THE GEORGE WASHINGTON UNIVERSITY
CYBER SECURITY POLICY AND RESEARCH INSTITUTE
Thoughtful Analysis of Cyber Security Issues

Recruiting, Educating, and Retaining Cyber Security Professionals in the Federal Workforce: Lessons Learned but not yet Applied

Diana L. Burley, Ph.D.
Graduate School of Education and Human Development
The George Washington University

Report GW-CSPRI-2011-1

February 2, 2011

Abstract

Cyber security risks pose some of the most serious economic and national security challenges of the 21st Century. In order to effectively meet this challenge, the United States must develop a comprehensive and coordinated effort to recruit and retain cyber security professionals in the federal workforce (Partnership for Public Service/Booz Allen Hamilton 2009). This talk will explore the impact of one such effort, the Federal Cyber Service Scholarship for Service (SFS) program. Although service corps programs like SFS are an effective recruitment method, they do not guarantee that the new service corps members will remain in the federal cyber security workforce after the public service commitment period expires. However, given the high cost of this recruitment and socialization tool, it is critical to gain insight about the retention of federal cyber corps members. Thus, this talk will present the results of a study that investigated the turnover intentions among future members of the federal cyber corps. We will explore how individual, job-related and organizational factors influence their ex-ante intention to stay. Through our discussion, the talk will place the study results within the larger context of the cyber security workforce.

Recruiting, Educating, and Retaining Cyber Security Professionals in the Federal Workforce: Lessons Learned but not yet Applied

Diana L. Burley, Ph.D.
Graduate School of Education and Human Development
The George Washington University

Introduction

President Obama, like Presidents Bush (ref. *National Strategy to Secure Cyberspace*) and Clinton (ref. *National Plan for Information Systems Protection*) before him, has made the recruitment and retention of cyber security professionals a national security priority[1]. Noting that cyberspace underpins almost every facet of modern society and that the nation's computer networks face constant attack from a host of enemies, Mr. Obama asserts that cyber security risks pose some of the most serious economic and national security challenges of the 21st Century (CPR 2009).

To effectively meet this challenge, industry analysts suggest that the United States must develop a comprehensive and coordinated effort to recruit and retain cyber security professionals in the federal workforce (Partnership for Public Service/Booz Allen Hamilton 2009). For many federal agencies this effort includes innovative strategies to bolster the federal workforce. For instance, service corps programs, which provide educational scholarships in exchange for some period of public service, are being used as creative recruitment and socialization tools. The federal cyber corps programs, offered through the National Science Foundation in partnership with the Departments of Defense and Homeland Security, are model service corps programs. The federal cyber corps programs consist of the Federal Cyber Service: Scholarship for Service (SFS) program and the Information Assurance Scholarship Program (IASP). The larger of these two offerings, the SFS program, is the focus of this study.

SFS is an inter-agency service corps program that recruits future members of the federal cyber security workforce (see https://sfs.opm.gov/). Since the program's inception in 2001, the federal government has distributed more than $75 million in scholarship support, with another $15 million used to develop curricular innovations and socialization activities, for nearly 800 current and future members of the federal cyber corps. The SFS program was offered through 21 different academic institutions (see the program website at https://sfs.opm.gov for a list of participating institutions) and had 196 current students at the time of this study. In exchange for post-graduation service in the federal cyber corps, SFS students receive scholarship support for up to two years of study in a cyber security program. These two years of study can be the last two years of undergraduate study, two years of a master's degree, or two years of doctoral study as new as possible to degree completion.

Although service corps programs like SFS are an effective recruitment method, they do not guarantee that the new service corps members will remain in the federal cyber security

---

[1] Cyberspace Policy Review: Assuring a Trusted and Resilient Information and Communications Infrastructure,
<http://www.whitehouse.gov/assets/documents/Cyberspace_Policy_Review_final.pdf>

workforce after the public service commitment period expires. Although significant research has been conducted on the turnover intentions of IT professionals once they are engaged in an employment relationship, not much is known about the ex-ante turnover intentions of future IT professionals. Moreover, no study of the turnover intentions of future cyber-security professionals has been done. Given the high cost of this recruitment and socialization tool, however, it is critical to gain insight about the turnover intentions of cyber corps participants prior to their entrance into the federal cyber corps. Thus, this study investigated the turnover intentions among future members of the federal cyber corps and asks the question of how do individual, job-related and organizational factors influence their ex-ante intention to stay? This report summarizes the study premise, conceptual framework and findings. The report concludes with a brief discussion of the implications of the study results.

Determinants of Turnover Intentions

The high cost of recruitment and socialization activities, along with the strategic importance of an organization's human capital, has led to the wide investigation of employee retention and turnover in the scholarly IT literature (e.g. Agarwal et al. 2007, Kim and Lee 2007). For public sector IT workers, job-related factors such as public service motivation (e.g. Perry, 1997), affective commitment to the agency (e.g. Mowday, Steers and Porter 1979, Naff and Crum 1999, Kim and Lee 2007), role ambiguity and conflict (e.g. Igharia and Greenhaus 1992, Kim 2005, Reid et al. 2008) and organizational factors such as task variety (e.g. Reid et al. 2008) have been identified as key antecedents of turnover intention. Agarwal et al. (2007) experimentally examine the ex-ante turnover intentions of new IT workforce entrants. Focusing on risk and situational variety, their findings reinforce the importance of individual, job-related, and organizational factors on turnover intentions, and suggest that the interaction of these factors can influence turnover intentions.

This study extended the research on ex-ante turnover intentions among public sector IT workers by focusing on future members of the federal cyber corps as indicated by their participation in the SFS service corps program. Four antecedents of turnover intention are considered: affective commitment to the agency, public service motivation, role stressors (role ambiguity, role conflict), and preferred variety. As suggested by Agarwal et al. (2007), focusing the analysis to a limited set of antecedents that have been shown to be relevant factors for public sector IT workers, has both theoretical and practical benefits. Theoretically, fewer variables allow for a more parsimonious explanation. Practically, fewer variables should facilitate the use of study results to influence recruitment and retention activities.

The conceptual model, adapted from Agarwal et al. (2007) and shown in Figure 1, posits that the role stressors of role ambiguity and role conflict, and commitment to public service directly influence turnover intentions, and that the influence of affective commitment to the agency is moderated by individual preferences of an ideal work environment. Although Agarwal and her colleagues (2007) include situational risk in their model, it is not included here. Situational risk refers to the level of vulnerability associated with the organization. This study focused on future IT professionals who have already made the commitment to go to work for the federal government and SFS participants are effectively guaranteed employment for the length of their service period (typically 2 years).
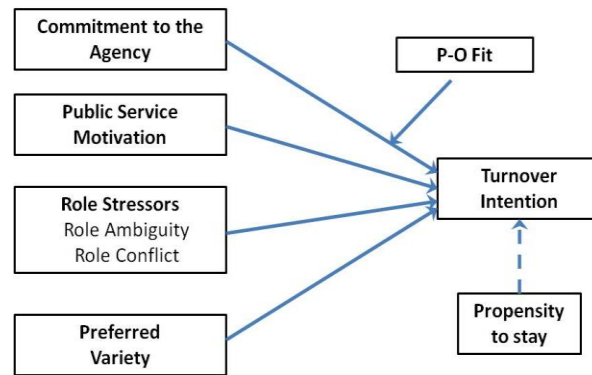
Figure 1. Conceptual model of turnover intentions for future cyber corps members.

The second adaptation of the model is the inclusion of affective commitment to the agency. Affective commitment to the agency has been shown to be an important consideration for turnover intention in the public and non-profit sectors (Kim and Lee 2007). Affective commitment is the strong belief in and acceptance of the organizational (or agency) mission (Mowday, Steers and Porter 1979). Although the overall mission of the federal government is consistent across agencies, each individual agency has its own distinct mission. Public sector agencies are mission-driven institutions where employee mission attachment plays a significant role in retention (Kim and Lee 2007). The mission at NASA is very different than at the Department of Defense, which is different from the mission at the Department of Education.

Given these distinctions, matching the agency mission to individual preferences of an ideal work environment is an important factor to consider. For cyber security professionals, a significant distinction exists between Department of Defense and intelligence community agencies and civilian agencies. Thus, the model includes affective commitment to the agency with a moderator of person-organization fit. Though support for the moderating effect of situational variety was not supported in the Agarwal et al. (2007) study, as they suggest, additional exploration is warranted.

Public service motivation has been empirically shown to have a negative association with employee turnover intentions in government agencies (Naff and Crum 1999). Further, Ihrke (2004) suggests that the fit between an agency's mission and the preferred mission of the individual employee is a determining factor for intention to stay in that agency; finding that a fundamental change in the mission of a federal agency significantly influenced the desire to change jobs.

Role ambiguity is the extent to which the responsibilities of and expectations for the role are not well defined (Bostrom 1981). The more clearly a role is defined, the easier it is for the employee to fulfill role requirements (Bostrom 1981). IT professionals often experience role ambiguity as their tasks are often broadly defined and variable (Igharia and Greenhaus 1992). Moore (2000) found that role ambiguity and role conflict are contributing factors of work exhaustion and turnover intentions of IT professionals. Role conflict occurs when employees

perceive an inconsistency in expectations and job requirements (Bostrom 1981) and has a negative influence on IT employee retention (Igharia and Greenhaus 1992).

Preferred variety refers to the individual preferences for variety that a job could offer in their career. Specifically, this variable refers to the preference for variety of work experience, the variety to mobility among IT jobs, and the preference for variety of skills obtained in this job. Larger, more complex agencies are likely to have a greater variety of both technologies and experiences than smaller agencies. It is also true that the desired amount of variety in an organization varies across individuals (e.g. Inman 2001). Given the importance of the person-organization fit for reducing turnover (Kristof 1996), it is critical to understand preferred variety with turnover intentions.

Finally, we include propensity to stay as a control variable for turnover intention in the context of future members of the federal cyber corps since there may be differences in each individuals' propensity to remain in a specific job. In this context, propensity to stay refers to the individual's expected employment duration with a single agency.

Data Collection and Sample Demographics

Study participants included future members of the federal cyber corps as indicated by their current participation in the Federal Cyber Service: Scholarship for Service (SFS) program. At the time of this study, the program included 196 participating students and all 196 SFS students were included in the study sample population. Data collection occurred through a web-based survey administered during early January 2010. Data collection efforts resulted in 122 survey responses; yielding a 61% response rate. Of these, 106 responses (or 54% of the population) were complete and used in the analysis.

Table 1 shows the demographic characteristics of the sample. The 106 respondents attended 21 different academic institutions. Of them, 69% joined their program in 2009, 62% had relevant prior work experience, 63% were under the age of 25, 78% were male, and 75% were enrolled in master's degree programs. Slightly more than 50% of respondents identified themselves as majoring in computer science or engineering. Less than 10% responded favorably to the statement that they would likely leave the public sector cyber corps at then end of their service period, and approximately 60% indicated a preference to work for an intelligence or security agency.

Table 1. Sample Demographics

Variable	Frequency	%
Gender		
Male	83	77.6
Female	24	22.4
Age		
< 25	67	62.6
25-35	40	37.4
Degree Program		
BA	21	20.1
MS	78	75
PhD	5	4.8
Prior Work Experience	66	62.3
Concentration/Major		
Computer Science/Engineering	56	52.9
Information Assurance/Security	27	25.5
Information Science/Management	23	21.7
Year of Program Entry		
'2008	24	23
'2009	70	67.3
'2010	7	6.7

Analysis Method

The survey instrument was designed to collect data on the relationship between individual, job-related and organizational factors and the ex-ante intention to stay in the federal cyber corps. Variables were measured using survey items as provided in the validated instruments used in Argawal et al. (2007) for preferred variety, Bright (2008) for person-organization fit, propensity to stay, Tsui et.al. (1997) for commitment, Perry (1996) for public service motivation, and Moore (2000) for role ambiguity and role conflict. Items were measured using a seven-point Likert-type scale ranging from strongly disagree to strongly agree. Item

correlations and regression models were used to determine if/how individual, job-related and organizational factors influence the ex-ante intention to stay of future members of the federal cyber corps. Findings are summarized below.

Summary Findings

Table 2 shows the combined response means for each of the key variables in the model. Of the scaled items, respondents indicated that the variety of tasks and experiences, along with the fit between their individual preferences and the organizational priorities were important antecedents to turnover intention. The job related characteristics, balanced workload and role conflict, also proved to be important factors for turnover intention. Public service motivation and the attachment to agency mission were not as important to turnover intention.

The results of the correlation and regression analyses provided the following key findings:

- Individual factors: Public service motivation was significantly, negatively correlated with turnover intention.

- Job-related factors: Respondents preferred a high degree of task variety. However, they wanted this variety to come with clear job roles and low levels of role conflict. Both role ambiguity and role conflict were positively correlated with turnover intention.

- Organizational factors: Mission attachment was negatively associated with turnover intention. The higher the attachment to the agency mission, the lower the turnover intention.

- The better the fit between workplace mission and preferred mission of the individuals, the lower the turnover intention.

- The results did not indicate significant differences in motivators for turnover intentions based on demographic variables, program tenure, or academic major.

Table 2. Combined response means

Items	Combined Mean
Preferred variety	6.16
Person-organization fit	6.07
Propensity to stay	5.71
Role ambiguity	5.68
Balanced workload	5.63
Public service motivation	5.37
Role conflict	5.34
Mission attachment	4.99

Conclusion

This research sought to explore how individual, job-related and organizational factors influence the ex-ante intention to stay in the workforce of future members of the federal cyber security workforce. The results of this study suggest that this population of future members of the federal cyber security workforce will be driven by similar individual, job-based, and organizational characteristics as those which motivate current members of the public sector IT workforce to remain with their employer. The results highlight the importance of person-organization fit in maintaining a strong employment relationship and suggest that care should be taken to ensure that employees and employers are properly matched.

References

Agarwal, R. and Ferratt. 1999. *Coping with Labor Scarcity in Information Technology: Strategies and Practices for Effective Recruitment and Retention*, Cincinnati, OH: Pinnaflex.

Agarwal, R., Ferratt, T. and De, P. 2007. "An Experimental Investigation of Turnover Intentions Among New Entrants in IT," *The Database for Advances in Information Systems*.

Baroudi, J. J. 1985. "The impact of role variables on IS personnel work attitudes and intentions," *Management Information Systems Quarterly*. 9, 4, 341-356.

Bostrom, R. P. 1981. Role conflict and ambiguity: Critical variables in the user-designer relationship.

Igharia, M. and Greenhaus, J. H. 1992. "Determinants of MIS employees' turnover intentions: A structural equation model," *Communications of the ACM*, 359, 2, 34-45.

Ihrke, D. M. 2004. "Mission Change in a Federal Agency and its Link to Employee Transfer Preferences," *American Review of Public Administration*. 34, 2, 181-198.

Inman, J. 2001. "The Role of Sensory-Specific Satiety in Attribute-Level Variety Seeking," *Journal of Consumer Research*, 28, 1, 105-120.

Kim, S. 2005. "Factors Affecting State Government Information Technology Employee Turnover Intentions," *The American Review of Public Administration*, 35, 2, 137-155.

Kim, S. E. and Lee, J. W. 2007. "Is Mission Attachment an Effective Management Tool for Employee Retention? An Empirical Analysis of a Nonprofit Human Services Agency," *Review of Public Personnel Administration*, 27, 227-248.

Kim, S., Wright, B. E. 2007. "IT Employee Work Exhaustion: Toward an Integrated Model of Antecedents and Consequences," *Review of Public Personnel Administration*, June, 27,147-170.

Lewis, G. B. and Frank, S. A. 2002. Who wants to work for government. Pubic Administration Review, 62, 395-404.

Mowday, Steers, R. M. and Porter, L. W., (1979). The Measurement of Organizational Commitment. Journal of Vocational Behavior, 14, 224-247.

Naff, K. C. and Crum, J. 1999. Working for America: Does Public Service Motivation Make a Difference? Review of Public Personnel Administration, 19, 4, 5-16.

Opsahl, A. 2008. IT Workforce shortage Forces Government to Change Recruiting Methods. Public CIO Magazine, 2/1/2008.

Porter, L. W. and Steers, R. M. 1973. Organizational work and personal factors in employee turnover and absenteeism. Psychological Bulletin, 80, 2, 151-176.

Reid, M. F., Riemenschneider, C. K., Allen, M. W. and Armstrong, D. J. 2008. "Information Technology Employees in State Government," *The American Review of Public Administration*, 38, 1. 41-61.

Rigas, P. 2009. "A model of turnover intention among technically-oriented information systems professions," *Information Resources Management Journal*, 22:1, pp. 1-23.

Diana L. Burley, Ph.D.
Department of Human and Organizational Learning
Graduate School of Education and Human Development
The George Washington University

GW Virginia Science and Technology Campus
44983 Knoll Square, suite 147
Ashburn, VA 20147
703-726-3761
dburley@gwu.edu

Diana L. Burley is an Associate Professor in the Graduate School of Education and Human Development at The George Washington University. Dr. Burley joined GW in 2007 and during her tenure at the university she has served as the inaugural Department Chair of the Human and Organizational Learning Department and as Director of the Executive Leadership Doctoral Program. Prior to joining the GW faculty, she served as a Program Officer in the Directorate for Education and Human Resources at The National Science Foundation (NSF). At NSF, she managed multi-million dollar grant programs designed to increase the capacity of the U.S. higher education enterprise to produce professionals in scientific fields. Her area of expertise at NSF was in computer science education. Based on her work, she was honored by the Federal Chief Information Officers Council and the Colloquium on Information Systems Security Education for outstanding efforts toward the development of the federal cyber security workforce. She currently serves as Vice Chair of the Association for Computing Machinery Special Interest Group on Computers and Society. Dr. Burley holds an M.S. in Management and Public Policy, an M.S. in Organization Science, and a Ph.D. in Organization Science and Information Technology from Carnegie Mellon University.