel frequently change employers, and have shown this tendency ever since statistics have been kept. Studies on turnover in the IT work force in the late 60's and early 70's [3-7], showed that annual turnover ranged between 15 percent and 20 percent in this period [8]. In the late 1970s, turnover ran as high as 28 percent annually [9] and up to 20 percent in the early 1980s. By the 1990s, the turnover rate reached 25 percent to 33 percent per year [10], and even Fortune 500 firms have similarly high turnover rates among their IT personnel [11].

Although women have comprised nearly 48% of the total American work force throughout the last 10 years, the percentage of women in the IT workforce fell from 41% to 29% between 1996 and 2004 [12-14]. Female scientists and engineers in industry are more likely to leave their technical occupations and the workforce altogether than women in other fields. Attrition data on female scientists and engineers show that their exit rates are not only double those of men (25% versus 12%), but they are also much higher than those of women in other employment sectors [15]. Preliminary research has shown that the key barriers to retention of women in the IT workforce include lack of role models and mentors, exclusion from informal networks, stereotyping and discrimination, unequal pay scales and inadequate work/family balance [15, 16].

Turnover of highly skilled employees can be very expensive and disruptive for firms [17]. Losing highly skilled staff members means that companies incur substantial costs associated with recruiting and re-skilling, and hidden costs associated with difficulties completing projects and disruptions in team-based work environments [2]. Determining the causes of turnover within the IT workforce and controlling it through human resource practices and work system design is imperative for organizations [18].

This study has the following goals:

- (1) To determine the causes of turnover in IT. Based on a comprehensive literature review, a conceptual turnover model is developed and tested. The model aims to explain the relationships between job and organizational characteristics, human

resource management (HRM) practices, quality of working life (QWL) and turnover intention.

- (2) To test the model for gender differences. Possible direct and moderator effects of gender on the relationships in the conceptual model are examined.

THEORETICAL FRAMEWORK AND HYPOTHESES

There are two bodies of literature that have examined turnover intention and turnover. One is the job and organizational design and job stress literature, which focuses on the job and organizational characteristics that may cause people to leave their jobs. The other is the human resource management literature. This literature focuses on the human resource management (HRM) practices that help an organization to meet its strategic goals by attracting and maintaining employees and managing them effectively. We will briefly describe the factors related to turnover and turnover intention found in these two bodies of literature.

Job and Organizational Characteristics Literature

Over the past decades, several job and organizational characteristics associated with turnover intention and turnover have been identified in this body of research. Most of the studies on antecedents of turnover show that the relationship between job and organizational characteristics and turnover is mediated by QWL variables such as job satisfaction and organizational commitment [19-21]. QWL has been defined as “the quality of the relationship between employees and the total working environment, with human dimensions added to the usual technical and economic considerations” [22 p. 80]. However, some studies show a direct relationship between job characteristics and turnover. Most of these studies have focused on the relationship between role stressors (role conflict and ambiguity) and turnover [e.g. 23, 24-27]. Results of these studies have shown that role ambiguity is more strongly related to job satisfaction, organizational commitment and turnover intention than role conflict [26-28]. Other studies have shown that task repetitiveness [19, 29], routinization [20] and challenge [30] are related to turnover. Studies in IT have shown that lack of work-related challenges is one of most important reasons for turnover [7, 18]. Beehr, et al. [31] found that job demands and decision latitude are both directly negatively correlated with turnover intention.

The relationship between social support and turnover has also received attention in the literature. For example, results of the literature review by Mobley, et al. [29] showed that supervisory support is negatively related to turnover. Rhoades, et al. [32], showed in a more recent review that organizational support is strongly related to a variety of other job characteristics such as salary, rewards, fairness of treatment and promotion, job security, autonomy, role stressors (including role ambiguity and role conflict), and training. Results of the meta-analysis also showed that organizational support is weakly and positively related to age, education, and tenure and negatively related to gender. Further results show that organizational support is related to a variety of outcome measures such as organizational commitment, job satisfaction, job involvement, performance, strain, turnover intention and actual turnover [32]. Lee [33] examined the effect of three sources of social support (supervisory support, support from colleagues and home support) on job satisfaction and turnover intention, showing that supervisory support is both directly related to turnover intention and indirectly related via job satisfaction [33]. Jawahar, et al. [34] focused on the importance of organizational support for women's career advancement and turnover intentions. Although social support is directly related to turnover intention, most of this relationship is mediated by job satisfaction [34].

Another factor that is associated with QWL and turnover intention is Person-Organization (P-O) fit [35, 36]. P-O fit has been defined as “the compatibility between people and organizations that occurs when: (a) at least one entity provides what the other needs, or (b) they share similar fundamental characteristics, or (c) both” [37]. Results of a meta-analysis by Verquer, et al., [38] showed that P-O fit is related to organizational commitment, job satisfaction and turnover intention.

Work-family conflict has also been negatively linked to several organizational outcomes such as job satisfaction, organizational commitment, job stress [39, 40] and turnover [41, 42]. Work-family conflict can be considered a source of occupational stress [39, 43]. In many IT-related jobs, employees are expected to work late, be on-call to solve technical problems and travel; all of these factors can result in conflicts between working and family life. Work-family conflict has been defined as “a form of inter-role conflict that occurs when the demands of work and family are mutually incompatible”

[44]. The two components of work-family-conflict, family matters that spill over into working life (FW) and work factors that spill over into family life (WF), can add to the psychological demands placed upon workers and therefore affect their well-being, stress and depression [45], physical ailments [46] and life satisfaction [44]. This is particularly true for women [47].

Most reviews conclude that quality of working life is one of the best predictors of turnover and turnover intention [19-21]. Most studies have examined the following indicators of QWL: job satisfaction, organizational commitment, perceived stress, and particularly burnout. While job satisfaction is generally considered to be the primary indicator of quality of working life [e.g. 20], organizational commitment has also been identified as an important attitudinal outcome reflective of it [29, 48-50]. Low job satisfaction was found to be a significant predictor of turnover intention and turnover in the widely accepted turnover intention model of Mobley, Horner and Hollingsworth [51], which was at least partly confirmed in follow-up studies [e.g., 52, 53]. The meta-analysis of Griffeth, Hom & Gaertner [20] confirmed the important role of job satisfaction for turnover intention and turnover. In another meta-analysis, Hellman [54] calculated a mean corrected correlation of -0.52 between job satisfaction and turnover intention.

Organizational commitment also plays an important role in the turnover process [19, 28, 55, 56]. It has been reported that organizational commitment is more strongly related to turnover intention than job satisfaction [28]. Research suggests that satisfaction and organizational commitment are related but distinguishable attitudes: commitment is an affective response to the entire organization, whereas job satisfaction represents an affective response to more specific aspects of the job [57]. However, the results of a study by Igbaria and Greenhaus [24] in the IT workforce showed that job satisfaction has a stronger direct effect on turnover intention than organizational commitment. They found that job satisfaction and organizational commitment had the strongest influence on turnover intentions, and the impact of other job factors (role ambiguity and role conflict) on turnover intentions was mediated by job satisfaction and organizational commitment [24].

Finally, burnout is another a powerful QWL factor significantly correlated with organizational commitment, job satisfaction and turnover intention [1]. Emotional

exhaustion (the core dimension of burnout) is linked to reduced job satisfaction [58-61], reduced organizational commitment [62-64], and high turnover and turnover intention [1, 58, 63, 65]. Results of a meta-analysis by Lee & Ashford (1990) showed the correlation between emotional exhaustion and turnover intention to be 0.44 [66]. Technology professionals are particularly vulnerable to work exhaustion [67, 68]. Role ambiguity, role conflict and job tasks can be considered as risk factors for burnout among IT professionals [1, 69, 70].

To summarize our review of job and organizational characteristics, the literature has shown that the following job and organizational characteristics are directly or indirectly related to turnover and turnover intention: job demands, control (decision latitude), role ambiguity, lack of challenge, social support, person-organization fit, work-family-conflict, job satisfaction, organizational commitment and emotional exhaustion.

Research has also shown that several personal variables are associated with these factors and turnover intention. Personal variables have direct effects on work-related attitudes [19, 24, 29, 71-73]. Age and organizational tenure are positively related to satisfaction and commitment [19, 24, 71] and negatively related to turnover [19]. Education has been found to be negatively related to satisfaction [24, 74], and organizational commitment [72, 75] and positively related to turnover [19]. Salary has been found to be negatively related to turnover [19]. Gender has been found to be positively related to turnover in the meta-analytic study by Cotton, et al. [19]. Prior research suggests that demographic variables have direct effects on turnover intention over and above their indirect effects on turnover intention through satisfaction and involvement [24, 74]. In a study among 464 IT employees, Igarria, et al. [18] found age, organizational level, organizational tenure and job tenure to be negatively correlated with turnover propensity and education to be positively related to turnover intention. Therefore, we will control for personal variables in our models.

Human resource management practices literature

Human Resource Management (HRM) practices help an organization to meet its strategic goals by attracting, maintaining and effectively managing employees. HRM practices can influence the performance of an organization through the provision of structures that

encourage participation among employees and allow them to improve how their jobs are performed [76]. One of the basic assumptions of HRM is that employee involvement and commitment can have a positive effect on organizational performance, such as higher productivity and quality of products and services, and reduced absenteeism and turnover [77-79]. The HRM literature stresses the importance of factors such as training (availability and satisfaction with training opportunities at the company), developmental (e.g. management development programs, coaching from peers and supervisors, mentorship) and career advancement opportunities (promotional opportunities), as well as fair reward system. Review studies have shown that the use of practices such as extensive recruitment, selection and training procedures; formal information sharing; and systems that recognize and reward employee merit such as performance appraisal, promotion and incentive compensation have all been linked to organizational outcomes such as reduced turnover [80], increased productivity [81], and improved financial performance [82, 83]. These practices are also known as “high performance work practices” and “high involvement work processes” [84].

Vandenberg, et al. [85] examined the impact of high involvement work practices and processes on organizational effectiveness in 49 life insurance companies. Their analysis supported a model in which a set of organizational practices positively influenced high involvement work processes. In turn, the high involvement processes influenced organizational effectiveness (i.e., low employee turnover) both directly and indirectly, through positive influences on employee morale. The organizational practices assessed were work design, incentive practices, flexibility, training opportunities and direction setting. High involvement work processes were power, information, rewards and knowledge. Findings suggested significant influences of business practices on employee involvement and that involvement improved organizational effectiveness. Examining the direct associations between organizational practices and effectiveness showed that training opportunities significantly decreased turnover [86].

Huselid [76] conducted a study of human resource professionals across 3,452 US firms to evaluate the relationships between high performance work practices (e.g., training, promotion criteria, job design, information sharing), the individual-level factors

of turnover and productivity and firm performance. Overall, the high performance work practices were found to significantly reduce the rate of turnover [76, 85].

Neither of the HRM studies described above was conducted in the IT sector and we do not know of any similar studies that examined the effect of HRM practices on turnover and retention in the IT work force. However, Agarwal and Ferrat [87] examined the relationship between HRM systems and retention in a study of 350 IT professionals in 10 different organizations. Results showed that employee perceptions of the fairness of HRM systems are related to turnover intention.

To summarize, the literature on HRM practices highlights a number of factors that can contribute to QWL and turnover: training, career and developmental opportunities, and fairness of rewards [74, 76, 86]. These factors are in addition to the job and organizational design aspects listed in the previous section.

Both the research on job and organizational characteristics and the literature on HRM practices highlight the potential mediating role of QWL in explaining the impact of job and organizational factors on turnover intention. Conceptual and empirical models of turnover provide strong support for the proposition that a behavioral intention to turnover constitutes the most immediate determinant of actual turnover behavior [19, 24, 28, 72, 74, 88-90].

Conceptual model

Our review of the research literature has highlighted the importance of the following job and organizational factors and HRM practices in relation to turnover intention: job demands, role ambiguity, decision latitude, work-related challenges, social support, person-organization fit, work-family conflict, training, developmental and career advancement opportunities, and fairness of rewards. The literature also stresses the importance of quality of working life in relation to turnover intention, i.e. job satisfaction, organizational commitment and burnout. These factors also act as *mediators* between job and organizational characteristics and HRM practices, and turnover intention [18, 74, 91]. Figure 1 shows the conceptual model.

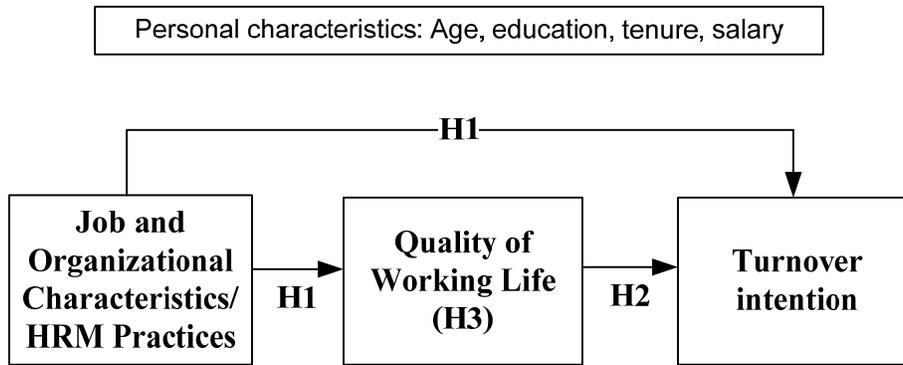


Figure 1: Conceptual model

The following hypotheses are derived from the conceptual model.

- **HYPOTHESIS 1 (H1): Job and organizational factors and human resource management practices affect QWL and intention to turnover.** Specifically, high job demands, role ambiguity, having more work-family conflict, having less decision latitude, a lack of work-related challenges, low social support, poor person-organization fit, a lack of training-, developmental-, or career advancement opportunities, and perceived unfairness of rewards are related to both (1) low job satisfaction and organizational commitment and (2) high stress and intention to turnover.
- **HYPOTHESIS 2 (H2): QWL affects intention to turnover.** High job satisfaction, organizational commitment and low stress are related to low turnover intention.
- **HYPOTHESIS 3 (H3): QWL mediates the relationship between job/organizational factors and HRM practices, and intention to turnover.** The relationships between turnover intention and job factors, organizational factors and HRM practices are *mediated* by job satisfaction, organizational commitment and stress.

Gender

Baroudi, et al. [23] studied the role gender plays in career success within IT occupations. They found that, even when demographic variables (i.e. education, knowledge and skills) were controlled for, women in IT hold lower level positions than men, receive lower salaries and have fewer opportunities to interact with peers. There were no significant

differences between men and women in satisfaction and commitment, but there was a significant difference in terms of intention to stay. Contrary to predictions, women were more likely to estimate longer continuing employment. Baroudi, et al. [23 {Truman, 1994 #106}] concluded that there is a need to look for gender bias in hiring, salary, promotion and personnel practices and to examine additional factors, such as family constraints, relocation and discriminatory practices at work, in order to explain the gender differences in quitting [23, 92]. Little research examines the range of job and organizational factors and HRM practices that can affect women in IT work. The research conducted by Igbaria and colleagues [24] provides a useful foundation, but does not provide a *systematic test* of gender differences in the relationships between job and organizational factors, HRM practices and turnover intention.

Conceptually, there are two possibilities for how gender can affect job and organizational factors, HRM practices, quality of working life and turnover intention. Either there is a *direct* effect of gender on job and organizational factors and HRM practices, QWL and turnover intention or gender *moderates* [93] the relationships between job and organizational factors, HRM practices, QWL and turnover intention (see Figure 2). In the first case, women are more often employed in lower status jobs, experience lower quality of working life and (therefore) have a higher propensity to leave their jobs. In the second case, men and women experience the same job and organizational factors and HRM practices, but women have different attitudinal and behavioral reactions to the similar organizational experiences and practices. Although suggested by Baroudi, et al. [23], the moderating effect of gender has not been tested in previous research in the IT work force.

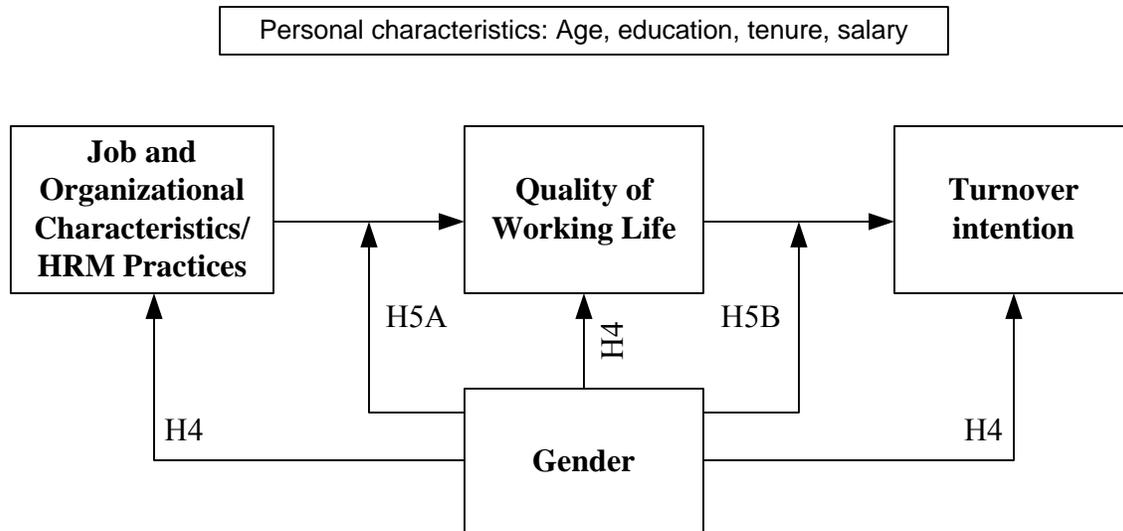


Figure 2: Gender Effects

- HYPOTHESIS 4 (H4):** Gender has a direct effect on job and organizational factors and HRM practices, quality of working life and turnover intention. As female employees are more likely to be exposed to ‘negative’ job and organizational factors and/or can benefit less from HRM practices, they will report lower QWL and higher intention to turnover. Female employees report higher job demands, more role ambiguity, and lower decision latitude, more lack of challenge, less social support, a worse person-organization fit and more work-family conflict than males. Female employees report less training opportunities, development activities, career advancement, and lower rewards than males. Female employees report lower job satisfaction and organizational commitment and higher burnout than males. Female employees report higher intention to turnover than males.
- HYPOTHESIS 5 (H5):** Gender moderates the relationships between job and organizational factors and HRM practices and quality of working life as well as the relationship between QWL and turnover intention.

METHOD

Procedure

We used a web based survey to collect the questionnaire data. For a detailed description of the web based survey system, see Barrios [94]. The participating companies sent out e-mails to notify their employees of the survey. Two days later we sent the employees an e-mail describing the study, asking for their participation and providing them with a link to our web based survey. The informed consent procedure was an integrated part of the web based survey management system.

Sample

A total of five Information Technology organizations participated in the study: one large company (N>500), one medium sized company (N=200) and three small companies (N<100). Overall, we collected data from 624 respondents. Fifty-four percent of the respondents are male. Twenty-six respondents chose not to reveal their gender and were excluded from the analysis. Respondents vary in age from 20 to 68 years (M=39.7 years). The majority of the sample is married (61%), while 9% are living with a partner, 9% are single, and 8% are separated, divorced or widowed. Fifty-six percent of the respondents have children, and the vast majority of these (83%) have children living at home. Forty-three percent of the respondents have children younger than 7 years. There are no gender differences in marital status, number of children, number of children that still live at home, or number of children younger than seven years. The overall response rate was 56%. The sample is fairly representative of the IT workforce (see Table 1).

Table 1: Job categories in the sample by gender

	Men	Women	Total
Application analyst	1 (0%)	6 (2%)	7
Application software developer	13 (4%)	2 (1%)	15
Business analyst / consultant	12 (4%)	17 (6%)	29
Database administrator / manager / security	10 (3%)	6 (2%)	16
Database analyst / Database architect	2 (1%)	5 (2%)	7
Data center operator	8 (2%)	6 (2%)	14
Documentation / Technical writer	2 (1%)	3 (1%)	5

	Men	Women	Total
Network administrator / manager	14 (4%)	10 (4%)	24
Network engineer / technician / PC technician	41 (13%)	5 (2%)	46
Project/Program/Applications/Operations manager	61 (19%)	81 (30%)	142
Quality assurance / Testing engineer	0 (0%)	2 (1%)	2
Server engineer	8 (2%)	1 (0%)	9
Software engineer / Software life cycle management	36 (11%)	22 (8%)	58
Systems administrator / Systems security	9 (3%)	0 (0%)	9
Systems analyst / Systems architect / Application engineer	35 (11%)	48 (18%)	83
Systems programmer / Network software developer	12 (4%)	6 (2%)	18
Technical support / Field technician	24 (7%)	3 (1%)	27
Telecommunications	5 (2%)	16 (6%)	21
Training	0 (0%)	5 (2%)	5
Webmaster / Web site developer	2 (1%)	2 (1%)	4
Other	29 (9%)	26 (10%)	61
Total	324 (100%)	272 (100%)	596

Table 1 shows the distribution of men and women in the IT job categories. Results show that jobs are not equally distributed among men and women ($\chi^2= 91.6, p<0.001$). Men hold technical positions more often: nearly 90% of the technicians (technical support/field technician) and more than two-thirds of the developers (application software developers and system programmer/network software developer) are male. Women hold analyst positions more often. Nearly two-thirds of the analysts (application analyst; business analyst/consultant; database analyst/database architect and systems analyst/system architect/applications engineer) are female. A greater proportion of women in our sample hold positions in telecommunications and training, and more women hold managerial jobs than men (see Table 4).

Questionnaire

The dimensions and variables identified in the literature review were incorporated in the first version of a questionnaire, which was tested in interviews with key IT personnel. Based on the interviews, changes were made to the questionnaire, to address the specific problems of the IT work force (see Carayon, et al. [95]). The final version of the questionnaire consists of five sections: (1) personal characteristics: age, education and organizational tenure; (2) job and organizational characteristics; (3) HRM practices; (4) quality of working life; and (5) turnover intention. To measure job and organizational

characteristics, HRM practices and quality of working life we used existing scales that were found to be valid and reliable in previous research. All scales we used in the questionnaire were converted to scores from 0 (lowest) to 100 (highest). The measures of job and organizational characteristics included the following scales: job demands for the IT workforce (adapted from Quinn, et al. [96]; $\alpha = 0.87$); role ambiguity (Caplan, et al. [97]; $\alpha = 0.87$); decision latitude (McLaney, et al. [98]; $\alpha = 0.89$); work-related challenges (Seashore, et al. [99]; $\alpha = 0.82$); person-organization fit (adapted from Nixon [100]; $\alpha = 0.86$); and social support at work, consisting of supervisory support (Caplan, et al. [97]; $\alpha = 0.83$) and colleague's support (Caplan, et al. [97]; $\alpha = 0.79$). The measures of HRM practices included the following scales: training opportunities (developed in our pilot study; Carayon, et al. [101]; $\alpha = 0.92$); development opportunities (adapted from Igbaria, et al. [102]; $\alpha = 0.85$); career advancement (adapted from Nixon [103]; $\alpha = 0.81$); and fairness of rewards (adapted from Vandenberg, et al. [86]; $\alpha = 0.84$). The following quality of working life scales were used: job satisfaction (Quinn, et al. [96]; $\alpha = 0.78$); organizational commitment (Cook, et al. [104]; $\alpha = 0.72$); and the core measure of burnout, emotional exhaustion (Maslach, et al. [105]; Leiter, et al. [106]; $\alpha = 0.91$). Turnover intention was measured using a single item: "How likely is it that you will actively look for a new job next year?" on a seven point scale ranging from 1, not at all likely, to 7, extremely likely (mean = 2.87, sd = 1.83). For a full description of the measures used, see Carayon, et al. [95]. Our analysis showed the measures to be reliable and valid [95].

Analysis

To test hypotheses H1 (Job and organizational factors and HRM practices affect QWL and intention to turnover) and H2 (QWL affects intention to turnover) we used correlation analysis. Hierarchical regression analysis was used to test H3 (QWL mediates the relationship between job and organizational factors and HRM practices, and turnover intention), following the procedure suggested by Baron and Kenny [93]. According to Baron and Kenny, to demonstrate mediation, three conditions must be met. First, the presumed independent variables (job and organizational factors and HRM practices) must

be related to the presumed mediator (the QWL variables). Second, the presumed mediator (QWL) must be related to the presumed dependent variable (turnover intention). Third, a previous significant relationship between the independent variables (job and organizational factors and HRM practices) and the dependent variable (turnover intention) must no longer be significant when controlling for the mediator (QWL). When we tested for the mediating effect of QWL, we first controlled for personal characteristics (age, education, tenure and salary).

We used t-tests and cross-tabulations to test the *direct* effect of gender on job and organizational factors and HRM practices, QWL and turnover intention (H4). If the results of the t-tests and cross-tabulations show significant gender differences in job and organizational factors and HRM practices, QWL and turnover intention, H4 will be accepted.

To test the *moderating* effect of gender (H5) we used path analysis. We started with a full model, including all variables and pathways as proposed in the conceptual model. Next, we improved the path model by removing nonsignificant variables and paths. The improved path model was tested separately for men and women to test for a moderating effect of gender (H5).

RESULTS

Hypotheses 1 and 2

Personal characteristics are only weakly related to job and organizational characteristics and HRM practices, quality of working life and turnover intention. The job and organizational characteristics and HRM practices are interrelated and correlated with QWL and turnover intention. Two of the QWL variables (job satisfaction and emotional exhaustion) are highly correlated and show a strong association with turnover intention, but are weakly correlated with organizational commitment. Organizational commitment is not significantly correlated with turnover intention. The results of the correlation analysis confirm H1 (Job and organizational factors and HRM practices affect QWL and intention to turnover) and partly confirm H2 (QWL affects intention to turnover) (see also Table 2).

Table 2: Pearson correlations between demographic characteristics, job and organizational characteristics, QWL and turnover intention. Correlations for women above the diagonal; for men below the diagonal.

	Age	TE	EDU	IT-EDU	SA	JD	RA	DL	CH	SS	CS	HS	FJ	JF	PO	TO	DO	CO	RE	JS	OC	EE	TI
Age		.21**	.21**	.07	.33***	.05	-.03	.11	.12	-.06	-.04	-.15	-.10	.03	-.09	0.01	-.02	-.15	-.04	.10	.12*	-.13*	-.15*
TE	.42**		-.02	-.09	.18**	.22**	-.13*	.20**	.18**	.07	.07	-.01	.04	.04	.05	.06	-.01	.01	-.11	.05	.02	-.04	-.07
EDU	.12*	-.06		.25**	.33***	.06	.03	.14*	-.01	-.08	-.07	-.04	.09	.08	.04	0.11	-.08	-.06	.02	.06	.14*	.05	-.01
IT-EDU	-.08	-.15**	.34**		.07	-.07	-.04	.05	.08	.01	.04	-.08	.05	-.06	-.02	.01	-.06	-.06	.01	.07	.05	.00	-.07
SA	.17**	.08	.27***	.20***		.29***	-.09	.59***	.34***	.09	.03	-.05	-.01	.08	.15*	.32***	.12	.14*	.20**	.26***	.15*	-.11	-.23***
JD	.05	.09	.07	-.02	.30***		.01	.31**	.30**	-.19**	-.13*	-.04	.15*	.48**	0.03	.01	.02	-.07	-.10	-.09	.10	.38**	.14*
RA	-.02	.01	-.05	-.09	.05	-.01		-.31**	-.39**	-.45**	-.36**	-.18**	.08	.19**	-.43**	-.37**	-.12	-.32**	-.36**	-.34**	-.05	.33**	.31**
DL	.04	.14*	.20**	.07	.37***	.31**	-.11*		.48**	.26**	.25**	.06	.01	.09	.30**	.43**	.11	.32**	.30**	.39**	.12*	-.18**	-.23**
CH	.15**	.03	.10	.04	.27***	.39**	-.27**	.28**		.33**	.25**	.03	.04	.02	.30**	.42**	.27**	.41**	.37**	.48**	.16**	-.24**	-.43**
SS	-.09	-.06	-.02	.13*	-.08	-.08	-.35**	.12*	.22**		.41**	.12	-.05	-.33**	.45**	.45**	.32**	.54**	.60**	.55**	.06	-.49**	-.49**
CS	-.06	-.06	.08	.07	.00	-.07	-.18**	.12*	.15**	.37**		.25**	.04	-.17**	.48**	.27**	.26**	.35**	.30**	.38**	.18**	-.33**	-.24**
HS	-.08	-.25**	.02	.03	.10	-.01	-.22**	.03	.14*	.18**	.25**		-.011	-.13*	.11	.15*	.14*	.15*	.11	.01	.04	-.10	.08
FW	-.05	-.02	.09	.08	.12*	.17**	.06	.10	-.03	.00	.07	-.08		.47**	-.02	-.01	.12	-.11	-.12	-.12	-.13*	.30**	.04
WF	-.01	.01	.04	.02	.21***	.51**	.10	.07	.14*	-.24**	-.12*	-.05	.42**		-.15*	-.13*	-.08	-.25**	-.26**	-.33**	-.04	.59**	.30**
PO	-.11	-.05	.09	.00	.13*	.05	-.22**	.28**	.31**	.34**	.47**	.17**	.02	-.06		.30**	.25**	.43**	.42**	.43**	.27**	-.36**	-.31**
TO	-.04	.04	.00	.08	.03	-.05	-.33**	.20**	.31**	.40**	.24**	.08	-.12*	-.16**	.41**		.27**	.54**	.52**	.48**	.19**	-.29**	-.32**
DO	-.18**	-.23**	.01	.15*	.00	.06	-.16**	.08	.18**	.37**	.19**	.12*	.07	.06	.29**	.28**		.28**	.28**	.26**	.04	-.16*	-.29**
CO	-.18**	-.08	.08	.11*	.05	.05	-.25**	.35**	.40**	.45**	.27**	.13*	.02	-.16**	.45**	.52**	.33**		.65**	.52**	.16**	-.50**	-.42**
RE	.01	-.01	.03	.11*	.09	-.03	-.30**	.22**	.30**	.53**	.26**	.08	-.02	-.22**	.42**	.52**	.28**	.64**		.55**	.22**	-.46**	-.48**
JS	.02	.02	.08	.09	.09	-.03	-.34**	.23**	.45**	.36**	.25**	.11	-.07	-.25**	.45**	.40**	.22**	.54**	.54**		.25**	-.61**	-.67**
OC	.01	-.02	.01	.06	.10	.07	-.19**	.21**	.19**	.10	.17**	.17**	-.06	-.03	.27**	.09	.15*	.19**	.12*	.14*		-.16**	-.09
EE	-.08	.06	-.13*	-.10	.05	.40**	.23**	.00	-.03	-.26**	-.16**	-.06	.24**	.56**	-.23**	-.24**	-.13*	-.27**	-.30**	-.45**	-.08		.50**
TI	-.06	-.05	-.05	-.04	-.04	.08	.28**	-.11*	-.21**	-.35**	-.17**	-.04	-.03	.21**	-.32**	-.33**	-.19**	-.41**	-.45**	-.51**	-.11	.41**	

* Significant at the p<0.05 level; ** significant at the p<0.01 level, *** significant at the p<0.001 level

Hypothesis 3

Table 3 shows the results of the regression analysis.

Table 3: Hierarchical regression analysis of turnover intention on personal characteristics, job and organizational characteristics, HRM practices, QWL and gender (N=519)

Step		Model 1			Model 2			Model 3			Model 4		
		Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.	Beta	t	Sig.
1	Age	-0.08	-1.73	.08	-0.11	-2.54	.01	-0.05	-1.44	.15	-0.07	-1.77	.07
	Tenure	-0.04	-0.88	.38	-0.04	-0.94	.35	-0.03	-0.96	.34	-0.04	-0.97	.34
	Highest Level of Education	0.02	0.35	.73	-0.01	-0.16	.91	0.02	0.59	.56	0.01	0.37	.71
	IT Education in Formal Schooling	-0.04	-0.94	.35	0.01	0.23	.82	-0.01	-0.15	.88	0.01	0.29	.77
	Salary	-0.11	-2.46	.01	-0.08	-1.76	.08	-0.03	-0.95	.34	-0.07	-1.50	.13
2	Job Demands				0.10	2.13	.03				0.04	0.82	.42
	Role Ambiguity				0.10	2.21	.03				0.06	1.64	.10
	Decision Latitude				0.04	0.84	.40				0.06	1.43	.15
	Challenge				-0.15	-3.25	<.001				-0.05	-1.18	.24
	Supervisory Support				-0.11	-2.17	.03				-0.08	-1.65	.10
	Colleague Support				0.03	0.68	.50				0.04	1.07	.28
	Home Support				0.09	2.40	.02				0.07	1.84	.07
	Family Life Spills over into Job				-0.10	-2.43	.02				-0.11	-2.75	.01
	Job Spills over into Family Life				0.17	3.55	<.001				0.07	1.30	.19
	P-O Fit				-0.07	-1.48	.14				-0.02	-0.42	.68
	Training Opportunities				0.03	0.53	.59				0.03	0.69	.49
	Developmental Opportunities				-0.08	-2.00	.05				-0.07	-1.71	.09
	Career Advancement Opportunities				-0.13	-2.35	.02				-0.05	-0.99	.32
Fairness of Rewards				-0.18	-3.42	<.001				-0.12	-2.33	.02	
3	Job Satisfaction							-.49	-12.24	<.001	-0.35	-7.03	<.001
	Organizational Commitment							.02	0.63	.53	-0.02	0.59	.56
	Emotional Exhaustion							.19	4.91	<.001	0.14	2.70	.01
4	Gender										-0.04	-1.06	0.29
	R ²	3%		**	36%		***	38%		***	44%		***

* Significant at the p<0.05 level; ** significant at the p<0.01 level, *** significant at the p<0.001 level

The significant effects of the personal characteristics (age, tenure, education and salary) become insignificant after controlling for the other variables. Job and organizational characteristics and HRM practices are significantly associated with turnover intention. Two of the three QWL variables (job satisfaction and emotional exhaustion) completely mediate the relationship between turnover intention and job and organizational characteristics (job demands, role ambiguity, decision latitude, challenge, supervisory support, support from colleagues, support from home, person-organization fit, job spills over into family life) and HRM practices (training, development and career advancement opportunities). “Family life spills over into job” and the fairness of rewards are not fully mediated by QWL. Therefore, H3 (the relation between job and organizational characteristics and turnover intention is mediated by QWL) is only partly confirmed. Results of the separate regression analyses for men and women show some gender differences. For men, there is a direct effect of “family spills over into work” on turnover intention; for women there is not. For women, the direct effect of (lack of) challenge on turnover intention is still significant after the mediating effects of the QWL variables.

Hypothesis 4

Table 4 shows the results of a comparison between men and women on the variables in the model: there are relatively few significant gender differences. Women in the sample are significantly older; have a significantly higher level of education; are more likely to hold a managerial job type; have more years of tenure in the organization; earn significantly less money; receive less supervisory support; have more developmental opportunities; and are more committed to their organization. Except in the case of supervisory support, H4 (Female employees are more likely to be exposed to ‘negative’ job and organizational factors and/or can benefit less from HRM practices, will report lower QWL and higher intention to turnover) can be rejected.

Table 4: Demographic characteristics, job and organizational characteristics, HRM practices, QWL and turnover intention by gender

		Men	Women
N		324 (54%)	273 (46%)
Age*		38.8	40.9
Education (ED)*	High school or GED	4.9%	4.4%
	Some college	25.3%	12.8%
	Bachelors degree	38.9%	37.4%
	Some graduate or professional study	12.3%	15.4%
	Graduate or professional degree	22.5%	30.0%
Job type*	Professional	75.5%	66.5%
	Managerial	21.1%	25.7%
	Other	3.5%	7.8%
Tenure (TE)*		4.9	6.0
Salary (SA)*		~\$68,000	~\$62,000
IT Job Demands (JD)		55.7	56.9
Role Ambiguity (RA)		70.1	70.3
Decision Latitude (DL)		42.8	41.8
Challenge (CH)		71.4	71.9
Supervisory Support (SS)*		73.4	69.2
Support from Colleagues (CS)		68.7	69.2
Family Life Spills over into Work (FW)		44.5	42.3
Work Spills over into Family Life (WF)		48.6	49.3
Person-Organization Fit (PO)		72.6	71.2
Training Opportunities (TO)		56.0	58.0
Developmental Opportunities (DO)*		71.8	76.4
Career Advancement Opportunities (CO)		51.2	53.4
Fairness of Rewards (RE)		58.1	59.6
Job Satisfaction (JS)		75.5	74.3
Organizational commitment (OC)*		79.6	82.7
Burnout (EE)		33.6	35.6
Turnover Intention (TI)		2.57	2.47

* Differences between men and women are statistically significant at $p < 0.05$.

Hypothesis 5

To test hypothesis 5, we started with a full path model (M1) that includes all variables in the three blocks of conceptual and personal characteristics. This model shows an insufficient fit (see table 5). Next, we improved the full model by deleting all insignificant variables and pathways (for details of the improvement process, see Hoonakker, et al. [107]). In the final model (M2), all relations between job and organizational characteristics and HRM practices are mediated by two QWL variables:

emotional exhaustion and job satisfaction (see figure 3). There are three exceptions, direct paths between “family life spills over into working life” and turnover intention, lack of work-related challenges and turnover intention, and fairness of rewards and turnover intention. To test hypothesis 5 (Gender moderates the relation between job and organizational factors and HRM practices and QWL, and also moderates the relationship between QWL and turnover intention.) we conducted a multi-group analysis (see Table 5).

Table 5 Goodness of fit statistics*

	χ^2	df	p	GFI	AGFI	NFI	CFI	SRMR	RSMEA
Null Model (M0)	3416.8	153	<.001	.45	.39	.00	.00	.00	.190
Full model (M1)	1034.4	89	<.001	.85	.71	.71	.71	.170	.130
Final model (M2), full sample	62.9	35	.003	.99	.96	.98	.99	.030	.036
Improved model for men	36.0	35	.42	.99	.95	.98	1.00	.029	.001
Improved model for women	55.1	35	.02	.97	.92	.97	.99	.044	.046

As the goodness of fit statistics show, the model fits the data for men better than for women. Results of multi-groups analysis show that that both the structural weights (Beta-coefficients) and covariances (correlations between job and organizational characteristics and HRM practices) differ statistically significant for men and women ($\chi^2 = 32.7$, $df=20$, $p=0.04$ and $\chi^2 = 100.9$, $df=66$, $p=0.03$ respectively). Therefore, hypothesis 5 is confirmed. Figure 3 shows the turnover models for men and women separately. Only the significant paths between job and organizational characteristics, HRM practices, QWL and turnover intention are shown. Correlations between job and organizational characteristics and HRM practices are not shown. These correlations are the same as in the correlation table (Table 2).

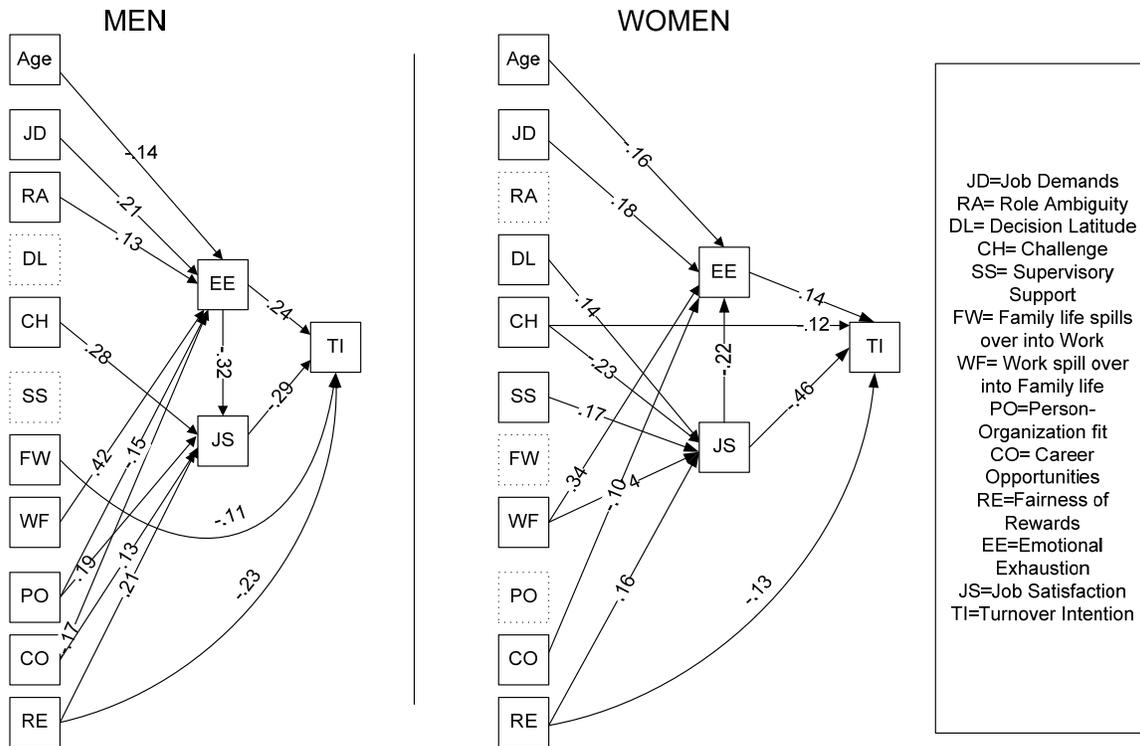


Figure 3 Turnover models for men and women

Results of the path analysis confirm the central role of two of the QWL variables, emotional exhaustion and (lack of) job satisfaction, in the model. Results also show that over half of the relationships between job and organizational characteristics and turnover intention in the model for men are mediated by emotional exhaustion. In the model for women over half of the relations are mediated by (lack of) job satisfaction. In the model for men there are direct relationships between “family life spills over into work” and “fairness of rewards” and turnover intention. In the model for women there are direct relations between “(lack of) work-related challenges” and “fairness of rewards” and turnover intention. In the male model, supervisory support and decision latitude do not play a significant role. In the female model, family life spills over into work and person-organization fit do not play a significant role.

Discussion

Turnover has been a problem for IT organizations since the 1960s. Since then, several studies have been conducted to shed light on the problem. In our study we examined a range of job and organizational characteristics (JOC), human resources management practices (HRMP) and quality of working life (QWL) variables that are related to turnover intention. Notably, the HRM practices addressing the retention of personnel have received little attention in the turnover literature. Based on a review of the literature, we developed a conceptual turnover model for the IT workforce. Most of the turnover literature assumes that the relation between JOC and HRMP is mediated by QWL, and there is relatively little literature that examines possible direct effects of JOC and HRMP on turnover intention. Therefore, we examined the direct effects of JOC and HRMP on QWL and turnover intention (hypothesis 1), the effects of QWL on turnover intention (hypothesis 2) and tested the mediating role of the QWL variables in the model (hypothesis 3). Results show JOC and HRMP are related to QWL and turnover intention, that QWL is related to turnover intention, and that QWL, and more particularly job satisfaction and burnout, indeed mediates most of the relations between JOC and HRMP and turnover intention. This means that hypotheses 1-3 are in principal accepted. However, organizational commitment, one of the QWL variables that in previous research has shown to be strongly related to turnover intention does not play a significant role in our model. Furthermore, there are three variables that have a direct effect on turnover intention: “family life spills over into the job” (in particular for men); “lack of work related challenges” (in particular for women); and fairness of the reward system (for both men and women). But in general, our turnover model, in which the relations between JOC and HRMP are mediated by QWL, does fit the data. The validity of the model has been confirmed in a transnational study [108].

The turnover rate of women can exceed 2½ times the turnover rate of men [19, 109-113]. Attrition data on female scientists and engineers show that their exit rates are not only double those of men (25% versus 12%), but they are also much higher than those of women in other employment sectors [15]. The proportion of women in the IT workforce has declined from 41% in 1996 to 29% in 2004. There is comparatively little research

examining how JOC and HRMP affect *women* in IT work. The research conducted by Igarria and colleagues [18, 24, 27, 102, 114, 115] provides a useful foundation, but does not provide a systematic test of JOC and especially HRM practices in relation to turnover for gender. We tested whether gender has a direct effect on JOC and HRMP, QWL and turnover intention (hypothesis 4), or whether gender moderates these relationships (hypothesis 5). We found very few gender differences in JOC, HRMP, QWL and turnover intention and the differences that are statistically significant show that women are less exposed to negative job and organizational factors and report higher QWL, except in the case of supervisory support. Female employees receive less supervisory support than their male colleagues (see Table 4). Therefore, hypothesis 4 is rejected. We did find that the relationships between JOC, HRM, QWL and turnover intention are statistically different for men and women. Therefore, hypothesis 5, gender moderates the relationships between JOC, HRMP, QWL and turnover intention is accepted.

These results are interesting, because results of several studies on turnover in the IT workforce in the 1990s, especially by Igarria and colleagues [115-118] did show gender differences in JOC, HRMP, QWL and turnover intention. Igarria and colleagues explained these gender differences from a human-capital perspective. According to the human-capital paradigm continued gender (and racial) discrimination can be explained because individuals are rewarded in their jobs for their investment in education and job training [119]. The paradigm suggests that women accumulate less human capital (knowledge and skills derived from on-the-job training and continuous work experience) than men do, because women have lower educational levels, less experience and fewer skills, particularly in professional and managerial areas [118]. In several of their studies, Igarria and colleagues found support for the human-capital paradigm: women in their studies were less experienced, lower educated, earned less, and less often held managerial positions [115, 118]. Historically, women have had lower levels of educational attainment [120, 121], which in turn could negatively affect their opportunities in the labor market. However, in the past decade, this has changed dramatically. In general, more women have completed college, and more women have received Bachelor's and Master's degrees than men. Only in the highest level of education (Ph.D.), men hold more degrees than women [120, 122]. Although women have made tremendous progress

in social sciences, history, psychology, biological sciences/life sciences, business management and administrative services where they have attained relative gender parity or made up the majority in 2001, other fields such as computer and information sciences, physical sciences, science technologies, and engineering continue to have a larger proportion of males. However, the percentages of females majoring in those fields is increasing [121]. Female employees in our sample are statistically more highly educated than men. Significantly more women than men hold a graduate or professional degree. There are also relatively few gender differences in training opportunities or satisfaction with training opportunities [123]. Thus, the fact that there are no gender differences in educational attainment and training can possibly explain why we do not find gender differences in JOC, HRMP, QWL and turnover intention. In three other recent studies in the IT workforce, few gender differences were found. Campbell, et al. [124] found no gender differences in job satisfaction and career advancement opportunities. Major, et al. [125], too, found no gender differences in job satisfaction. Men and women were equally satisfied with several aspects of their jobs such as pay, supervision, the social environment and opportunities for growth. One of the few gender differences in their study was with regard to organizational commitment. Women were equally committed to their organization but were less committed to a career in IT. They were less likely to view IT as their “life’s work” than men [125]. O’Leary-Kelly, et al. [126, 127] also found few gender differences in IT workforce experiences such as burnout, perceptions of fair treatment, supervisory support related to family issues, pays, rewards and burnout. However, these studies did not examine possible differences in the *relationships* between the concepts.

And that is another interesting result of our study: gender moderates the relationship between JOC, HRMP, QWL and turnover intention. Women do not perceive job and organizational characteristics and HRM practices differently than men, but they perceive *the relationships between those concepts and the relation with QWL and turnover intention differently* than men. Why do the relationships between job and organizational characteristics, QWL and turnover intention vary across gender? The most striking difference in the relationship between the different concepts is that for women, job satisfaction plays a crucial role. In their study on gender differences in turnover intention,

Giacobbe Miller, et al. [111] found that turnover intention among women was twice as high as men in comparable occupations. However, after controlling for age and job dissatisfaction, the gender effect disappeared. The researchers also found that meaningfulness of work was a strong predictor of intention to leave for women. We found similar results in a study on gender differences in job and organizational factors as predictors of quality of working life [128]. For female employees in the IT department of a large public organization, *task identity* was one of the most important factors explaining gender differences in quality of working life (job strain, job commitment and job satisfaction). Task identity is the extent to which employees do an entire piece of work (instead of small parts) and can clearly identify the results of their effort [129]. Campbell, et al. [124] found similar results. They found that the only gender differences in job satisfaction was that women more often than men found failure to see much meaning in their work a more frequent source of job dissatisfaction. This can also explain why lack of work-related challenges has a direct effect on turnover intention for women and not for men.

Results of our study also show that for women, supervisory support is associated with job satisfaction. However, in the model for men supervisory support does not play a significant role. In a study focusing on the reasons why college-educated women change employment, Allen, et al. [130] found similar results. For women, supervisory support was a key element in the relation between commitment, satisfaction and reasons for leaving their jobs.

For men, family life spilling over into work is directly, negatively associated with turnover intention, but not for women. It could mean that men do not want to leave their jobs until the family issues that affect their work have been resolved. However, for women there are no significant relationships between family life spilling over into work and QWL and turnover intention. Armstrong, et al. [131] found similar results in a study of voluntary turnover of women in IT. They found that for women, family responsibilities did not cause stress; only work responsibilities caused stress. They explained this finding by using Cinamon, et al.'s [132] argument that from a women's perspective, if the family interferes with work, it is troublesome but natural, whereas if work interferes with family

responsibilities it is seen as less appropriate and is more likely to be perceived as a conflict that creates stress (Amstrong, et al., 2004).

Obviously, our results have consequences for retention of men and women in the IT work force. For both men and women, most of the relations between job and organizational characteristics, HRM practices and turnover intention are mediated by quality of working life (i.e. job satisfaction and burnout). Therefore, it is imperative for organizations to keep their personnel satisfied and to prevent burnout of their employees.

Further, for both men and women, there is a direct relation between fairness of rewards and turnover intention. Therefore, in order to retain their IT personnel, companies should create a system that guarantees the fairness of the reward system. Attention should be paid for example to the relationship between how well employees perform and the likelihood of receiving recognition and praise, receiving a raise in pay and receiving high performance appraisal ratings.

Finally, our results show that work-family conflict also plays an important role. For both men and women in the study, work spills over into family life is strongly related to burnout. Burnout in turn is strongly related to turnover intention. Therefore, IT companies should examine the possibility of offering family-friendly practices, to better balance work and family. Results of analysis on effective Human Resource Management practices to retain personnel have shown that offering family-friendly practices, such as telecommuting and part time work to retain IT personnel can be effective. IT personnel who can make use of these options, who think the options are sufficient for their needs and who do not feel discouraged from taking advantage of these options are significantly more willing to stay with their company. Research has shown that employees who can take advantage of these practices are more than three times more likely to remain with their company [133].

The study limitations include the fact that data was collected from only five companies, therefore limiting the generalizability of the results. Also, these data are cross-sectional which limits the interpretation regarding causal relationships between job/organizational factors and turnover intention. Finally, this research is focused on turnover intention, not actual turnover.

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5. Paper 4

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Quality of Working Life and Turnover Intention in Information Technology Work

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ABSTRACT

High turnover has been a major issue in information technology (IT) organizations. A conceptual model to explain turnover was developed and tested in two national samples of IT and IT manufacturing work. The model postulates that quality of working life mediates the relations between job/organizational characteristics and turnover intention. The American sample consisted of 624 IT employees of five IT organizations. The Austrian sample consisted of 677 employees from an international IT production company (IT manufacturing work). A similar questionnaire was used in both studies. The model was tested with path analysis. A core model with main pathways between job demands and supervisory support to emotional exhaustion, and between emotional exhaustion and job satisfaction to turnover intention was confirmed in the national samples and in subsamples of demographics and job types.
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1. INTRODUCTION

Turnover has been a major issue pertaining to information technology (IT) personnel since the very early days of computing and continues in the present (Moore, 2000a; Niedermann & Summer, 2003). IT workers have a strong tendency to leave a current employer to work for another organization. Ever since statistics have been kept, IT turnover has been a problem. Turnover has also been an issue of increased importance in manufacturing companies (Smith, Daskalaki, Elger, & Brown, 2004).

Turnover of skilled employees can be very expensive and disruptive for firms (Reichheld, 1996). Losing highly skilled staff members means that companies incur substantial costs associated with recruiting and reskilling, and hidden costs associated with difficulties completing projects and disruptions in team-based work environments (Niedermann & Summer, 2003). At least of similar importance is the fact that turnover intention and turnover decisions may also be an indicator of low and decreased quality of working life (QWL).

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Both job and organizational design approaches have been suggested to reduce employee turnover. An *Information Week* salary survey showed that IT workers ranked challenge of their job, responsibility, and job atmosphere as more important than their base salary. QWL, job stability, and learning opportunities through job assignments dominated the responses (Meares & Sargent, 1999). Organizational design has also been suggested as an important solution component. A multitude of innovative human resource management practices have been put forward as potential or partial solutions: mentoring programs, educational opportunities, flexible hours, and telecommuting options, among many others (Carver, 2000; Commission on the Advancement of Women and Minorities in Science, Engineering and Technology Development, 2000; Information Technology Association of America, 2000; Meares & Sargent, 1999; Office of Technology Policy, 1997).

Besides job and organizational factors, QWL has been found to be a key predictor for turnover intention and turnover decisions. There are many factors that can influence job satisfaction, organizational commitment, turnover intention, and eventually actual turnover. However, there is little literature on the effectiveness of retention practices.

In the following section, we present an overview of literature on quality of working life and turnover intention in IT and IT manufacturing work. Based on the literature and interviews with key IT personnel in a pilot study (Carayon, Haims, Brunette, & Hoonakker, 2002b; Carayon, Schoepke, Hoonakker, Haims, & Brunette, 2006), a conceptual model aiming to explain turnover intention has been developed. The model has been transformed in a measurement model and tested cross-nationally in two large samples of IT and IT manufacturing workers in the United States and in Austria. Based on the results of the model test, practical recommendations to reduce employee turnover are discussed.

2. THEORETICAL BACKGROUND

There is a wealth of literature on the relation between QWL and turnover. QWL has been defined by many researchers in a variety of ways, such as quality of work (Attewell & Rule, 1984) and employment quality (Kraut, Dumais, & Koch, 1989). Davis (1983) defined QWL as “the quality of the relationship between employees and the total working environment, with human dimensions added to the usual technical and economic considerations” (p. 80).

Low job satisfaction was found to be a significant predictor of turnover intention and turnover in the widely accepted turnover intention model of Mobley, Horner, and Hollingsworth (1978), which was at least partly confirmed in follow-up studies (e.g., Bannister & Griffeth, 1986; Hom, Caranikas-Walker, Prussia, & Griffeth, 1992). Also, the meta-analysis of Griffeth, Hom, and Gaertner (2000) confirmed the important role of job satisfaction for turnover intention and turnover.

Other empirical studies confirm the important role of organizational commitment in the turnover process (Baroudi, 1985; Blau & Boal, 1987; Cotton & Tuttle, 1986; Sjoberg & Sverke, 2000). It has also been reported that organizational commitment is more strongly related to turnover intention than job satisfaction (Baroudi, 1985). Thus, considerable research has linked job satisfaction to organizational commitment and turnover (Baroudi, 1985). It has been suggested that satisfaction and organizational commitment are related but distinguishable attitudes: Commitment is an affective response to the entire organization, whereas job satisfaction represents an affective response to more specific aspects of the job (Porter, Steers, Mowday, & Boulian, 1974). However, the results of the study by Igbaria and Greenhaus (1992) showed that job satisfaction has a stronger, direct effect on turnover intention than organizational commitment.

Another powerful factor that prior research has repeatedly shown to be significantly correlated to organizational commitment, job satisfaction, and turnover intention is burnout (Moore, 2000b). Research has shown that emotional exhaustion (a core dimension of burnout) is linked to reduced job satisfaction (Burke & Greenglass, 1995; Maslach & Jackson, 1986; Pines, Aronson, & Kafry, 1981; Wolpin, Burke, & Greenglass, 1991); reduced organizational commitment (Jackson, Turner, & Brief, 1986; Leiter & Maslach, 1988; Sethi, Barrier, & King, 2004); and high turnover and turnover intention (Firth & Britton, 1989; Jackson et al., 1986). The research literature suggests that technology professionals are particularly vulnerable to work exhaustion (Kalimo & Toppinen, 1995; Moore, 2000a).

The different facets of QWL—job satisfaction, organizational involvement, and stress—are assumed to mediate the relationship between job organizational factors and intention to turnover (Igarria & Greenhaus, 1992; Parasuraman, 1982; Smith & Carayon-Sainfort, 1989).

The organizational/job design and job stress models highlight the importance of a variety of job and organizational factors as predictors of QWL and turnover (Carayon, Haims, & Yang, 2000). The most important job and organizational factors identified in the literature are: job demands, job control, social support, job content, role conflict, and role ambiguity (Carayon & Smith, 2000; Cooper & Marshall, 1976; Karasek, 1979; Theorell & Karasek, 1996).

The human resources management (HRM) literature stresses the importance of factors such as training and career opportunities and a fair reward system. For example, Huselid (1995) and Vandenberg, Richardson, and Eastman (1999) examined the impact of high involvement work processes upon organizational effectiveness. The results of these studies supported a model in which a set of organizational practices (work design, incentive practices, flexibility, training and career opportunities, and direction setting) positively influenced high involvement work processes (power, information, rewards, and knowledge). In turn, the high involvement processes influenced organizational effectiveness (i.e., employee turnover) both directly and indirectly, through positive influences on employee morale.

The literature on human resource management and the results of our pilot study identify a number of factors that, in addition to the job and organizational design factors listed in the previous section, can contribute to QWL and turnover: training, career advancement, development, and rewards (Huselid, 1995; Vandenberg et al., 1999).

Conceptual and empirical models of turnover provide strong support for the proposition that behavioral intentions to turnover constitute the most immediate determinant of actual turnover behavior (Bluedorn, 1982; Cotton & Tuttle, 1986; Igarria & Greenhaus, 1992; Mobley, 1977; Parasuraman, 1982). Parasuraman (1982) provided evidence that the most proximate predictor of actual voluntary turnover is the behavioral intention to turnover.

The research conducted so far provides a useful foundation, but does not provide a *systematic test* of job/organizational factors in relation to retention and turnover. Based on the research literature and interviews with key personnel in a pilot study (Carayon, Haims, et al., 2002; Carayon et al., 2006) we developed a conceptual model of turnover intention (Carayon, Brunette, Haims, & Hoonakker, 2002; Hoonakker, Carayon, Schoepke, & Marian, 2004), which was examined in this study. The model aims to integrate the study results presented above. It is comprised of four sets of variables: (1) job characteristics—job demands, role ambiguity, decision control, challenge in the job, supervisory support, and support from colleagues; (2) organizational characteristics—satisfaction with training, career and developmental opportunities, corporate integration, and rewards; (3) quality of

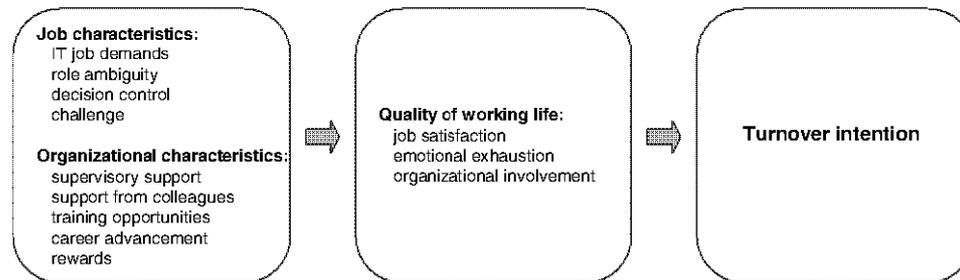


Figure 1 Conceptual turnover intention model.

working life—organizational involvement, job satisfaction, and emotional exhaustion; and (4) turnover intention (Figure 1).

In this study, the model has been tested in two large samples in a cross-national research design. A cross-national test allows us to evaluate the model relations in different working contexts. Thus, such an approach can be seen as a strong replication study. Furthermore, the model was tested for different gender, age, job tenure, job type, and education subsamples.

3. METHOD

3.1. Samples

The American sample consisted of 624 IT employees of five IT organizations in the United States. The response rate in the American study was 56%. The sample consisted mainly of white-collar IT workers ($N = 376$, lower educated IT professionals [high school level]; and $N = 248$, higher educated IT professionals [university level]). The American sample is largely representative for the IT work force in the United States with regard to gender and ethnicity.

The Austrian sample consisted of 677 employees of an international IT production company. The sample consisted of IT production (blue collar) workers ($N = 575$) and IT professionals and managers ($N = 102$). The response rate in the Austrian study was 74%. The education level of the sample in Austria was lower than that of the sample in the United States. With regard to company, production line, worker structure, and response rate, the sample is a representative example of (blue collar) IT manufacturing work in a Western country.

A comparable percentage of employees in both samples was older than 45 years (United States: $N = 175$, 28%; Austria: $N = 138$, 20%). Table 1 shows the descriptive statistics (means and standard deviations) and differences between the two samples.

The scale mean differences between the two samples confirm the different types of IT work (white collar/blue collar) in the two samples: As expected, the (white collar) American sample reported better working conditions than the (blue collar) Austrian sample. This is also reflected by higher job satisfaction and organizational involvement. Moreover, the employees in the Austrian sample showed less job support and lower job satisfaction as compared to the sample in the United States (Table 1). No significant differences were observed in turnover intention. The mean value of the turnover intention item was relatively low in both national samples.

TABLE 1. Comparison Between the American and the Austrian Samples

Scale	USA (<i>n</i> = 624)		Austria(<i>n</i> = 677)		t	p
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
IT Job Demands	53.3	20.0	50.7	14.1	2.69	.00
Role Ambiguity	29.8	20.3	31.1	20.2	-1.16	<i>ns</i>
Decision Control	42.7	28.9	29.7	22.5	8.99	.00
Challenge	71.8	21.1	53.5	21.1	15.5	.00
Supervisory Support	71.7	26.1	53.9	26.6	12.0	.00
Support from Colleagues	68.9	20.4	63.5	22.6	4.45	.00
Training Opportunities	56.1	21.1	40.8	24.1	11.3	.00
Career Advancement	55.4	19.0	38.4	18.1	16.3	.00
Rewards	58.7	19.4	40.8	17.8	17.0	.00
Job Satisfaction	75.1	23.8	56.8	25.5	13.1	.00
Organizational Involvement	80.1	15.7	68.5	20.8	13.0	.00
Emotional Exhaustion	34.4	37.1	33.6	25.6	.55	<i>ns</i>
Turnover Intention	25.2	30.7	24.1	28.3	.65	<i>ns</i>

Note: *M* = mean, *SD* = standard deviation, *ns* = nonsignificant. All scales are transformed to a range of 0–100.

3.2. Procedure

To collect data in the United States, we used a Web-based survey. For a detailed description of the Web-based survey system, see Barrios (2003). The participating company sent an e-mail notifying its employees of the survey, and 2 days later we sent the employees an e-mail describing the study, asking for their participation, and providing them with a link to our Web-based survey. An integrated part of the Web-based survey management system is an informed consent procedure.

In Austria, a paper-and-pencil version of the questionnaire was used. About 4 weeks before data collection, the employees were informed about the study by the top management. Data were collected directly at the company during the monthly employee information meetings. In both studies, participation was voluntarily and anonymously.

3.3. Questionnaire

Based on the research model, the questionnaire consisted of five sets of variables: (1) demographic variables—age, education, and organizational tenure; (2) job characteristics; (3) organizational characteristics; (4) quality of working life; and (5) turnover intention. To measure job and organizational characteristics and quality of working life we used existing scales that were found to be valid and reliable in previous research. All scales we used in the questionnaire were converted to scores from 0 (lowest) to 100 (highest). The measures of job characteristics included the following scales: job demands of the IT workforce (adapted from Quinn et al., 1971); role ambiguity (Caplan, Cobb, French, Harrison, & Pinneau, 1975); decision control (McLaney & Hurrell, 1988); challenge (Seashore, Lawler, Mirvis, & Cammann, 1982). Social support at work consisted of the following scales: supervisory support and colleague’s support (Caplan et al., 1975). The measures of organizational

characteristics included the following scales: training opportunities (developed in our study; Carayon, Hoonakker, Marchand, & Schwarz, 2003); development opportunities (adapted from Igarria & Wormley, 1992); career advancement (adapted from Nixon, 1985); corporate fit (adapted from Nixon, 1985); and rewards (adapted from Vandenberg et al., 1999). The following QWL scales were used: job satisfaction (Quinn et al., 1971), organizational involvement (Cook & Wall, 1980), and emotional exhaustion (Leiter & Schaufeli, 1996; Maslach & Jackson, 1986). Turnover intention was measured using a single item (“How likely is it that you will actively look for a new job next year?”; Seashore et al., 1982) on a 7-point scale ranging from 1 (not at all likely), 2–3 (somewhat likely), 4–5 (quite likely), to 6–7 (extremely likely). All measures used had been proven to be valid and reliable. For a description of the development and test of the questionnaire, see Carayon et al. (2006). The items for the questionnaire for the Austrian sample were carefully translated into the German language. Pretests were made to improve the scales. With regard to the context of the questionnaire, hardly any changes were made.

4. RESULTS

The model was tested with path analysis using AMOS 5.0. Table 2 shows the correlations between the model variables and provides information about scale consistencies in both samples.

Because of the large number of items used to operationalize the variables in our model, simultaneous consideration of all observed variables (i.e., items) would result in unreliable parameter estimates and insufficient power (Bentler, 1990). Therefore, we decided to use the scales and tested the model as a path model.

First, the conceptual model (Figure 1) had to be transformed in a full path model. The full path model includes the expected relations between job and organizational factors, quality of working life, and turnover intention (Figure 2).

We started the model tests with this full path model of relationships between demographics, job and organizational characteristics, social support, and QWL on the one hand, and QWL and turnover intention on the other (see Figure 2) and used the American sample. Two distinct but related concepts were tested: The first theoretical concept (see “Theoretical Background” section) postulates that job characteristics influence QWL and turnover intention. The second theoretical concept postulates that organizational characteristics, that is, human resource practices like training, career advancement, development, and rewards (Huselid, 1995; Vandenberg et al., 1999), can additionally contribute to QWL and turnover intention. Therefore, we chose not to allow for covariance between these constructs. However, we assumed that social support and especially supervisory support are related to both job and organizational characteristics. For example, supervisory support is associated with job demands and role ambiguity on the one hand, and with training and career opportunities, developmental opportunities, and rewards on the other. Therefore, we conceptually positioned social support between job and organizational characteristics. Thus, we allowed for covariance between the job characteristics, the organizational characteristics, and the social support variables, and between job characteristics and social support, as well as between organizational characteristics and social support. The model was tested in both national samples. We used the following fit indices: Goodness of Fit Index (GFI), Normative Fit Index (NFI), Comparative Fit Index (CFI), Standardized Root Mean Square Residual (SRMR), and Root Mean Square Error of Approximation (RSMEA; e.g., Bentler, 1990).

TABLE 2. Correlation Matrix of All Study Variables

	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1 Job Demands (6)	.83													
2 Role Ambiguity (4)	.66	.88												
3 Decision Control (4)	.01	.79	.91											
4 Challenge (4)	.30**	-.21**	.83	.84										
5 Supervisory Support (4)	.04	-.21**	.38**	.72	.78									
6 Support from Colleagues (4)	.12**	-.27**	.50**	.80	.39**	.87								
7 Training Opportunities (3)	-.10*	-.28**	.19**	.27**	.42**	.85	.85							
8 Career Advancement (5)	-.13**	-.32**	.23**	.30**	.24**	.35**	.41**	.87						
9 Rewards (8)	-.14	-.39**	.19**	.27**	.39**	.45**	.46**	.75						
10 Emotional Exhaustion (6)	-.20**	-.36**	.36**	.39**	.42**	.38**	.49**	.66						
11 Job Satisfaction (5)	-.01	-.34**	.31**	.36**	.24**	.55**	.47**	.62**	.88					
12 Organizational Involvement (2)	-.06	-.16**	.46**	.49**	.28**	.41**	.87	.51**	.52**	.85				
13 Turnover Intention (1)	-.01	-.26**	.33**	.40**	.29**	.45**	.46**	.75	.37**	.91				
14 Gender	-.04	-.23**	.39**	.40**	.22**	.38**	.49**	.66	-.24**	-.37**	-.34**			
15 Age	-.07	-.33**	.26**	.33**	.28**	.55**	.47**	.62**	-.29**	-.20**	-.19**	-.26**		
	-.16**	-.28**	.38**	.37**	.33**	.43**	.51**	.52**	.85	.53**	.55**	-.53**		
	.39**	.28**	-.09*	-.13**	-.24**	-.37**	-.23**	-.34**	-.37**	.91	.82	-.10*		
	.41**	-.14**	-.19**	-.20**	-.24**	-.29**	-.20**	-.19**	-.26**	.92	.81	-.49**		
	-.07	-.34**	.31**	.46**	.31**	.46**	.42**	.43**	.39**	-.44**	.19**	-.10*		
	-.18**	-.24**	.41**	.50**	.30**	.42**	.43**	.39**	-.44**	-.46**	.19**	-.49**		
	.08*	-.12**	.16**	.18**	.18**	.07	.13**	.16**	.17**	-.11**	.23**	-.08*		
	.01	-.26**	.15**	.20**	.20**	.21**	.21**	.12**	.20**	-.15**	.23**	-.10*		
	.11*	.30**	-.17**	-.32**	-.20**	-.41**	-.30**	-.40**	-.46**	.45**	-.59**	-.10*		
	.09**	.14**	-.18**	-.36**	-.13**	-.22**	-.20**	-.11**	-.19**	.31**	-.49**	-.08*		
	.03	-.01	-.03	.01	.01	-.08*	.05	.07	.06	.05	-.02	.10*	-.02	
	.19**	-.02	-.04	.01	.04	-.08*	-.01	-.04	-.12**	.12**	-.01	.05	-.05	
	.04	-.07	.02	.10**	-.01	-.05	-.15**	-.15**	-.06	-.05	-.03	.03	-.04	.07
	.11**	-.07	.08*	.14**	-.10*	-.03	-.13**	.04	.05	.04	.08*	-.01	-.19**	-.09*

Notes: Upper lines: United States; lower lines: Austria. Number of items in variable in parentheses. Diagonals: Cronbach alphas. * $p < .05$; ** $p < .01$.

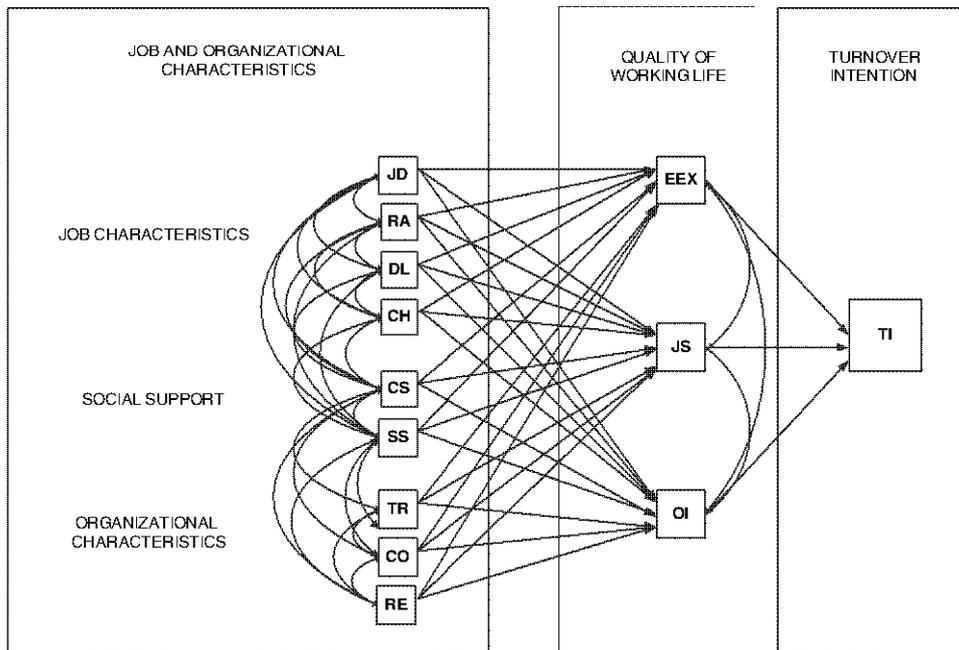


Figure 2 Full model of turnover intention.

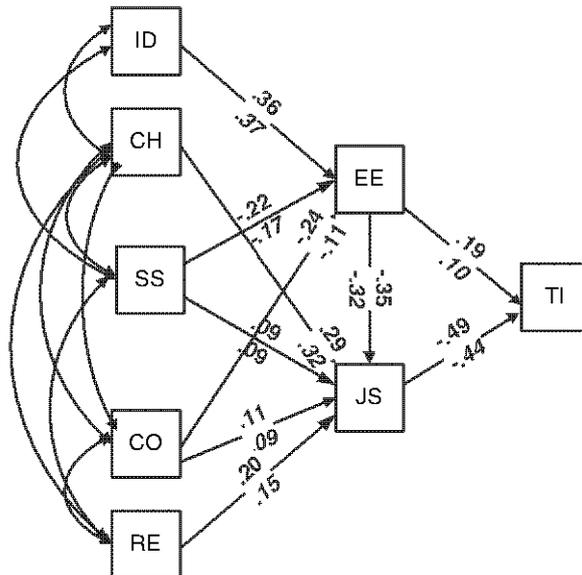


Figure 3 Optimized model (coefficients above arrows: U.S. sample; below arrows: Austrian sample).

The fit between the data and the model was not optimal (see Table 3). The model was therefore statistically optimized by first removing nonsignificant paths and then removing nonsignificant covariances between job and organizational characteristics and social support. In addition, we allowed for theoretically meaningful covariances between job and

organizational characteristics. The resulting core model of the optimization process is shown in Figure 3. This core model retains the originally proposed theoretical relations between job and organizational characteristics, QWL, and turnover intention. IT job demands and challenge are included as job characteristics, supervisory support as social support dimension, and career opportunities and rewards as organizational characteristics. A test of the core model shows a satisfactory goodness of fit (see Table 3).

Next, we replicated the test of the core model for the Austrian sample. To further test for stability of the core model, the model was tested separately for the combined data set, males and females, two age groups, three job types, and three job tenures. The main pathways between job demands and supervisory support to emotional exhaustion on the one hand, and between emotional exhaustion and job satisfaction to turnover were found to be similar in both national samples. Table 3 shows the model fit indicators for the two samples and data subsets.

For both national samples, the optimized model shows an acceptable model fit. In addition, similar model fits were found in the data subsets based on demographic variables. In both national samples, the best model fit is found in the subsets of older employees and higher

TABLE 3. Results of Structural Equation Modeling Analysis for the American and the Austrian Data Sets

	χ^2	Df	χ^2/df	GFI	NFI	CFI	SRMR	RSMEA
Full Model (USA, $n = 624$)	368.9**	41	9.0	.94	.86	.87	.11	.11
Optimized Core Model	54.08**	10	5.4	.99	.99	.99	.03	.06
USA ($n = 624$)	58.42**	10	5.8	.98	.97	.97	.05	.09
Austria ($n = 677$)	74.53**	10	7.4	.98	.95	.96	.06	.10
Total Sample ($N = 1301$)	54.08**	10	5.4	.99	.99	.99	.03	.06
Male ($n = 953$)	37.54**	10	3.7	.99	.99	.99	.03	.05
Female ($n = 322$)	29.16**	10	2.9	.98	.97	.98	.05	.08
Age: <45 ($n = 937$)	43.90**	10	4.4	.99	.99	.99	.04	.06
Age: >45 ($n = 373$)	17.71*	10	1.8	.99	.98	.99	.03	.05
Job: Blue Collar ($n = 555$)	67.52**	10	6.8	.97	.94	.95	.07	.10
Job: White Collar/Professional ($n = 435$)	49.68**	10	5.0	.97	.96	.97	.06	.10
Job: Managerial ($n = 225$)	18.52*	10	1.9	.98	.97	.99	.04	.06
Job Tenure: ≤ 3 ($n = 375$)	19.06*	10	1.9	.99	.98	.99	.03	.05
Job Tenure: 3–8 ($n = 366$)	16.38*	10	1.6	.99	.98	.99	.03	.04
Job Tenure: >8 ($n = 532$)	48.78**	10	4.9	.98	.97	.97	.04	.09

Note: χ^2 (Chi square) = difference between model and data; df = degrees of freedom (indicator of the model complexity); GFI = Goodness of Fit Index; NFI = Normative Fit Index; CFI = Comparative Fit Index, fit index adjusted for sample size; SRMR = (Standardized) Root Mean Square Residual, represents the average value across all standardized residuals; RMSEA = Root Mean Square Error of Approximation, takes the error of approximation in the population into account. Nonsignificant χ^2 and Goodness of Fit Indices in the 0.90s, accompanied by parsimonious fit indices in the 0.50s are not unexpected (Mulaik et al., 1989).

** $p < .01$. * $p < .05$.

educated employees. Therefore, the model test in the different samples led not only to a confirmation of the optimized model, but also showed further insights regarding the relevance of the model especially for older and well-educated IT employees.

The *core of the model* is formed by the pathways between IT job demands and emotional exhaustion ($\beta = .36/.37$); the pathway from emotional exhaustion to job satisfaction ($\beta = -.35/-.32$); the pathway between challenge and job satisfaction ($\beta = .22/.17$); and the pathways between career opportunities and emotional exhaustion ($\beta = -.24/-.11$) and job satisfaction ($\beta = -.11/-.09$). Supervisory support is related to emotional exhaustion ($\beta = -.22/-.17$) and job satisfaction ($\beta = .09/.09$). Rewards do have a direct effect on job satisfaction ($\beta = .20/.15$). (See Figure 3.)

To further confirm the stability of the model relations, invariant patterns in the causal path structure between the samples were analyzed by a simultaneous multigroup test using the core model of the total sample as a comparison group.

Country, sex, age, education, job types, and job tenure samples were each compared with the optimized model. Chi-square difference tests were calculated for each model comparison (c.f. Houkes, Janssen, de Jonge, & Nijbuis, 2001; Jöreskog, 1993). The Chi-square difference tests were found to be insignificant, confirming the general model of turnover intention. The path weights in the causal path structure were found to be invariant for the demographic variables (sex, age groups, and job tenure groups). Slightly higher regression weights between job satisfaction and turnover intention and between career advancement and emotional exhaustion were found in the American sample. Furthermore, slightly enhanced weights were also found between job demands and emotional exhaustion for blue-collar workers. All other weights were invariant. All in all, the sample comparisons indicate relatively stable pathways for the core model of turnover intention.

5. DISCUSSION

In this study we developed and tested a model explaining turnover intention in the IT workforce. The model was tested on a sample of IT work in the United States and a sample in Austria. The (white-collar IT work) American and (blue-collar manufacturing IT work) Austrian samples differ significantly in most job and organizational characteristics and quality of working life with exception for role ambiguity and emotional exhaustion. The model tests for an optimized turnover model fit both datasets and thus confirm the model as stable. Moreover, the model relations were found to be similar not only in the two national samples, but also for sex, age groups, tenure groups, and education. In other words, although the different groups differ significantly in the concepts measured, the relationship between the concepts is stable. The strongest relations are between job demands and emotional exhaustion, and emotional exhaustion and job satisfaction and turnover intention. It is surprising that decision latitude does not play an important role in the model. The stress literature (e.g., Karasek, 1979) shows that decision latitude can have a direct effect on job outcomes, such as job satisfaction, psychological well-being, and burnout (the strain hypothesis) as well as a moderating effect on the relation between job demands and various outcomes (the buffer hypothesis). In our study, we found a direct effect as well as a moderating effect of decision latitude on job satisfaction and emotional exhaustion. Shen and Gallivan (2004), using the same decision control items in a test of Karasek's model among IT users, had similar results. However, in our model to predict *turnover intention*, decision latitude becomes insignificant. Nevertheless, there is a wealth of literature on the "beneficial" effects of decision control on quality of working life (for a literature review

of the Karasek model, see van der Doef & Maes, 1999). Thus, one of the possibilities for retention is to give employees more control over their work. A second important factor is the relation between (lack of) challenge and emotional exhaustion on the one hand and (lack of) job satisfaction on the other. A second recommendation would be to make jobs more challenging. This is not a new concept. As mentioned in the introduction, turnover has been a problem for the IT workforce since the early days of computing. Therefore, there are many studies on turnover in the IT workforce. In most of these studies, (lack of) challenge has been found to be an important factor in predicting turnover. For example, Willoughby (1977) reviewed the literature on turnover intention in the '60s and early '70s. In his review he quotes a study conducted by the Association of Computer Programmers and Analysts (ACPA) among its members in 1970. The results of the study showed that lack of challenge was the most important reason for turnover.

A third factor that is related to turnover intention is supervisory support. Lack of supervisory support is associated with emotional exhaustion (e.g., Baruch-Feldman, Brondolo, Ben-Dayan, & Schwartz, 2002; Brown & O'Brien, 1998; Cherniss, 1980) and (lack of) job satisfaction (e.g., Baruch-Feldman et al., 2002; Eisenberger, Cummings, Armeli, & Lynch, 1997), and may moderate the effects of stress on burnout (Greenglass, Fiksenbaum, & Burke, 1994). Hoonakker et al. (2004) found that supervisory support plays a central role in turnover models for women in the IT workforce.

The fourth factor in the model concerns career opportunities. In a study by Igarria and Siegel (1992) on reasons for turnover of information systems (IS) personnel, promotability was negatively correlated with intention to leave. For those IS employees facing limited advancement opportunities, there is a desire to leave the organization rather than compromise career goals. Igarria and Siegel suggest that organizations provide IS employees with greater career opportunities, possibly by establishing dual career paths (managerial and technical career paths) to expand the career options within the IS department.

The fifth factor in the model is rewards. Igarria and Siegel (1992) found salary to be negatively correlated with intention to voluntarily leave. In the literature, salary is often cited as a primary reason for a career move. In our study, an opportunity for higher salary is the most important reason to leave the job (Hoonakker, Korunka, & Carayon, 2005). However, the scale rewards in our study does not refer to salary, but to the "fairness of the reward system in the organization." It is addressed by statements such as: "There is a strong link between how well I perform my job and the likelihood of my receiving a raise in pay/salary" and "There is a formal process in place in my company that rewards employees who make an extra effort." Employees who feel that a fair system that rightfully rewards their efforts is in place have less intention to leave the organization.

A surprising finding was that organizational involvement does not play an important role in the paths to turnover. Besides measurement problems, a possible explanation could be that the tenure in IT companies is short: on an average employees work 4 years for the same company before they move to another job.

Data indicate a good model fit for all subsamples and a very stable general model. However, it should be emphasized that in both national studies slightly better model fits were found for older and well-educated employees. This could be an indication that turnover and turnover intention have an increased importance for these groups, indicating increased job flexibility (in the sample of well-educated employees) or reduced job flexibility (in the sample of the older workers).

The model was tested on different age and educational samples of employees. The two national samples represent two different groups of IT work. Therefore, the stability of the

model paths confirm (again) the similar importance of job/organizational characteristics and quality of working life for all groups of employees (e.g., white-collar IT work and blue-collar manufacturing IT work).

Our study again confirms the importance of the well-known job design factors for quality of working life. Although in a time where output optimization is often the only goal of organizational change processes, it is especially important to point again to the fact that a high quality of working life is the most important factor to accomplish the goals of minimizing costs and optimizing organizational outputs.

5.1. Study Limitations

It should be emphasized that both studies were realized in a cross-sectional design. Therefore, “causal” pathways are based mainly on theoretical considerations and plausibility, and not on a strict empirical test. On the other hand, the cross-national approach—based also on different sample strategies (conventional questionnaire and online sampling), two language versions of the questionnaire, and realized in different fields of IT work (white collar and blue-collar manufacturing)—adds considerable strength to the model test, that is, confirms the model as highly stable. However, in future research, the model should be tested with longitudinal data. Another limitation is that we examined turnover intention, not actual turnover. Although the literature shows that turnover intention is the best predictor of actual turnover (e.g., Parasuraman, 1982), in the future the model should be tested with actual turnover data. Finally, based on the literature and the results of this study we have made recommendations for retention of IT personnel. These recommendations should be tested in intervention studies.

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6. Paper 5

Hoonakker, P.L.T., Korunka, C. & Carayon, P. (2008). Turnover and retention of women and minorities in IT. Submitted to *Communications of the ACM*, Accepted with revisions.

Turnover and retention of women and minorities in IT

Peter Hoonakker, Christian Korunka & Pascale Carayon

Offering incentives to retain personnel has become a hot topic in Human Resource Management (HRM), as shown in recent headlines such as “Female IT pros push for flexible workplaces” (Computerworld, Nov 14, 2007); “Seeking loyal, devoted workers? Let them stay at home” (The Wall Street Journal, Sep 11, 2007); and “Companies begin reaching out to dads with family-friendly programs” (USA Today, Dec 11, 2007). A recent survey of 225 American organizations [9] shows that work/life balance is one of the top reasons for employee turnover. The survey also shows that employers provide widely different programs to help IT professionals in more effectively managing work/life demands and meeting their personal and professional goals. However, little is known about the effectiveness of these programs in retaining personnel, particularly “family-friendly” programs.

Turnover has been a major issue in IT since the early days of computing. Because IT professionals are highly skilled, their loss can be very expensive and disruptive for firms. The costs include recruitment and re-skilling, as well as difficulties in completing projects and disruptions in team-based work environments.

The first literature review of turnover among IT personnel was published in 1977. Annual turnover of IT personnel ranged between 15 and 20 percent in the 1960s and early 1970s. In the late 1970s, turnover was as high as 28 percent, while in the early 1980s, it ranged up to 20 percent. By the 1990s, the turnover rate reached 25 percent to 33 percent annually [18]. Although demand for IT workers dropped considerably after the dot.com bust, companies still face a lack of *qualified* workers, referred to as the “gap” in IT workers. For example, through 2010 the occupation of computer specialists is projected to grow by 69 percent and the occupation of computer and information systems managers is projected to grow by 48 percent [14]. The gap in IT workers is therefore likely to widen in the coming years.

A factor contributing to the shortage of IT workers is the under representation of women and minorities, potentially caused by too few members of these groups entering the IT workforce or too many of them leaving. In this study we focus on turnover and retention of women and underrepresented minorities. Do these workers have different reasons to leave their jobs? Do retention options such as family-friendly programs reduce their turnover intention?

Women

According to statistics from the U.S. Department of Commerce and the Census Bureau, women represent 46% of the total workforce, but only 30% of the IT workforce [23]. Only 20% of computer *professionals* are women. Female scientists and engineers in industry are more likely to leave their technical occupations and the workforce altogether than women in other fields: attrition data on female scientists and engineers show that their exit rates are two times as high of those of men (25% versus 12%), and they are also much higher than those of women in other employment sectors [6].

Minorities

Blacks and Hispanics hold only 5% of IT jobs, yet make up respectively 12% and 14% of the U.S. population [22]. American Indians and Alaskan natives are 0.6% of IT workers and 0.9% of all workers. On the other hand, Asian Americans are three times more prevalent in the IT workforce than in the workforce overall [6].

Studies show that the key barriers to the entrance and retention of women and underrepresented minorities in IT are lack of role models and mentors, exclusion from informal networks, stereotyping, discrimination, unequal pay scales and inadequate work/family balance [6, 17]. How can employers change the culture and environment of the IT workplace to reduce and eliminate those barriers and accommodate the needs of underrepresented IT workers?

Both job and organizational design approaches have been suggested to improve retention and reduce turnover. An *Information Week* salary survey showed that IT workers ranked “challenge” of their job, “responsibility” and “job atmosphere” as more important than their base salary. Quality of working life, job stability and learning opportunities through job assignments dominated the responses [21]. Organizational design has also been suggested as an important solution component. Many innovative human resource management practices have been put forward as potential or partial solutions, including mentoring programs, educational opportunities, flexible hours and telecommuting options [6, 17, 21].

Retention options

Employers have several options to retain their personnel. For example, they can offer financial incentives, including salary, more extensive health insurance or better pension plans; career incentives such as training and mentoring; and family-friendly programs. In this paper we focus on family friendly programs.

The challenge of balancing work and family life is one of today’s concerns for both individuals and organizations, especially in industries like IT that are characterized by high job demands. Offering family-friendly programs can help to restore the work-family balance. We briefly examine various retention options and their effect on reducing turnover intention. Some of the family-friendly options are mandated by the Family and Medical Leave Act (FMLA) for eligible employees.

- ***Telecommuting or teleworking*** means periodic work for one or more days per week outside of the principal office, either at home or at a client’s site. Results of several studies show that telecommuting is positively related to job performance, job motivation, organizational commitment and employee retention, and negatively to work-family-conflict, work exhaustion and turnover intention [11, 15].
- ***Flextime*** means that employees can decide what time of the day they arrive at work and what time they leave work. Results of a meta-analysis showed that flextime is positively related to higher productivity and job satisfaction and lower absenteeism [3]. However, other studies have not found any relationship between flextime and turnover rates [12, 24].

- ***Job sharing*** is defined as two (or more) people sharing the same position in a company, each working part of the week. Results of a study in the UK found that job sharing increased productivity and resulted in greater retention of staff [13].
- ***Maternal and paternal leave*** is defined as the opportunity to take time off work, paid or unpaid, to care for a child or make arrangements for the child's welfare. Some evidence suggests that maternal or paternal leave does have an impact on retention of personnel. Results of a study on maternal leave showed that the passage of the FMLA in 1993 increased mothers' postpartum employment continuity and job retention, but lowered wages [16].
- ***Extended leave*** is defined as taking unpaid time off for other reasons than those covered by the FMLA. Little evidence is available about the impact of offering extended leave on turnover and retention. However, some estimates show that turnover is considerably more costly to employers than granting extended leave.
- ***Part-time work*** is defined as less than a full-time organizational commitment on the part of the employee. Some evidence [19] suggests that part-time work is related to higher turnover of personnel, but the relationship is complicated. For example, part-time work is only related to higher turnover if employees have a preference for a full-time job [4].
- ***Child care and on-site child care*** means provision of full-time care and education of children under the age of 6 and before and after school care for older children. The literature shows evidence that providing child care reduces turnover and enhances retention [10, 25].
- ***Sick child care*** means providing care for children who are mildly ill or recovering from a health problem. An employer saves the cost of a replacement or lost work time when an employee uses a sick child care program rather than staying home with a child. There is very little literature on the relation between offering sick child care and retention.
- ***Leave for family related appointments/events*** means short-term leave with pay to attend family-related appointments or events. We did not find any literature on the effect of this family-friendly option.
- ***Elder care*** means providing assistance with the daily living activities for an elderly relative who is chronically frail, ill or disabled. Results from studies by the Families and Work Institute [7, 8] showed that one of four employees who were responsible for the care of elderly relatives had problems with the costs of services needed and one in five employees worried about their relative while on the job. However, little is known about the effectiveness of offering elder care on turnover and retention.

Little research assesses the effectiveness of family friendly options to reduce turnover intention *in IT*. Agarwal and Ferrat [1] examined the practices that successful organizations use for recruiting, developing and retaining IT staff in a variety of IT environments. Based on interviews with Chief Information Officers and Human Resources executives, they found that work arrangements that provide an opportunity to work on interesting and challenging projects were effective in retaining personnel. Flexible work arrangements such as telecommuting, flextime and social activities were viewed as effective in allowing IT staff to balance work and family and to better deal with the stress and burnout associated with many IT jobs.

Our study

We collected data from 624 respondents working in five IT organizations (response rate: 56%): one large company (N>500), one medium sized company (N=200) and three small companies (N<100). For a description of our study and the questionnaire used, see Carayon et al. [5]. Forty-six percent of the sample is female, and 7% are members of underrepresented minorities (Hispanics, African Americans, and Native Americans). Asians and Pacific Islanders make up 6% of the sample, but are not underrepresented in the IT workforce. On average, women in the sample are more highly educated than men, are more likely to hold managerial jobs, and earn significantly less than men. Underrepresented minorities have less education on average than non-Hispanic whites, hold lower status jobs and earn significantly less. Average age of the sample is nearly 40 years old and 70% of the sample is married or living with a significant other. More than half of the respondents have children (55%); 49% have one or more children still living at home; and 25% have one or more children younger than 6 years old. Thirty-five respondents (6%) have a part-time job. Using this dataset, we examined differences in turnover intention, reasons for leaving a job and availability of family-friendly options between white men, white women and men and women who are underrepresented minorities. The sample of underrepresented minorities in our study is relatively small (N=38).

The average turnover intention was measured on a scale from 1 (not at all likely to actively look for a new job in the next year) to 7 (extremely likely to actively look for a new job in the next year). Underrepresented minorities (3.4) have significantly higher turnover intention than white men (2.6) and white women (2.4). Figure 1 shows turnover intention for the different groups.

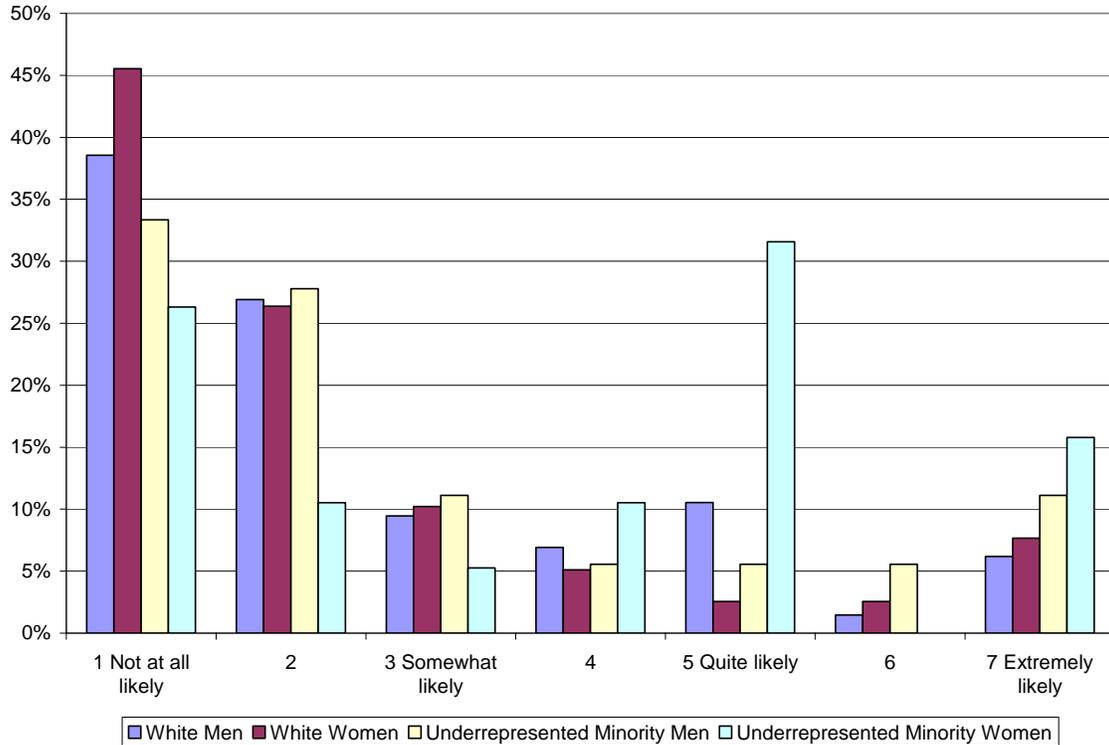


Figure 1: Turnover intention of white men, women and underrepresented minorities

To examine reasons for leaving the job, we asked the following question: “If you’d consider leaving your current job, please check all the reasons that would apply”. Results are shown in Table 2.

Table 1: Reasons for leaving the job

	White Men (N=277)	White Women (N=235)	Under-represented Minorities Men (N=18)	Under-represented Minorities Women (N=20)	Total (N=594)
Want a higher salary	53%	41%	67%	70%	48%
Want the opportunity to learn new things	40%	44%	67%	55%	42%
Want to advance my career	44%	32%	50%	60%	39%
Want to obtain more expertise	34%	36%	50%	50%	34%
Inadequate rewards/reviews/raises	36%	27%	33%	35%	32%
Ineffective management	34%	34%	17%	20%	31%
Lack of challenge or boredom	32%	29%	33%	50%	30%
Inadequate career advancement	32%	24%	33%	50%	28%
Lack of development opportunities	29%	24%	28%	30%	26%
Want more challenge in my job	25%	26%	39%	45%	26%

	White Men (N=277)	White Women (N=235)	Under-represented Minorities Men (N=18)	Under-represented Minorities Women (N=20)	Total (N=594)
Want a higher job status	26%	18%	39%	40%	24%
Want a better compensation plan	29%	17%	6%	25%	22%
Conflicts between work and family	15%	24%	11%	20%	18%
Lack of training	20%	16%	17%	20%	17%
Long working hours	16%	19%	17%	10%	16%
Inadequate flexible work practices	12%	20%	17%	20%	15%
High job demands	13%	17%	17%	5%	14%
Feeling of not fitting in	7%	12%	17%	5%	9%
Lack of social support	7%	10%	17%	10%	9%
Feeling discriminated against	4%	9%	11%	15%	7%

The **bold percentages** represent groups that score statistically significant lower or higher than white men at $p < 0.05$

The first four reasons for leaving one’s job – salary, opportunity to learn new things, career advancement and gaining expertise – are much more common for underrepresented minorities than for the other groups. For women, the lack of opportunity to learn new things is a more common reason for turnover than a higher salary. Also, for white women, work-family conflict is a significantly more common reason to leave the job than for other groups. Several studies have shown that work-family conflict has become one of the most important reasons for IT employees to leave their job.

Interestingly, reasons for leaving a job in the IT workforce have not changed all that much in the past 35 years. Compared to the results of one of the first turnover studies in IT, a study by the Association of Computer Programmers and Analysts in 1970 [2], results of our study show that although financial reasons are common (28% in 1970, and 48% in 2004), other reasons are nearly as common. In the 1970 study, lack of challenging work (38%) was even more common than financial reasons. In our 2004 study, lack of challenge or boredom (30%); challenge in one’s work (26%); and opportunity to learn new things (42%) were not as common as financial reasons, but not far behind. Interestingly, many of these reasons are also motivators for workers entering the IT workforce [20].

To examine family friendly retention options offered by IT companies, we asked respondents the following question: “To help employees balance work and family/home responsibilities your company may offer the following options. In the following list please check all the options that you could take advantage of if you need them”. Results are shown in Table 2.

Table 2: Availability of family-friendly options

	White Men (N=277)	White Women (N=235)	represented Minorities Men (N=18)	Under-represented Minorities Women (N=20)	Total (N=594)
Flextime	69%	74%	67%	75%	72%
Telecommuting	74%	69%	44%	30%	71%
Leave for family related appointments/events	63%	72%	67%	65%	67%
Maternal or paternal leave time	60%	65%	61%	60%	62%
Extended leaves (> 3 months) other than maternal/paternal leaves	38%	46%	28%	45%	42%
Sick child care, sick days for sick children	37%	31%	24%	30%	33%
Part-time work	18%	38%	22%	50%	29%
Elder care	15%	21%	6%	20%	22%
Child care	16%	22%	11%	25%	19%
On-site child care	14%	21%	17%	20%	18%
Job sharing	9%	13%	28%	24%	13%

The **bold percentages** represent groups that score statistically significant higher or lower than white men at $p < 0.05$

On average, white women report having access to more family-friendly options than men and underrepresented minorities. The positions held by women more often offer part-time employment. Positions held by underrepresented minorities were more likely to permit job sharing. Whites, particularly white men, more often hold positions offering telecommuting.

We analyzed data to examine the options that are significantly related to turnover intention. Results show that respondents in jobs offering *telecommuting* and *part-time* work had significantly lower turnover intention. Offering part-time work is significantly related to lower turnover intention, especially for white men. For white men with young children (<6 years), offering paternal leave and/or leave for family-related events is also significantly related to lower turnover intention. For women, and especially women with children, offering on-site child care and sick child care is significantly related to lower turnover intention. For underrepresented minority men, offering child care and sick child care is significantly related to lower turnover intention. Finally, for women belonging to an underrepresented minority group, offering flextime and/or telecommuting is significantly related to lower turnover intention.

Job and organizational characteristics can reduce turnover intention by improving job satisfaction and making a worker feel more involved with his or her organization. Employees who have access to family-friendly options – telecommuting, part-time work and maternal and paternal leave – report significantly higher job satisfaction and organizational involvement. The effect of offering maternal/paternal leave is stronger for white men than for women.

Are these options sufficient for the needs of employees?

Several studies show that offering family-friendly options alone is not enough. Most of the time, it is the direct supervisor who decides whether employees can benefit from the family-friendly programs. If employees have the feeling that their supervisors do not support them or if employees perceive that taking advantage of these options may have a negative impact on their career, offering the options may not improve retention. Therefore, we asked respondents two additional questions: “Are these options sufficient for your needs?” and “Do you feel discouraged to take advantage of these options?” Results of our analysis show that the options are sufficient for most employees (77%) and that the majority of the employees (66%) do not feel discouraged to take advantage of these options. However, more than one-fifth of employees (21%) do feel discouraged. Women feel significantly more often discouraged than men. Results of our analysis show that employees for whom the options are not sufficient or who feel discouraged to take advantage of these options have a statistically significantly higher turnover intention than other employees. These results emphasize that offering family-friendly programs alone is not enough. Family-friendly options must be supported by supervisors and management. If employees have the feeling that making use of the options will limit their careers, offering the family-friendly programs will not be successful in retaining personnel.

Results of our study support what others have found. According to a survey of 225 organizations in the U.S. by Gartner Consulting, work/life balance is one of the top reasons for employee turnover: teleworking was one of the most-powerful family-friendly options, as several other studies have also found. However, results of the study by Gartner Consulting show that less than 20% of survey participants’ in the IT workforce have some type of telework arrangement [9].

Results of our study show that offering family-friendly arrangements is not a “one size fits all” solution for retaining IT personnel. Results of our analyses show that different groups (white men, white women, and underrepresented minority men and women) benefit from different family-friendly arrangements, depending on their family situation (having children or not, the age of the children, etc.). Therefore, IT organizations should offer “tailored” family-friendly arrangements to retain their personnel. In addition, specific arrangements need to be supported by supervisors and management.

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7. Conclusion

In the last 25 years the Information Technology Revolution has had a major impact on society and may be considered as profound as the Industrial Revolution. Not only has the IT Revolution an impact on the people who use computers in their daily life --according to the latest statistics there are now more than 1,5 billion people connected to the Internet—but it also has a major impact on the workforce. The number of employees working in the information (or knowledge) sector has increased from 13% in 1900 to nearly 50% in 2000. There are about 10 million people employed in the U.S. Information Technology sector in jobs such as application analyst, computer security, database administrator, network engineer, network administrator and/or manager, software engineer, systems administrator, webmaster, web site developer, etc. Most of these employees (90%) work for federal, state and local government, in the education sector, the bank and insurance sectors and hospitals. Only about 10% employees work in the IT industry, producing computer hardware and software.

Turnover has been a major issue for Information Technology (IT) personnel since the very early days of computing and continues to be a problem. Annual turnover rates of 25% are not unusual, which means that one out of four employees changes their job every year. Turnover can be very expensive and disruptive for firms (Reichheld, 1996). Losing highly skilled staff members means that companies incur substantial costs associated with recruiting and re-skilling, and hidden costs associated with difficulties completing projects and disruptions in team-based work environments (Niedermann & Sumner, 2003). Determining the causes of turnover within the IT workforce and controlling it through human resource practices and work system design is imperative for organizations (Igarria & Siegel, 1992).

Turnover rates among women can be twice as high as turnover rates of men and women, especially scientist and engineers leave the IT workforce in great numbers. The percentage of women in the IT workforce fell from 41% to 29% between 1996 and 2004 (ITAA, 2002; National Center for Woman & Information Technology (NCWIT), 2007; Trauth, Quesenberry, & Huang, 2006).

The goal of our study was to examine antecedents of turnover in information technology (IT): why do people leave their jobs and more in particular: why is turnover among women in IT so high? We reviewed both the job and organizational design literature and the Human Resources Management (HRM) literature to develop a conceptual turnover model for IT; first tested the model with questionnaire data and afterwards tested the model for gender differences. We published the results of this research project in 5 research papers that form the core of this dissertation.

This dissertation relies heavy on Methods. Two of the 5 papers are about Methods: the first paper about questionnaire development and the second paper about using the Internet for data collection. The time and effort spent on the methods very much contributed to the success of the project. In addition, two papers related to those research methods have been published.

We firmly believe that investing in Research Methods did pay off. When conducting a questionnaire survey, it is very important to use valid and reliable measures, an observation which may be considered all too obvious. A questionnaire needs to meet certain minimum criteria. To quote Shortell et al. (1991): “Among the most important criteria of useful measures is that they be theory-based, reliable, valid, relevant to unit of analysis, and relatively easy to administer” (Shortell, Rousseau, Gillies, Devers, & Simons, 1991). Unfortunately, questionnaires used in research are not always reliable or valid. For example, in a study on patient satisfaction with health care, Sitzia (1999) evaluated data of 195 studies. Results showed that in 80% of the studies a new satisfaction assessment instrument was developed. Sixty percent of the studies in which a new instrument was developed did not report any data on validity or reliability of the instrument. Only 6% of the studies used instruments that were tested and met the minimum requirements for reliability and validity. Results of a study examining validity and reliability of instruments measuring nurse-physician collaboration showed that only five questionnaires in 225 studies met the inclusion criteria used by the researchers (Dougherty & Larson, 2005). Research studies need to use valid and reliable instruments.

However, as mentioned above, developing a valid and reliable questionnaire is very time consuming and does cost a lot effort. In the first paper we described the sometimes tedious questionnaire development process: a review of the literature on existing questionnaires and scales, pilot test of the first draft of the (paper and pencil version of the) questionnaire in

interviews with key personnel, qualitative data analysis of the pilot study data, changes to the questionnaire, adaptation of the questionnaire to a web-based survey, and pilot test of the web-based survey version of the questionnaire.

Using questionnaires and scales that have been proven to be reliable and valid in previous research also offers the opportunity to benchmark results with other studies, which will add tremendous value to research. Unfortunately, we did not make use of this opportunity, in part because changes were made to the questionnaire to make it specific for IT: this made it impossible to compare our results with results of other studies (Hoonakker, Carayon, & Schoepke, 2005). We did however compare the results we obtained with the questionnaire in the study in the USA with the results of the study in Austria. All in all, we think that the long process of questionnaire development resulted in a valid and reliable questionnaire.

The second methods paper deals with the generalizability of the results. There are several potential problems with generalizability. First of all, coverage error (part of the population of interest cannot become part of the sample) may occur. Other errors that can occur include: sampling error (only a subset of the target population is surveyed, yet inference is made about the whole population); measurement error (a respondent's answer to a survey question is inaccurate, imprecise, or cannot be compared in any useful way to other respondents' answers), and nonresponse error (respondents do not participate in any part of the survey (unit nonresponse) or individuals do not answer individual questions (item nonresponse)).

In our study, all respondents were working in IT organizations, and all employees in these organizations had a valid e-mail-address, thereby greatly reducing *coverage error*. We also think that the risks of *sampling error* are low: our sample seems to be fairly representative of the general IT employee population (see Appendix 1, Paper 3), although this is hard to prove because there are no statistics available at the national level on the different occupations in IT.

With regard to *measurement error*, using a web-based survey to collect data has two major advantages. First of all, when using so called radio buttons in a WBS, respondents can only select one choice only, which greatly reduces the confusion of paper & pencil versions of questionnaire when respondents checked two (or more) responses. Second, data do not have to be entered manually in a database, thereby eliminating errors due to data entry. Further, both samples were large (the US sample consisted of 624 respondents and the Austrian sample consisted of 677 respondents), thereby reducing the risk of random measurement error. Last,

before conducting the statistical analyses, we examined the data for normal distribution. We performed stem & leaf plots and Q&Q plots to detect outliers, and if needed, removed the outliers from the data.

Non response error, the focus of the second paper, has two components: unit nonresponse (respondents do not participate in any part of the survey) and item nonresponse (individuals do not answer individual questions). Response rate in the U.S. study was 56%; response rate in the Austrian study was even higher: 74%. Although not extremely high, both studies met the criterion of Babbie (Babbie, 1990, 1992) that response rates should be at least 50%. Item nonresponse was low. Even though respondents had ample opportunity to skip whole parts of the long questionnaire (120 questions), overall the quality of the responses was good. Totally, on most questions, we had between 20 and 30 missing values per question (2 to 3% of the sample). Furthermore, all participants who gave their consent filled out the survey completely, even though they had the chance to terminate the survey prematurely, skip parts of the survey or not submit their responses.

We conducted a small non-response study with the first company that participated in the web-based survey (WBS). One month after the survey, an e-mail was sent to both respondents and non-respondents, inviting them to the response/non-response study. In this completely anonymous follow up survey, two open-ended questions using text-boxes were asked to both respondents and non-respondents about (1) the reasons why they chose (not) to participate in the study and (2) any suggestions for improvement of the web-based survey. A total of 35 employees (response rate: 18%, 6 non-responders and 29 responders to the original) responded to the follow-up survey. We had decided beforehand not to send any reminders to reduce the “survey burden” on the employees of this company. The results of the (small) response/non-response survey showed that non-respondents mainly did not respond because they were too busy (“too busy working on other things”). Most of the respondents filled out the survey either because of the salience of the topic (e.g. “I felt that this was an important topic, plus I hope that the information gathered by this study will improve the working conditions for all IT workers”) or the fact that management supported it (e.g. “because it is important and I was encouraged to participate by my company”). Most of the respondents had no suggestions on how to improve the survey apart from the questionnaire being too long. Results of this non-response survey did not give us any cause for concern about our study procedures or specific reasons for nonresponse.

All and all, we think that the methods we used were methodologically sound: the samples were fairly representative for the target populations; the questionnaire produced valid and reliable measures, and possible errors with regard to generalizability were minimal. We think that our results can be generalized to the whole IT employee population.

From a theoretical point of view, the results are also interesting. First of all, we combined the job and organizational design (JOD) and stress literature and the HRM literature. Most studies examine turnover either from a JOD perspective or from a HRM perspective. The job and organizational design and stress literature provides us with more insight on why people want to leave their jobs; the HRM literature provides us with insight in what organizations can do to retain their personnel.

Second, we demonstrated that work-related attitudes or quality of working life factors such as job satisfaction and burnout mediate most of the relationships between antecedents of turnover (both job and organizational characteristics and HRM practices) and turnover intention. However, organizational commitment, a work-related attitude that plays an important role in most turnover studies, did not play a significant role in our turnover model for IT. From a theoretical perspective, job satisfaction can be considered as an affective response to specific aspects of the job, and organizational commitment can be considered as an affective response to the whole organization. This affective response to the whole organization does not seem to play a role when it comes to the decision to leave one's job in IT. The relations between job and organizational characteristics and HRM practices have either a direct relationship with turnover intention, or are mediated by emotional exhaustion and job satisfaction. For men, most relationships are mediated by emotional exhaustion; for women job satisfaction is the main mediator.

Thus, we may conclude that for IT personnel, characteristics of the *job* are more important than characteristics of the *organization* they work for when deciding to leave their job. To retain IT personnel, more can be gained from job (re)design than from offering employee benefits. In other words, it may be better for a company to make the job more interesting and more challenging rather than making it interesting to work for the company. Two of the four HRM practices, training opportunities (availability and satisfaction with training opportunities at the company) and development opportunities (e.g. management development programs, coaching

from peers and supervisors, mentorship), did not play a significant role in the model of turnover intention. One possible explanation is that there is considerable overlap between the four HRM practices (training, career advancement, and development opportunities and fairness of rewards). Another explanation is that indeed HRM practices offered by a company are less important for retaining personnel than the job characteristics. Fairness of rewards is an exception: for men and women, fairness of rewards –apart from being mediated by job satisfaction and in that way having an impact on turnover intention- does have a *direct* relationship with turnover intention. Fairness of rewards (e.g. “There is a strong link between how well I perform my job and the likelihood of my receiving recognition and praise”) is about the fairness of the reward system, not about salary. Salary is one of the factors that we controlled for, but was not significant in the model. In other words, in order to retain personnel, companies have to create a fair and transparent reward system.

With regard to gender differences in turnover intention, we did not find any evidence that turnover intention among women is higher than turnover intention among men. Admittedly, turnover intention is not the same as actual turnover, but turnover intention is the strongest predictor of actual turnover (Baroudi & Igarria, 1995; Bluedorn, 1982; Cotton & Tuttle, 1986; Fishbein & Ajzen, 1975; Igarria & Greenhaus, 1992; Igarria & Guimaraes, 1999; Mobley, 1977; Parasuraman, 1982). Neither did we find any important gender differences in job and organizational characteristics (JOC), HRM practices (HRMP) or quality of working life. These results are interesting, because results of several studies on turnover in the IT workforce in the 1990s, especially by Igarria and colleagues (Igarria & Baroudi, 1995; Igarria & Chidambaram, 1995, 1997; Igarria, Parasuraman, & Greenhaus, 1997) did show gender differences in JOC, HRMP, QWL and turnover intention. Igarria and colleagues explained these gender differences from a human-capital perspective. According to the human-capital paradigm, continued gender (and racial) discrimination can be explained because individuals are rewarded in their jobs for their investment in education and job training (Blau & Ferber, 1987). The human-capital paradigm suggests that women accumulate less human capital (knowledge and skills derived from on-the-job training and continuous work experience) than men do: women have lower educational levels, less experience and fewer skills, particularly in professional and managerial areas (Igarria & Chidambaram, 1997). In several of their studies, Igarria and colleagues found support for the human-capital paradigm: women in their studies were less experienced, had lower

education levels, earned less, and less often held managerial positions (Igbaria & Chidambaram, 1997; Igbaria, Parasuraman, & Greenhaus, 1997). Historically, women have had lower levels of educational attainment (Freeman, 2004; National Center for Education Statistics (NCES), 1999), which in turn could negatively affect their opportunities in the labor market. However, in the past decade, this has changed dramatically. In general, more women have completed college, and have received Bachelor's and Master's degrees than men. Only in the highest level of education (Ph.D.), men hold more degrees than women (National Center for Education Statistics (NCES), 1999, 2002). Although women have made tremendous progress in social sciences, history, psychology, biological sciences, life sciences, business management and administrative services where they have attained relative gender parity or made up the majority in 2001, other fields such as computer and information sciences, physical sciences, and engineering continue to have a larger proportion of males. However, the percentages of females majoring in those fields is increasing (Freeman, 2004). Female employees in our sample are statistically more highly educated than men. Significantly more women than men have a graduate or professional degree. There are also relatively few gender differences in training opportunities or satisfaction with training opportunities (Carayon, Hoonakker, & Schoepke, 2006). Thus, the fact that there are no gender differences in educational attainment and training can possibly explain why we did not find gender differences in JOC, HRMP, QWL and turnover intention. In three other recent studies in the IT workforce, few gender differences were found. Campbell et al. (2006) found no gender differences in job satisfaction and career advancement opportunities. Major et al. (2006), too, found no gender differences in job satisfaction. Men and women were equally satisfied with several aspects of their jobs such as pay, supervision, the social environment and opportunities for growth. One of the few gender differences in their study was about organizational commitment: women were equally committed to their organization but were less committed to a career in IT. They were less likely than men to view IT as their "life's work" (Major, Davis, Sanchez-Hucles, & Mann, 2006). O'Leary-Kelly and colleagues (McKinney, Wilson, Brooks, O'Leary-Kelly, & Hardgrave, 2008; O'Leary-Kelly, Hardgrave, McKinney, & Wilson, 2006) also found few gender differences in IT workforce experiences such as burnout, perceptions of fair treatment, supervisory support related to family issues, pays, rewards and burnout. However, these studies did not examine possible differences in the *relationships* between the concepts.

That is a very interesting result of our study: gender *moderates* the relationship between JOC, HRMP, QWL and turnover intention. Women do not perceive job and organizational characteristics and HRM practices differently than men, but they perceive *the relationships between those concepts and the relation with QWL and turnover intention differently* than men¹. Evidently, this has consequences for retention of women in IT.

Another interesting factor that plays an important role in the turnover model and that shows interesting gender differences is work-family conflict. For men, work spills over into family life is highly correlated with emotional exhaustion, but not with job satisfaction. Family life spills over into work is directly and negatively associated with turnover intention. It could mean that men do not want to leave their jobs until the family issues that affect their work have been resolved. For women there are no significant relationships between family life spills over into work and QWL and turnover intention. However, for women work life spills over into family life is related to emotional exhaustion and job satisfaction. Amstrong et al. (2004) found similar results in a study of voluntary turnover of women in IT: for women, family responsibilities did not cause stress; only work responsibilities caused stress. They explained this finding by using Cinamon et al.'s (2002) argument that from a women's perspective, if the family interferes with work, it is troublesome but natural, whereas if work interferes with family responsibilities it is seen as less appropriate and is more likely to be perceived as a conflict that creates stress (Amstrong, Riemenschneider, Reid, & Allen, 2004).

The importance of work-family conflict for IT is reflected in our fifth paper. We examined the family-friendly practices offered by organizations to retain personnel and their relationship to turnover intention. Results show that respondents in jobs offering telecommuting and part-time work had significantly lower turnover intention. Offering part-time work is significantly related to lower turnover intention, especially for white men. For white men with young children (<6 years), offering paternal leave and/or leave for family-related events is also significantly related to lower turnover intention. For women, and especially women with children, offering on-site child care and sick child care is significantly related to lower turnover intention. For underrepresented minority men, offering child care and sick child care is significantly related to

¹ Interestingly, the situation for underrepresented minorities in IT is completely different. Underrepresented minorities do end up in lower status jobs, have more complaints about JOC and HRM practices, experience lower QWL and higher turnover (Hoonakker & Carayon, 2006).

lower turnover intention. Finally, for women belonging to an underrepresented minority group, offering flextime and/or telecommuting is significantly related to lower turnover intention. Results of our study show that offering family-friendly arrangements is not a “one size fits all” solution for retaining IT personnel. Results of our analyses show that different groups (white men, white women, and underrepresented minority men and women) benefit from different family-friendly arrangements, depending on their family situation (having children or not, the age of the children, etc.). Therefore, IT organizations should offer “tailored” family-friendly arrangements to retain their personnel.

With the fifth paper we have come full circle: the first two papers describe the development of an instrument to examine antecedents of turnover intention in IT and its use in collecting data, the third and fourth papers describe the results of the main questionnaire data collection, and the last paper describes strategies that companies use in retaining IT personnel.

This study has obvious limitations. First of all, we did not examine actual turnover, but turnover intention. Although turnover intention is the best predictor of actual turnover, we would have liked to obtain and use the actual turnover statistics of the participating companies. However, participation in this study was confidential, and therefore it would have not been possible to link the actual turnover data to the questionnaire data. Second of all, the design of the studies was cross-sectional and not longitudinal and therefore we can not establish causal relationships.

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Abstract

Employee turnover in the Information Technology (IT) workforce is high: it can reach more than 20% on an annual basis. Turnover rates of women are higher than turnover of men, and the percentage of women working in IT fell from 41% in 1996 to 29% in 2004. Turnover of highly skilled employees can be very expensive and disruptive for firms. Losing highly skilled staff members means that companies incur substantial costs associated with recruiting and re-skilling, and hidden costs associated with difficulties completing projects and disruptions in team-based work environments. Determining the causes of turnover within the IT workforce and controlling it through human resource practices and work system design is imperative for organizations.

The goal of this study is to examine antecedents of turnover in IT. In this dissertation we describe how we developed a questionnaire to examine antecedents, work-related attitudes and turnover intention in IT (Paper 1); the process of questionnaire implementation through a web-based survey system and the survey design factors that play a role in achieving high response rates (Paper 2). Further, we describe the development of a turnover model for IT based on the literature, how we tested the model with path analysis, and how we tested the model for gender differences, using data collected in the USA (Paper 3). In the fourth paper we describe how the turnover model is tested with data collected in a transnational (Austrian) study. Finally, recommendations are made for retention of IT personnel (Paper 5).

Results of the study show that we developed a reliable and valid questionnaire (Paper 1). Further, results of our comparison between postal mail and Internet surveys show that the web-based survey we used to collect the data in the American study generated response rates that are comparable to postal mail studies; and that the results -- in principal -- can be generalized to the whole IT population (Paper 2). Results of our statistical analysis show that there is a good fit between the turnover model that we developed for IT, and the data. Results show that there are a number of job and organizational factors and human resources practices that are related to turnover intention, such as lack of challenge in the job, high job demands, work-family conflict, lack of career opportunities and the lack of fairness of the reward system. Results show that most of the relationship between the antecedents of turnover intention is mediated by work-related attitudes such as job satisfaction and burnout. Results also show that gender moderates the relationship between antecedents of turnover, work-related attitudes and turnover intention. These results have an impact on retention of IT personnel (paper 3). We tested the robustness of the turnover model in a transnational study, using data collected in Austria (Paper 4). Results of the transnational studies show that the optimized turnover model fits both databases (American and Austrian) and thus confirm the stability of the model. Moreover, the model relations were found to be similar not only in the two national samples, but also for gender, age groups, groups with different tenure at their organizations, and groups with different educational backgrounds.

Finally, using the American sample, we examined what family-friendly practices are effective in retaining white men and women, and underrepresented minorities in IT (Paper 5). Results show that there is not a "one size fits all" approach for retaining IT personnel. Retention practices have to be tailor-made in order to be effective.

Zusammenfassung

Die Fluktuation von Mitarbeitern in der Computerbranche ist im Vergleich zu anderen Tätigkeitsbereichen besonders hoch; sie kann bis zu 20% pro Jahr betragen. Die Fluktuationsraten von Frauen sind dabei in der Regel höher als die von Männern. Der Anteil von Frauen in den USA, die in der Computerbranche arbeiten, ist dabei von 41% im Jahr 1996 auf 29% im Jahr 2004 zurückgegangen. Hohe Fluktuationsraten von gut ausgebildeten Mitarbeiter/innen können für Unternehmen sehr teuer und im Betriebsablauf sehr störend sein. Der Verlust von gut ausgebildeten Mitarbeiter/innen bedeutet, dass Unternehmen hohe Kosten für die Aufnahme bzw. Ausbildung von Personal aufbringen müssen. Dazu kommen versteckte Kosten, die z.B. entstehen, wenn Projekte nicht abgeschlossen werden können und sich Zusammensetzungen von Arbeitsteams verändern. Die Analyse von Ursachen von Fluktuation im Bereich von IT-Arbeitskräften und ihre Kontrolle durch entsprechende HR-Maßnahmen ist daher ausgesprochen wichtig für die Unternehmen.

Das Ziel dieser Arbeit ist die Analyse von Ursachen von Fluktuation in der IT-Branche. In der vorliegenden Dissertation wird beschrieben, wie ein Fragebogen zur Erfassung der Ursachen von Fluktuation, arbeitsbezogenen Einstellungen und Fluktuationsintentionen entwickelt wurde (Beitrag 1). Es wird die Durchführung der Implementierung des Fragebogens als Online-Tool vorgestellt; dabei wird auf Überlegungen zum Fragebogendesign eingegangen, um den Rücklauf zu erhöhen (Beitrag 2). In weiterer Folge wird ein Modell zur Vorhersage von Fluktuation literaturbasiert entwickelt und pfadanalytisch überprüft. Zusätzlich wird dabei auf Geschlechtsunterschiede eingegangen (Beitrag 3). Im vierten Beitrag wird beschrieben, wie dieses Modell in einer transnationalen Vergleichstudie (mit Daten aus Österreich) überprüft wurde. Abschließend werden im fünften Beitrag Empfehlungen zur Verhinderung von hoher Fluktuation dargestellt.

Im ersten Beitrages kann gezeigt werden, wie ein reliabler und valider Fragebogen entwickelt wurde. Vergleiche zwischen postalischer Versendung einer Papier/Bleistift-Version und einer Online-Version zeigen ähnliche und akzeptable Rücklaufraten; die Ergebnisse dieser Studie (Beitrag 1) können auf die gesamte IT-Branche übertragen werden (Beitrag 2). Die statistischen Analysen erbrachten einen guten Fit zwischen den Modellüberlegungen und dem Datensatz. Es konnte gezeigt werden, dass eine Reihe von Prädiktoren auf organisatorischer Ebene sowie im Bereich von Personalentwicklungsmaßnahmen mit Fluktuationsintentionen einhergehen. Dazu gehören z.B. fehlende Herausforderung in der Tätigkeit, (zu) hohe Anforderungen, Arbeit/Familien-Konflikte, fehlende Karriereöglichkeiten und die Wahrnehmung eines ungerechten Belohnungssystems. Die Analysen zeigen, dass die Beziehungen zwischen diesen Prädiktoren und der Zielgröße durch arbeitsbezogene Einstellungen (Arbeitszufriedenheit und Burnout) mediiert werden. Es kann weiters gezeigt werden, dass das Geschlecht als Moderatorvariable auf die Beziehungen zwischen den Prädiktoren, den arbeitsbezogenen Einstellungen und der Fluktuationsneigung einwirkt. Die Ergebnisse können herangezogen werden, um die Bereitschaft zum Verbleib zu erhöhen (Beitrag 3). Die Robustheit des postulierten Modells wurde in einer transnationalen Vergleichstudie mit österreichischen Daten überprüft und bestätigt (Beitrag 4). Die Ergebnisse der Vergleichsstudien zeigen, dass ein optimiertes Modell einen zufriedenstellenden Fit in beiden Datensätzen (USA und Österreich) erbringt. Die Stabilität des Modells kann so bestätigt werden. Zusätzlich konnte gezeigt werden, dass die postulierten Modellbeziehungen auch für Frauen und Männer, für Altersgruppen sowie unterschiedliche Gruppen in den Unternehmen (Betriebszugehörigkeit und Qualifikation) bestätigt werden können.

Als Abschluss der Studienreihe konnte auf der Basis der amerikanischen Daten gezeigt werden, dass eine familienfreundliche Politik im Unternehmen sowohl bei weißen Mitarbeiter/innen als auch bei den unterrepräsentierten Minoritäten geeignet ist, um Bleiberaten im Unternehmen zu erhöhen (Beitrag 5). Die Ergebnisse zeigen aber auch, dass es keinen einheitlichen Ansatz für alle Unternehmen gibt. Um Fluktuationsraten möglichst gering zu halten, müssen die organisatorischen Praktiken an die jeweiligen Bedürfnisse der Unternehmen und Mitarbeiter/innen angepasst werden.

List NSF-IT Workforce Publications

1. Hoonakker, P. L. T. (2008). *Turnover and Retention in the Information Technology Workforce*. University of Vienna, Vienna, Austria (this dissertation).
2. Hoonakker, P.L.T. & Carayon, P., Non-response in Internet Surveys. Accepted for publication by the International Journal of Human- Computer Interaction (IJHCI).
3. Hoonakker, P.L.T., Korunka, C. & Carayon, P. (2008). Turnover and Retention of Women and Minorities in IT. Submitted to Communications of the ACM, accepted with minor revisions.
4. Hoonakker, P.L.T., & Carayon, P. and Korunka, C., (2008). The Relation between Job and Organizational Characteristics, Human Resources Management Practices, Quality of Working Life and Turnover Intention in the IT Workforce: Are There Differences Between Men and Women? Submitted to the Journal of Management Information Systems.
5. Korunka, C., Hoonakker, P.L.T. & Carayon, P. (2008). Quality of Working Life and turnover intention in information technology work. Human Factors in Ergonomics in Manufacturing, 18, 4, pp. 409-423.
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7. Carayon, P., Schoepke, J., Hoonakker, P.L.T., Haims, M. & Brunette, M. (2006). Evaluating Causes and Consequences of Turnover Intention among IT Users: The Development of a Questionnaire Survey. Behaviour and Information Technology, 25, 5, 381-397.
8. Hoonakker, P.L.T., Carayon, P. & Schoepke (2006). Discrimination and perceived hostility towards women and minorities in the IT Work Force. In: Encyclopedia of Gender and Information Technology (Eileen Trauth, editor). Hersey, PA: Idea Group Inc, pp. 207-215.
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11. Korunka, C., Hoonakker, P.L.T. & Carayon, P., (2006). Gender differences in an Austrian IT manufacturing plant. In: Encyclopedia of Gender and Information Technology (Eileen Trauth, editor). Hersey, PA: Idea Group Inc, pp. 522-527.
12. Hoonakker, P.L.T. & Carayon, P. (2006). Turnover of women and minorities in the ITWF. Paper presented as part of the panel: Workforce Diversity in the IT Profession: Remedies for the Shortage of Women and Underrepresented Minorities (together with Mike Gallivan, Monica Adya, Manju Ahuja and Amy Woszczinski) at the SIGMIS Conference 2006, Claremont, CA, April 13-15, 2006.
13. Hoonakker, P.L.T., Carayon, P. & Schoepke, J. (2005). Job and Organizational Characteristics, QWL and Turnover Intention in the IT Work Force: the Role of Minorities. Proceedings of the 11th Conference on Human-Computer Interaction (HCI), Las Vegas, NE, July 2005.
14. Hoonakker, P.L.T., Carayon, P. & Schoepke, J. (2005). Work Family Conflict in the IT Work Force. Human Factors in Organizational Design and Management - VIII, edited by Carayon, Kleiner, Robertson and Hoonakker. Santa Monica, CA: IEA Press, pp. 81-86.

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16. Korunka, C., Hoonakker, P.L.T. & Carayon, P. (2005). [A Universal Turnover Model for the IT Work Force - A Replication Study](#). Human Factors in Organizational Design and Management - VIII, edited by Carayon, Kleiner, Robertson and Hoonakker. Santa Monica, CA: IEA Press, pp. 467-472.
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Curriculum Vitae

Peter Leonard Titus Hoonakker was born on January 30, 1958 in Nijmegen, The Netherlands. He grew up in Hengelo, where he finished high school.

He received his Master's Degree in Psychology at Utrecht University in The Netherlands in 1988.

From 1988 until 1994, he worked as research scientist at first the Psychonomics Department and later the Department of Clinical and Health Psychology at Utrecht University. In 1994, he and some of his colleagues at Utrecht University started the Institute for Work & Stress where he was Director. In 1996 he started P2 Research and Advice, where he was Director.

In 1999, his partner and he got an offer to work at the Center for Quality and Productivity Improvement (CQPI) at the University of Wisconsin-Madison, in the United States of America. From 1999 until now, he has been working as research scientist at CQPI. Throughout his career, he has worked on many different research projects in The Netherlands and the USA, and on international research projects in collaboration with researchers in other countries.

His main interests are working conditions, job and organizational factors, and the relationships with quality of working life (job satisfaction, organizational commitment and burnout) and various outcome measures such as perceived health, work-related musculoskeletal disorders, psycho-somatic complaints, and injuries and absenteeism. He has conducted research in various branches of industry such as construction industry, manufacturing industry, the information technology sector, educational institutions, the public sector, mental health institutes, and most recently in health care.

He has published the results of his studies in more than 60 technical reports and nearly 100 conference papers, book chapters, and journal articles in for example the American Journal of Preventive Medicine, Applied Ergonomics, Behaviour and Information Technology, Human Factors in Ergonomics in Manufacturing, Theoretical Issues in Ergonomics, Total Quality Management, Social Science & Medicine, Social Science Research, and the Cochrane Database of Systematic Reviews.

He has reviewed articles for Applied Ergonomics, the European Journal of Information Systems, Human Factors, Information Technology & People (ITP), Applied Health and Safety Studies, Journal of Medical Internet Research, Journal of Occupational and Environmental Medicine, Organizational Research Methods, and the Scandinavian Journal of Work, Environment and Health.

For more information, visit his webpage at the Center for Quality and Productivity Improvement (CQPI) at UW-Madison: <http://cqpi.engr.wisc.edu/hoonakker> or his personal website: <https://mywebspace.wisc.edu/plhoonakker/web/Index.htm>

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