Improving the Retention of United States (U.S.) Government Science, Technology, Engineering, and Mathematics (STEM) Employees

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Improving the Retention of United States (U.S.) Government Science,

Technology, Engineering, and Mathematics (STEM) Employees

by

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ABSTRACT

The U.S. government workforce has been consistently shrinking since a peak in the 1990s. At the same time, the need for technologically-savvy government workers has dramatically risen in this same period. This divergence in the demand for science, technology, engineering, and mathematics (STEM) employees challenges government leaders to retain these highly demanded workers in the public sector.

Decades of psychological research across many industries has investigated what motivates workers and how best to incentivize them to increase productivity. Maslow and Herzberg, among others, theorized that adult workers have both intrinsic and extrinsic needs that drive their behaviors and resultant productivity. Following from those early psychological explorations, extensive Public Service Motivation theory and Job Design studies provide the scaffolding on which management of federal government employees is built. A number of themes emerged from these studies which affect public service personnel: competitive pay and benefits, bureaucracy, human resources, career options, personnel development. These themes are used to develop human capital policies that drive managerial incentives intended to motivate their employees. Traditionally, these studies focus only on groups of current civil servants.

This dissertation was a two-phased explanatory sequential mixed-method investigation into STEM workers who departed federal service. The first phase was a quantitative examination into former employees' motivations and decisions leading up to their departure; sample size = 73. Phase 2 qualitatively inquired into eight intentionally selected interviewees about the factors that influenced their decision-making process. Regression analysis of the responses showed a significant positive correlation between Years of Government Service with Decision Making Autonomy and Task Significance. In short, this means that if a person

has meaningful work and the self-authority to complete it, they will stay working longer. The Phase 2 interviews brought one additional important piece to the conclusions which is that supervisors are the key factor in motivation and retention. The results are in line with predictions of Herzberg's Motivation-Hygiene approach to motivation.

Recommendations were made to improve the control and impact of first-line supervisors; such as to standardize and monitor supervisor training; and, to implement a talent management program.

DEDICATION

There are two distinct groups for whom this work is dedicated. The first are my co-workers. These are the loyal and highly dedicated federal civil servants who supported and motivated me with their appreciation that I was taking on this study. It energized me to hear from them about the value of my research. They are the reason I go to work everyday.

The other group is my family, without whom I could not have completed this monumental task. My grandmother, Tutu, passed away before I finished; but even in her final weeks told me she was proud of me and would be there when I graduated. My mom and dad who instilled a life-long desire to learn, to constantly improve, and demonstrated how to love unconditionally. My in-laws who motivated me to strive for ever-bigger goals. My brother and his family who routinely checked up on my progress. My children, Danny and Becca, for expanding my mind and heart to consider alternative perspectives. And, of course, my best friend, life partner, and loving wife, Perla, for supporting and encouraging me through the crazy challenges of completing graduate school while working full time. (I know, I know…you were right!) I love you all very much, and never could have done this without you!

ACKNOWLEDGMENTS

What is not obvious to a reader of this dissertation is that I am actually nearing the end of my second career – I retired from the Navy as a helicopter pilot, then have worked many years as a federal civil servant. It has been more than ten years since I completed my Master's degree or had any formal academic education. Therefore, there are so many people who directly contributed to my doctoral work it is hard to know where to begin to thank them all.

In general, I have to thank the amazing faculty of University of San Diego. The SOLES program has profoundly changed me as an individual and leader. Specifically, I am so honored to have incredible leaders and intellectuals on my dissertation committee. Afsaneh Nahavandi was the first person to welcome me into graduate school, and included me in her group of graduate students creating a sense of community and learning. Hans Schmitz enthusiastically took on the role of committee chair and guided me to pursue research that was meaningful for me. Fred Galloway pushed me through the statistics and quantitative analysis with energy and humor. Bob Parker is also a co-worker who fearlessly jumped in with me on this journey to improve our civilian workforce. And one of my longest-term friends and mentors, Rear Admiral Shoshana Chatfield – from first squadron "on wing" now to "doctor", she has always been a guide, a leader, and an inspiration for me. Thank you all for helping me reach this tremendous milestone.

PREFACE

Imagine that you are the supervisor for a software-intensive military project. Perhaps your team is writing code to enable a missile seeker to transmit the video it is collecting back to headquarters so that national leadership can watch what the missile is "seeing" all the way to impacting the target; or, designing an intelligence analysis system that gives our imagery analysts access to big data repositories allowing for more accurate and actionable recommendations for leadership. In all cases, the team is an interdisciplinary group of software engineers, data scientists, computer scientists, communication specialists, and systems engineers responsible to deliver an effective solution to the warfighter while being good stewards of taxpayer dollars.

One of your key computer scientists who has been working on your project for several years, comes to your office and tells you that she was offered a lucrative position with FANGAMY[1] Corporation. You immediately realize that if this person leaves your team, her departure would have a significant impact because you would lose the benefit of her experience and knowledge. To hire a new specialist, train that person, and start to get useful work out of them will take a considerable amount of time. This delay will negatively impact your delivery timeline.

What can you as the manager do? Why would this talented employee leave? What incentives do you have at your disposal to keep this key player? What factors influenced her to take another job in the first place?

This scenario, which plays out several times a month across the government, sets the stage for my research. Because of the large price tags of highly sophisticated systems that are

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[1] Although clearly a fictional entity, the acronym FANGAMY includes the first letters of the companies where some former government STEM workers go after public service – Facebook, Amazon, Netflix, Google, Apple, Microsoft, and Yahoo!.

needed in today's technological environment, the U.S. government has always been one of

the leading employers of technical personnel. Supervisors and first-line managers need to

understand what motivates talented STEM workers to leave. So as technical specialists get

drawn away from government service for a variety of reasons, human capital policy and

talent management processes can enable managers, at all levels of government, to retain key

employees when circumstances dictate that retention is essential.

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CHAPTER ONE

Background: STEM Demand in the U.S. Government

Several decades ago, the U.S. government led the country, perhaps even the world, in technical research and employment of scientists, technologists, engineers, and mathematicians (STEM). Employment of these experts was necessary to design, develop, build, and maintain highly sophisticated systems in support of military and other national security operations. The complexity of systems has increased over time, and this growth in complexity of systems is compounded by the fact that more and more commercial companies include technology in their products. On a global scale, rising trends in technological advancements and scientific discoveries further force the U.S. government to place more emphasis on STEM policies and innovation. The outcome of existing policies has not been especially positive when compared to many of this country's international governmental counterparts (Gibbs, 2005; H. B. Gonzalez & Kuenzi, 2012; McPhie et al., 2008).

The issue of retaining STEM personnel is significant since evidence shows that the total numbers of U.S. government employees has been declining over the last several years, particularly in STEM fields (McPhie, Rose, & Sapin, 2008). Inadequate human capital policies do not address this challenge causing stress, frustration, and continued outflow of staff, while the amount of work required to be performed has increased. Furthermore, universities, colleges, and trade schools cannot graduate enough students to keep pace with the demand. There is also evidence that recruitment specialists in many government agencies

face ongoing challenges in recruiting and retaining top performers because younger workers (e.g., millennials) are more inclined than older employees to move jobs; they are not predisposed to remaining in a government position if a job outside the government is more interesting, lucrative, or socially-conscious. Thus, Human Resource representatives are competing with the private sector for talented human capital (Johnson & Libecap, 1994; Ertas, 2015).

Following a sharp contraction in the size of the federal government after World War II, in 1945-1946, there was a continuous expansion until 1990 (see figure 1). Since a peak in May 1990 of 3.4 million employees, according to Bureau of Labor Statistics data (BLS), the total number of U.S. government employees (including all three government branches and the military) has steadily decreased. Recent statistics available from the Office of Personnel and Management (OPM) website on November 2, 2020, indicate that the current number of civilian employees in the U.S. government is around 3.1 million people. This number includes the Postal Service and specialists from all professional areas such as administrative, scientific, and engineering. If we normalize the graph to eliminate decennial census workers, the total number is closer to 2.8 million. Many of these positions mirror similar jobs in the private sector, so the U.S. government competes for talented people with private businesses, large and small.

Figure 1

Federal government employees (1945-2020), seasonally adjusted

All employees, thousands, federal, seasonally adjusted
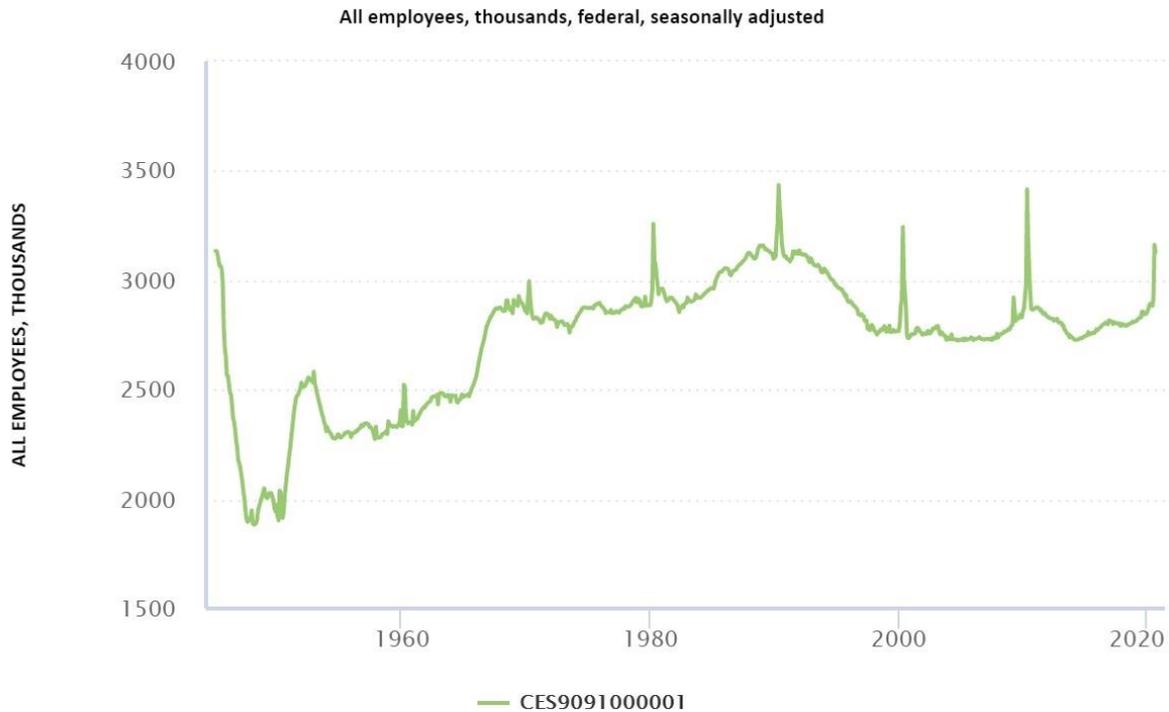
Retrieved on 2 Nov 20
Source: U.S. Bureau of Labor Statistics.

Because the number of government employees has shrunk in recent years, private

industry has taken over some research and development roles that previously were done by

government agencies, particularly in science and technology fields. However, given certain

federal regulatory factors, government personnel still are needed to oversee or perform key

technical tasks. Examples of these inherently governmental tasks listed in the Federal

Acquisition Regulation (FAR), Subpart 7.503, include activities such as: (a) ensuring that

contracting is accomplished in an equitable way; (b) creating appropriate requirements for

new systems; and, (c) validation and verification of delivered products. Without adequate

numbers of government employees, the U.S. government will not be able to accomplish these

necessary tasks. Therefore, an optimal number of government employees must be maintained

to support these activities. Retention of key employees is, therefore, critical for the government and military to fulfil their Constitutional duties.

<div align="center">**Retention of STEM Government Employees**</div>

The Current Situation

Year after year, a philosophical pendulum swings from one extreme to the other regarding the appropriate size of government. These oscillations change with the ideology of the political party in power and the corresponding size of the appropriated budget. Traditionally, Republican-controlled governments tend to be smaller with more power held at the state level; while governments led by Democrats swell the ranks of federal workers to administer additional social services and provide oversight roles. The non-partisan Pew Research Center confirmed these opposing philosophies during a sweeping survey. In fact, Pew went beyond confirming a simple ideological difference because their survey showed a widening partisan divide that could result in bigger swings in the future when political parties change majority control (Pew, 2015). As these fluctuations continue, retention of qualified federal employees has been the subject of much on-going debate and study for several years.

Is There a Crisis?

As the debates persist, addressing the issue of STEM retention is one of perpetual importance to the U.S. government. However, some recent studies question the idea that a crisis exists or even that a crisis is developing. To be sure, there is no clear evidence that a crisis currently exists; however, there are indications that shortages may be on the horizon (Butz, et al., 2015). Human capital shortages may ultimately be due to pipeline delays and slow-downs in academia. There may also be the additional challenge of enrollment of large numbers of international students in key technology programs who return to work in their own

countries after graduation (Xue, Larson, 2015), but who took up educational slots that may have been filled by U.S. students. Also, there are many students who graduate with STEM degrees but choose not to work in a STEM field. Not to mention post-pandemic studies that are just starting which may show longer education timelines, increased resignations, and a further exodus from the traditional workforce. These challenges will, over time, create a dearth of qualified degreed workers to fill U.S. government positions (Xue, Larson, 2015). It follows then, that a lack of inflow of STEM employees leaves a gap as current federal workers retire or resign.

STEM is a broad term encompassing many specialties and degree fields. Claims about an emerging STEM worker crisis also depend on the sub-section of STEM that is required to fill certain jobs and at what education or experience level (Xue, Larson, 2015). For example, although biologists and medical professionals may be abundant, a lack of computer scientists and software engineers, particularly with PhD degrees and related experience, could be cause for concern. Historically, studies have raised awareness and additional concern about the differential between professional specialties but resulted in only evolutionary adjustments to policy.

Carnegie Commission Recommendations

A seminal exploratory study addressing retention issues was a report by the National Research Council's Office of Scientific and Engineering Personnel submitted to the Carnegie Commission on Science, Technology, and Government titled "Recruitment, Retention, and Utilization of Federal Scientists and Engineers" (Campbell & Dix, 1990). The initial report and subsequent studies in 1990 and 1993 identified a number of factors that impact retention, including: (a) weak department leadership, (b) onerous ethics laws and reporting, (c) lack of

ownership of intellectual property, (d) geographic locations, (e) poor working conditions and equipment, and (f) an overall negative public image of federal workers (Campbell & Dix, 1990; Campbell et al., 1993). The findings triggered superficial and temporary changes in hiring and compensation policies from OPM (Campbell et al., 1993), but have not led to any fundamental systemic improvements.

Apart from these factors, the reports primarily emphasize salary recommendations proposing locality pay (a salary supplement based on where the employee lives) and the Demonstration Pay program (a standard pay scale that allows for pay bands which provide for a limited amount of raises at each paygrade) (Campbell & Dix, 1990; Campbell et al., 1993). These recommended pay differentials from 1993 are still in effect today, close to 30 years later.

In the past, perks, commonly referred to as *fringe benefits,* associated with federal employment have significantly lagged behind what the private sector offers. The U.S. Department of Labor publishes a standard way of calculating these indirect costs, which guides what different offices within the U.S. government must charge each other and foreign countries when working together (Labor, 2014). Fringe benefits, as defined by the Bureau of Labor, include, but are not limited to: life insurance, health insurance, pension, vacation, holidays, and sick leave (Labor, 2014). With the aim of better retention over the last several years, there have been several improvements and additions to benefit options available to government employees. Besides the traditional pension, options are now available for employees to participate in: an investment retirement fund with a percentage of the employees' contributions matched by the government, managed health care, faster accrual of vacation time, and more flexible sick leave days. These options are similar to fringe-benefit options found in the private sector.

Existing Challenge

When taken together – decreasing federal employment, possible STEM supply limitations, outdated government benefits, and increasing industry STEM capacity – and compared to the ongoing need to perform inherently governmental tasks, the problem of adequate retention becomes evident.

Federal STEM Retention: the perspective of those who departed

To add to existing studies, this study considers the issue of federal government STEM retention, from the perspective of individuals who have left government employment. The intent is to apply motivation theories to evaluate and analyze individuals' stated reasons for leaving their previous government positions. Specifically, public service motivation (PSM) and Job Design (JD) theory will be the focus of this study.

The results can be used to develop a profile for an employee who could be called an "at-risk" employee – someone who may be inclined to depart government service. In a next step, the representative profile of former employees will be compared to the characteristics of similar demographics from current STEM workers to estimate how many are "at-risk" and to develop possible mitigation strategies.

To summarize, additional and up-to-date research is needed to determine where the U.S. government has employee shortages today and where and when the country can expect to have professional gaps in the future. Ultimately, this approach can lead to policy and incentive changes targeted to retain an appropriate number of STEM professionals.

Research Questions: Why Do STEM Workers Leave?

It is the responsibility of the Office of Personnel Management (OPM) to manage and track retention rates across the entire government, and this agency typically accomplishes this

task by conducting surveys among the current workforce. Although these surveys are an important reference marker, OPM surveys ignore a critical group: individuals who have worked on STEM projects in the government in the past but have since departed. This is a challenging population to access. But the insights individuals in this sample frame conceivably can provide would be invaluable information for future retention incentive planning and overall policy development. While current employees are an important source of data for comparisons, their perspectives are hypothetical in nature. Only those who have actually left can provide critical insights into the decision-processes of someone having decided to depart government service.

Research questions are derived from the purpose expressed in the previous section. They are intended to, at least initially, respond to that purpose and must address why STEM employees departed their governmental positions.

Modeled after Marshall and Rossman (2016), the conceptual framework for this research is found in Figure 2. The general phenomenon to be studied is "Government STEM Capacity."

Figure 2

Conceptual framework for understanding why government STEM workers depart government service
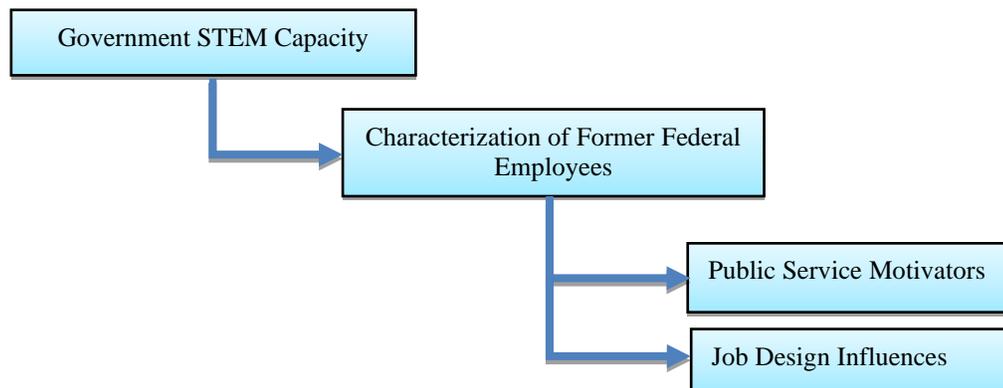
The specific focus area, or place to observe, is "Characterization of Former Employee Retention and Motivation." This framework leads to the following specific questions which will guide this study:

1. What are the most frequent factors (i.e., sub-constructs) that influence years of federal government service?

2. Which Job Design (JD) sub-constructs had the most and least influence on years of federal service?

3. Which Public Service Motivation (PSM) sub-constructs had the most and least influence on years of federal service?

4. How did the experiences of government STEM employees who left government service affect their decision to leave?

Significance of the Study: Effecting Human Capital Policy

Since the 1990s there has been and continues to be public administration research into areas within Public Service Motivation, and there appears to be almost exponential growth in the number of articles, journal entries, and first-time authors in this field (Bozeman & Su, 2015; Ritz et al., 2016). But among the studies reviewed for this paper, a limited number differentiated between specific STEM fields – chemistry, computer science, software engineering, information technology, etc. Motivations may differ depending on an employee's specific career field; and, incentives used to retain specialists in those areas will need to be tailored. For example, a biologist or forestry expert may be more motivated by environmental strategies and prefer to work toward ethical policy reform. In contrast, a software engineer may insist upon financial incentives due to higher private sector demands for their skills.

These distinctions need to be captured and analyzed to fully inform managers on how best to retain workers.

Additionally, the studies almost exclusively rely on survey data from employees who were currently employed in the public sector, with no data collected from individuals who used to work in the public sector and left. This typically disregarded population would provide useful insights into the main drivers motivating employees to stay or leave government service.

And finally, only recently have studies begun to scratch the surface of describing basic demographics such as race, gender, years of public service, etc., as they relate to PSM and motivations. The term "profile" has, perhaps, a negative connotation; however, once key demographic characteristics of a typical government STEM worker are collected and analyzed, assessed for when and why a worker departs government employment in terms of PSM values, then governmental managers will have a clearer picture of how best to motivate their workers to achieve better productivity and retention.

This study has the potential to affect federal STEM retention and incentives at both a micro and macro level. The micro impacts will be implementable by line managers. These incentives will apply to specific key members of an integrated product team that the manager believes may be at-risk for departing the government which would have a negative influence on the mission of that team.

Macro influence will be aimed at broad Navy and DoD policies for human capital that may include salary, bonus, promotion, education, leadership positions, etc. Changes to the macro level generally require years to implement, but would have far-reaching applicability in the government.

Site of Study

Although the federal government encompasses many departments and branches (Departments of Justice, Agriculture, State, Congress, etc.), the most technologically advanced, and therefore STEM "heavy", is the Defense Department. Responses were solicited from all branches and departments at the federal level, with a focus on the Defense Department.

Summary of Findings

This study garnered quantitative responses from 73 former federal government employees from which a subset of 8 individuals were selected to be interviewed. Results of the research found a significant correlation between four independent variables and the dependent variable, as well as meaningful qualitative inputs from the interviews. The analysis, gathered from this understudied population, is in keeping with Herzberg's *Motivation-Hygiene* theory when applied to Public Service.

Quantitatively, the data showed that YEARS_OF_SERVICE (dependent variable) is positively correlated with DECISION_MAKING_AUTONOMY and TASK_SIGNIFICANCE while being negatively correlated with WORK_CONDITIONS and FEEDBACK_FROM_JOB. The positive variables are both considered "Motivators" under Herzberg's theory, while the negatively correlated variables would be defined as "Hygiene" factors.

The interviews supported these quantitative points and added another dimension of supervisory support. Nearly all of the interviewees indicated that their final governmental supervisor could have changed the outcome of their decision to leave the government resulting in them staying in a STEM job instead of departing federal service.

Chapter Overview

The Introduction, Background, and Research Questions posed in Chapter 1 set the baseline knowledge for this study so that readers may understand and appreciate the focus and significance of this topic. Chapter 2 includes a detailed literature review of relevant texts, articles, and historical publications about Motivation Theory and Job Design. Chapter 3 provides the study's methodology, particularly the data collection and analysis strategies that were employed throughout the research. Chapter 4 details the findings of the work. And finally, Chapter 5 provides conclusions, human capital policy recommendations, as well as a short White Paper and slide presentation that will be used to brief Defense Department leadership on the findings.

CHAPTER TWO

Literature Review: Motivation and Public Sector Theory

Introduction

Controlling recruitment and retention efforts is the meat-and-potatoes of any organization's Human Resources (HR) department. For greatest organizational success, HR is constantly updating their Human Capital policies and talent management efforts. Yet to get at the heart of the answer behind why an employee would leave their position, there needs to be a fundamental understanding of incentives and disincentives from both the individual's perspective and also that of the position itself. Motivation is a cognitive psychological subject that delves into the reason individuals act a certain way. The academic study of motivation theory initiated in the early 20th century with well-known psychologists such as Maslow, Hertzberg, MacGregor, Freud, and others. It was propelled into the business world as researchers and practitioners alike saw potential gains in profits from a highly motivated workforce. Later in the 20th century, specialization occurred in different areas of motivation research. Specifically relevant for this study was work targeted at public sector employees, and particularly government civilians. This chapter will baseline the reader's knowledge in these areas.

Equally important to understanding why a person would depart a job besides the motivations around why they would take the job in the first place, is knowledge of the job itself. Early in the 21st century, the study of Job Design was introduced. This field looks at the characteristics of a job itself – autonomy, performance evaluation criteria, technical challenges, physical environment, etc., to try to identify more or less desirable attributes. In theory, a company would emphasize the more desirable aspects and downplay or remove the

less favorable ones in an effort to enhance employee performance. In addition to the Public Service Motivation (PSM) baseline, this chapter brings forward knowledge of Job Design Theory. Public Service Motivation and Job Design form the theoretical basis for this study.

Motivation Defined

Motivation is defined as providing a reason to act a certain way and having a strong reason to act or accomplish something. Theories of motivation, therefore, are concerned with what drives people to act (Beck, 1994). According to motivation theory, there are both internal and external drivers of behavior and the factors that impact motivation generally fall into three categories: characteristics of the individual, the job itself, and organizational practices. Because motivation is malleable, it has been the goal of managers for many years to try to understand those influences on their workers – the proverbial "pot of gold at the end of the rainbow" (Ott et al., 2008, p.131). If workers can be motivated to produce more, this motivation can result in economic benefit for the company.

Motivation theories have at their core the scientific work by Maslow, McGregor, and Herzberg. Their seminal research in organizational psychology, as well as goal-setting techniques, has often been cited in the literature on business and frequently tested, both formally and informally, in business units around the world. In fact, since the topic of motivation was first introduced in discourses about organizations, there has been a tremendous expansion of formal research into it, and much of that research has been conducted during the last decade (O'Leary, 2019; Ritz, Brewer, & Neuman, 2016). Because of the differences between the private and public sector, researchers have developed specific approaches to motivation for the public sector. These are discussed in a subsequent section.

Key Motivation Theories

There are a variety of ways to approach motivation. Theories have focused on the individual needs, the characteristics of the job and the organization, as well as the fit between the person and the job. Additionally, theories have considered human needs as well as cognitive processes and their role in motivating individuals.

Focus on the Individual

Maslow's Hierarchy of Needs. At its psychological root, motivation is based on emotions, and emotions are based on needs (Beck, 1994). A basic hierarchy of human needs was proposed by Maslow in 1943. Maslow hypothesized five states or needs that drive every human. In order of increasing importance, Maslow articulated the following needs: Physiological, Safety, Love, Esteem, and Self-Actualization (Maslow, 1943). Once a person satisfies each level of the hierarchy, that person moves up to the next level. Maslow was clear that these needs are not synonymous with behavior; basic needs are motivations and there are many determinants to behavior, including biology, culture, and context (Maslow, 1943). But as one of many influences on behavior, managers can use an awareness of these basic needs to incentivize or punish workers. To be sure, some motivation theories suggest that managers can just manipulate rewards and punishments to address employee needs (pay, security, self-worth) to improve productivity. But competing theories indicate that management manipulation tends to stifle productivity (Ott et al., 2008).

McGregor's Theory of Motivation. The complexity of approaches to motivation were no more evident than in the writings of McGregor. He proposed his Theory X versus Theory Y philosophies of what motivates workers in 1957. Theory X assumes that human beings dislike work and must be coerced, controlled, and punished into performing better.

This line of thinking indicates that people are generally stuck in the lower levels of Maslow's hierarchy, because they seek security above all else (McGregor, 1957).

The opposite of Theory X, according to McGregor, is a Theory Y approach. This philosophy advances the notion that humans like to work, and they find satisfaction in working. Thus, performance will improve when people are committed to the organization, while negative actions (shirking responsibilities, absenteeism, etc.) are a result of learned experiences (Ott et al., 2008). Theory Y reaches to the highest levels of Maslow's hierarchy urging workers to "achieve their own goals *best* by directing *their own* efforts," and it is management's responsibility to help (emphasis in original, McGregor, 1957).

Herzberg's Two Factors. Herzberg developed a two-factor theory of effects, called Motivation-Hygiene, that he used to describe influencers to workers' effectiveness. Factors that positively impact performance are called motivators: personal achievement, recognition for achievement, the work itself, responsibility, and growth or advancement. To describe the causes of dissatisfaction, on the other hand, Herzberg used the term *hygiene factors*. These factors may include: company policies, supervision, interpersonal relationships, working conditions, salary, status, and security (Herzberg, 1968). Herzberg's research showed that managers can improve employee satisfaction by focusing on motivators and negatively impact workers' attitudes (called dissatisfaction) by relying only on hygiene factors. This theory may prove particularly relevant to public sector workers as there often is not a lot of managerial control over hygiene factors, such as salary and policies; yet a worker who is fixated on these items might have a perennially negative attitude.

Focus on the Job

Goal Theory. A management technique intended to improve employee motivation is goal-setting (Wright, 2004). Although there appears to be some conflict between goal-setting research and social cognitive theory, it is likely that goal-performance methods work to improve motivation, particularly in public sector personnel. Specifically, Wright shows that public sector workers demonstrate higher levels of motivation when their job goals are specific, their job goals are challenging, and they believe they can achieve these goals (self-efficacy) (Wright, 2004). Conversely, goal-oriented public leadership can have a demotivating effect if workers' values do not align with organizational norms (Jensen et al., 2019). Therefore, public managers need to thoroughly assess organizational and workers' values to ensure alignment when choosing an appropriate leadership style to employ. The process for ensuring managerial efficacy becomes the starting point for establishing public sector motivation theories.

Job Design Theory. While considering motivations driven by personal reward or punishment, Hackman and Oldham (1997) posited that characteristics of the job itself would lead to improved performance. Aimed at the attributes of the work to be done, their Job Design Theory is based on three psychological states, that when present, will lead to better outcomes. They believed that jobholders needed meaningful work, to feel responsible for the results, and to receive feedback in order to be motivated. These three states led to the five job characteristics inherent in Job Design Theory: skill variety, task identity, task significance, autonomy, and job feedback (Hackman & Oldham, 1976).

Hackman and Oldham (2010) revisited their theory a decade later. They realized that although technologies such as the Internet, mobile phones, Wi-Fi hotspots, etc., have allowed

work situations such as telecommuting, matrixed teams, self-marketing, and constant global contact to change the face of the job, their basic premise of matching the core characteristics to a person's psychological states still motivates to improved results (Oldham & Hackman, 2010).

Public Service Motivation (PSM) Theories

Working towards the benefit of society at large is a special case of motivation theory. Early Greek philosophers wrestled with the concept of public service. Plato is credited with asking: Why would people work in the Public Sector, particularly in government? And, what draws them to a life of service? In answering Plato's questions, researchers hypothesized that individuals may be drawn to the typically hierarchical structure of the organization, or perhaps by altruistic or even patriotic mind frames (Gabris & Simo, 1995). Whatever the inspiration, many theorists have explored how best to motivate someone in the public sector.

In what is considered the seminal public administration paper on the topic of Public Service Motivation (PSM), Perry and Wise (1990) use three general categories from psychology to describe the motivations which justify a person's actions: rational, norm-based, and affective (Perry & Wise, 1990). Rational motives drive a person's behavior when they want to benefit from the actions. A rational person works in the public sector to help formulate good public policy or to take advantage of resources that are not available privately (e.g., large budget programs, or specific skills such as jet piloting or space travel). A desire to serve the public for altruistic or social equity reasons demonstrates a norm-based motivation to ensure the well-being of the larger society; while patriotic service is typically affective in nature. Of course, ultimately, people serve the public good for a combination of these reasons.

From these three general motivations, Perry and Wise (1990) deduced three implications that predict a person's behavior with respect to public service:

(1) The greater an individual's public service motivation, the more likely the individual will seek membership in a public organization;

(2) In public organizations, public service motivation is positively related to individual performance; and,

(3) Public organizations that attract members with high levels of public service motivation are likely to be less dependent on utilitarian incentives to manage individual performance effectively. (pp. 370-371)

It should be noted that governmental positions are not the only career field in the public sector. Most discussions of PSM also apply to non-governmental, non-profit sector careers, too (Bright, 2016).

Building off the general descriptions initiated by Perry and Wise, which could broadly apply to several industries, Gabris and Simo (1995) proposed their own set of core values that specifically drive public service employees:

- High concern for efficiency and effectiveness

- Adherence to merit selection principles

- Adherence to civil service neutrality

- Maintenance of regime values (democratic government)

- Broadly conceived desire to further the public interest

- Strong support for social equity (p.35)

International studies conducted with employees from different levels of government in several countries also reflect these values. Chinese public servants (Sun et al., 2019), Korean

managers (Shim & Park, 2019), and Oregon state workers (Haider et al., 2019) provide current examples of norm-based, affective, and rational motives being used to improve environmental sustainability and understand the beneficial effects of servant leadership in these organizations.

In contrast with these PSM incentives, there are several de-incentives or factors which undermine motivation in the public service. Studies sponsored by the National Research Council and the Carnegie Commission on Science, Technology, and Government identified a number of weaknesses in current practices (Campbell & Dix, 1990). Some of the challenges identified in this report are categorized in Table 1 below (Campbell & Dix, 1990, p. 3).

Table 1

Barriers to Effective Recruitment and Retention of Scientists and Engineers and Mechanisms to Reduce Them

Issue	Mechanism Intended to Reduce Impact
Inadequate Compensation	Pay banding, recruitment bonuses, occupation specific pay scales.
Lengthy time required to extend an offer of employment	Direct-hire authority, simplified hiring procedures, increased personnel authority for line managers.
Difficulty of promotion after reaching GS-12 level	Pay banding
Restricted role of line managers in personnel decisions	Flexibility in increasing salary without promoting, increasing personnel authority for line managers, occupation-specific salary schedules.
Excessive paperwork	Direct-hire authority, computer-assisted classifications, more generic classifications
Questionable tie between performance and pay	Performance appraisals and multiple components of pay increases that are not mutually exclusive; bonuses; awards
Personnel ceilings and reductions in force	Using adjunct personnel such as postdocs; flexibility in considering factors other than seniority; simplified classification systems that enable retraining of staff who were released from other billets.

Distilling the main points of PSM and Motivation theories, more generally, there are a

number of themes that emerge which affect public service personnel:

      i.   Competitive Pay and Benefits

     ii.   Bureaucracy

    iii.   Human Resources

    iv.   Career Options

     v.   Personnel Development

    vi.   Motivating Factors

These themes are used in many cases to drive incentives that managers may use to motivate

their employees.

CHAPTER THREE

Study Design and Methodology: A Mixed-Methods Approach

This chapter elaborates on the design of the study explaining how the specific approach to data collection and analysis led to meaningful conclusions. As shown in Chapter 2, there is a wealth of exploration and theory from both foundational and emerging studies that led to a list of themes which affect public servants. The existing research provides initial investigative topics to be examined in new ways, both quantitively and qualitatively. However, the themes resulting from existing research yield gaps in knowledge. The blind-spots include a lack of demographic information from STEM workers, the common mistake of overlooking personnel who departed federal service, and an incomplete understanding of why those employees left their government jobs.

Design Overview

This study takes an innovative approach to the questions raised by existing research. First, it focuses on former STEM employees who have departed federal service. Second, the study collects data from this under-researched population combining demographic and career-based information with the themes. And third, it develops novel explanations for employee decisions to leave the government. Both quantitative and qualitative techniques were applied in a two-phase explanatory sequential mixed-methods design to answer the research questions.

Figure 3

```
        Quant
        Data          ┐
        Collection    │
          │           ├  PHASE 1
          ▼           │
        Quant         │
        Data          │
        Analysis      ┘
          │
          ▼
      Semi-
      structured
      Interview Guide
      Development
          │
          ▼
        QUAL Data      ┐
        Collection     │
          │            ├  PHASE 2
          ▼            │
        QUAL Data      │
        Analysis       ┘
          │
          ▼
      Integration
      of Results
```
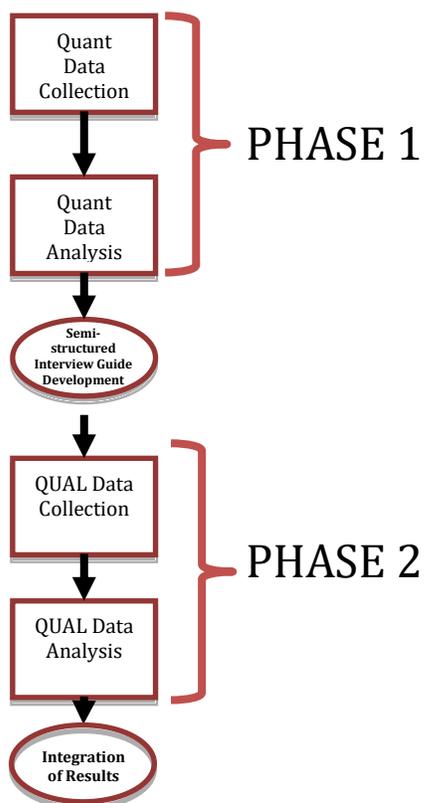
Explanatory Mixed-method approach (Creswell & Plano Clark, 2018)

According to Creswell et al. (2018), "the primary intent of this design is to use a qualitative strand to explain initial quantitative results" (p.77). Taking the Creswell model more broadly, in this study, the qualitative data was used to expand on the quantitative data. Consistent with what Creswell et al. recommend, this design model was executed in two distinct phases. The first phase collected and analyzed quantitative data via a survey instrument. The analysis of these quantitative data drove the development of a semi-structured interview guide which was used in the second phase to collect information about personal and professional experiences from a small subset of the survey respondents via recorded interviews. Ultimately, the analysis of these personal experiences provided depth and richness to the statistical results from the first phase.

Sample Selection Procedures

The population for this study was all former federal STEM employees from any branch of the federal government and from any agency or department within those branches, however excluding military personnel who did not also hold a position as a government civilian. This group is a very large, really unknown, number of people with no existing complete database or contact list. Thus, for this study, there needed to be numerous ways to contact and garner responses from this population. First of all, there are several national organizations that cater to the Defense Industry. Many of these associations have chapters at a city or regional level with a Board of Directors position responsible for Membership who manages their email lists. The membership undoubtedly includes former federal government workers, some of whom certainly worked in the STEM fields. Getting permission to send a simple email to the various distribution lists proved to be a challenge.

Next, as a current government manager, I have direct knowledge of and access to many individuals who fall into the sample frame for this study. Furthermore, these individuals identified other eligible respondents in a process known as snowball or network sampling (Coleman, 1958; Goodman, 1961). In his seminal work on survey methods, Coleman (1958) described the Snowball sampling approach as "first interviewing a small sample of persons, then asking these persons who their best friends are, interviewing these friends, then asking *them* their friends, interviewing these, and so on" (emphasis in original, Coleman, 1958, p. 3). For this study, this approach manifest itself by sending emails to as many other people as I thought could help get the word to the target population. Approximately 40 people got this email. I also made posts on my own social media pages, as well as other specialty groups that I joined specifically for this study, all of which included the link to the survey. Further, I

asked approximately five people who I knew had access to the individuals in the target population to add the survey link to their social media pages, as well as send direct emails to others who they knew fit the target population. This technique resulted in about half of the final respondents (36 completed surveys).

Finally, many survey portal providers such as Amazon, Qualtrics, and SurveyMonkey allow registered users access to a global on-demand workforce of potential survey takers. Each of these providers has hundreds of thousands of potential respondents available on short notice and for very little compensation. To double the survey responses for phase one of this study, I used Amazon Web Services Mechanical Turk (MTurk).

Amazon Web Services Mechanical Turk (MTurk) was launched in November 2005 to provide a ready population of human intelligence workers to crowd source any number of tasks that were not possible to be completed on a computer. For example, identifying items in a photo or video (image tagging), transcribing audio, and taking surveys. Because these workers were worldwide, a task could be posted at any time of the day expecting results within hours. This access was a boon to social scientists around the world who needed data from a diverse population. The number of tasks completed on MTurk grew rapidly from its inception until present, but there are several concerns raised by many researchers that have to be accounted for (Buhrmester, et al., 2018).

For example, Burhmester, et al., (2018) describe practical issues such inattention of respondents, as well as non-naïve and dishonest respondents. MTurk offers a few mitigation techniques designed to minimize the impact of these negative effects. But some researchers are not familiar enough with those techniques to use them effectively (Burhmester, et al., 2018).

It is not clear how often these negative situations arise in general, but I can report that in my survey I employed several mitigation techniques to ensure I was collecting the highest quality data. Since there was not an existing filter for former US Federal government employees, I chose an MTurk filter that limited the population pool to only those adults who had participated in a recent US Federal election. Then, as previously stated, the first section of my survey tool in Qualtrics included a weed-out section intended to cull the respondents to only those I was looking for. Even with those safeguards in place, I received several hundred responses from MTurk. I manually sifted through every survey response to ensure that they were providing legitimate data, and ended up with an additional 37 complete surveys; resulting in a total of 73.

In summary, an appropriate sample frame was achieved for this study in four ways:

1. By contacting local and national membership chairpersons for several Defense Industry organizations. The National Defense Industry Association (NDIA), Armed Forces Communication and Electronic Agency (AFCEA), Women in Defense (WID), as well as others, all have local chapters and national-level organizations that could have been willing to allow an email be sent to their members with a link to the survey.

2. By posting the link to the survey on social websites such as LinkedIn and Facebook. I also specifically joined several Facebook Groups that are dedicated to servicing government workers in an effort to attract more responses to the survey.

3. By emailing the survey link to personal connections and asking them to forward it to others and to post it on their social media sites.

4. By soliciting responses via Amazon mechanical Turk.

With these four approaches to reaching the target sample frame for phase 1, I achieved 73 legitimate responses to the survey (N = 73).

In phase 2, a small number of respondents (n = 8) was purposefully selected from the initial, much larger sample of participants. Upon completion of the phase 1 survey, they all indicated that they would be willing to participate in semi-structured interviews. The choice of these 8 individuals was guided by the results from phase 1. The respondents who were interviewed had a variety of STEM specialties, from multiple demographic groups (age, gender, race, years of service, etc.). This cross-section of responses helped gain a fuller understanding of how these and other factors contributed to employee turnover intention and motivations.

Data Collection Procedures

The first phase of this study used a survey instrument consisting of three main sections in order to assess levels of Public Service Motivation (PSM), identify Job design influences, and collect demographic information. Questions were drawn from an existing PSM survey instrument that has been widely tested, with known validity and reliability measures (Perry, 1996; Kim, et al, 2010). Similarly, questions on Job Design were derived from known tools. The final section of the survey ended with key demographic characteristics. The survey instrument can be found in Appendix A.

In order to conduct statistical analyses, a Qualtrics survey platform was used to present the survey and record the data. Qualtrics organically exports data into Statistical Package for the Social Sciences (SPSS) in a format that is easily manipulated and analyzed. The Qualtrics platform allowed for beginning the survey instrument with conditional, or "weed-out," questions. This feature ensured that only respondents in the target sample frame were allowed

to complete the questionnaire. Questions about the two main constructs of the survey, PSM and Job Design, were presented in a random fashion to the survey-taker. Followed then by a section that collected demographic information. And at the end of the survey, respondents were asked to identify their willingness to participate in a follow-up interview and to provide an email address as contact.

The only way to take this survey was via the online Qualtrics portal. Regardless of which of the four contact methods previously mentioned was used, the potential respondent always received an electronic link to the survey. Clicking on the link activated the Qualtrics portal displaying instructions and the first of the weed-out questions. If the respondent answered the weed-out questions appropriately, they were then admitted to the remainder of the survey.

The 76 questions in main section of the survey covering Job Design and Public Service Motivation were presented randomly, yet all questions required a response. In other words, there could be no blank or skipped answers. Therefore, a respondent either finished the entire survey or voluntarily exited in the middle without registering any results. This approach eliminated the opportunity for incomplete responses and missing data fields. Responses to these two main sub-sections of the survey were based on a 6-point Likert scale. Respondents were asked to select how strongly they agreed or disagreed with the statement or question that was presented. The 6-point Likert scale was chosen to eliminate the "middle" or "neutral" choice. The respondents could only select from varying degrees of agreement or disagreement, as follows: 1 = Strongly Agree, 2 = Agree, 3 = Somewhat Agree, 4 = Somewhat Disagree, 5 = Disagree, and 6 = Strongly Disagree. Of the 76 statements and questions, six were reverse coded.

As explained in the survey instructions, the survey results from phase 1 are confidential but not anonymous. Confidentiality assured the respondents that their answers would only be viewed by the researcher, while still allowing for the opportunity to be contacted again if they were chosen to be part of phase 2.

For phase 2, the interviewees were selected using a two-step process. First, survey respondents had to intentionally leave their email address at the end of the survey with the express agreement to be contacted for an interview. Second, out of all the survey respondents who agreed to be interviewed, I screened their demographic responses and deliberately reached out to individuals from a breadth of racial, gender, and age categories. The intent of this deliberate selection was simply to get inputs from a variety of races, genders, and ages in order to ensure diversity of experiences. Thus, I reached out to respondents from different races, genders, and ages who self-identified this way in the survey and were willing to be interviewed. I chose to interview eight people. Details such as dates, lengths, and general information about each interviewee can be found in Appendix B.

I selected a general interview style approach using a semi-structured guide. According to Turner (2010), this style provides more structure than the informal conversational interview yet allows more flexibility than a standardized interview. To carry out the general interview approach, I developed a semi-structured interview guide for phase 2 of this study that was influenced by the results of phase 1. The semi-structured guide ensured I asked similar questions each time and had goals of what topics needed to be covered. An initial list of questions is included in Appendix B, which provided the foundation from which to be able to ask a variety of questions. This allowed the interviews to be steered into areas prompted by

phase 1. Although each conversation was unique, they all generally followed the flow of the interview guide and had three main parts.

I always started with an introduction of myself and the purpose of my research. This included a review of their voluntary standing (i.e., no compensation and they could choose to not answer or end the interview at any time), the definition of confidentiality, and my intention for using the results of the study.

The middle part was the meat of the discussion. All interviewees covered: i) how they got into the government; ii) what influenced the complexity of their decision to leave government service; and, iii) what could their supervisor or anyone else have done to keep them from leaving (change their mind)? I often allowed the conversation to free-flow around these main topics and in keeping with results from the survey and references I had heard in other interviews. And because the interview was only semi-structured, I was able to ask follow-up questions to probe into certain responses.

The final part of the interview was the wrap up and farewell. It was surprising how many of the interviewees added further relevant thoughts after I indicated that our interview time was up. For example, one of my interviewees was a Black woman. We spoke at length during the interview about how racism played a significant part of her decision to leave the government. But it was not until I noted that our agreed upon meeting time was over and thanked her, that she spoke about how being a woman in a male-dominated field (specifically cyber engineering) had caused her to feel belittled and bullied. Not only was this highly informative for me, but it was likely somewhat cathartic for her too.

For the phase 2 of data collection, face-to-face meetings were not possible due to pandemic restrictions. Interviews were conducted over Zoom, recorded, and transcribed using

that application. Although the Zoom platform performed reasonably well and as expected, the transcription feature required significant manual intervention to be usable for in-depth qualitative analysis.

Phase 1 Quantitative Data Analysis

The phase 1 statistical analysis used the SPSS application to run basic descriptive statistics and multiple linear and non-linear regressions on the collected data. In order to best manipulate and analyze the data, the dependent variable was pulled out and the independent variables were combined into indices called "constructs". The constructs were further broken down into sub-constructs. These sub-constructs were then used in the statistical regressions and analysis.

Variable Definition and Constructs

Dependent Variable. This study used one dependent variable to indicate how motivated a STEM employee was to stay in their STEM position with the government. The Number of Years of Government Service Completed was measured to the nearest whole number. The expectation with collecting this information was that someone who continued to work for the government longer, was more "motivated."

Independent Variables. This study employed two main constructs and multiple sub-constructs as defined in Tables 2 and 3. The four items marked with an asterisk (*) had significance during the regression analysis.

Table 2

Definition of Sub-constructs within Public Service Motivation

Sub-constructs	Definition
Commitment to Public Interest	Employees' desire to serve society and the good of the general community
Civic Duty	Responsibilities expected from all members of a society

Self-Sacrifice	Giving up or subordinating one's own interest to advance a cause or help others

Table 3

Definition of Sub-constructs within Job Design

Sub-constructs	Definition
Task Characteristics	
Work Schedule Autonomy	The control employees have over timing and sequencing for their own tasks
Decision Making Autonomy*	The control employees have over their own task choices
Work Methods Autonomy	The control employees have over how to perform their own tasks
Task Variety	The extent to which employees perform a wide range of actions and activities
Task Significance*	The amount of influence or impact a given activity has on others
Task Identity	The extent to which an activity has an identifiable beginning and end tied to a clear outcome
Feedback From Job*	The extent to which the tasks themselves provide information to the employee about performance effectiveness
Knowledge Characteristics	
Job Complexity	The extent to which employee tasks are multifaceted and mentally challenging
Information Processing	The extent to which employees must track and analyze data to perform their job
Problem Solving	The extent to which employees are required to overcome challenges to complete tasks
Skill Variety	The extent to which the job tasks required a wide range of capabilities
Specialization	The extent to which the job required a depth of knowledge and expertise
Social Characteristics	
Social Support	The opportunity to meet with others, make friends, and have personal interest from others (particularly a supervisor)
Feedback From Others	The extent to which managers and co-workers provide information to the employee about performance effectiveness
Work Conditions*	The extent to which the workplace was excessively noisy, dangerous, clean, comfortable, etc.
Equipment Use	The extent to which the job required use of machinery or technology pieces

The next two tables show the means, standard deviations, and Cronbach's Alpha results for each sub-construct. The Cronbach's Alpha is a measure of internal reliability for each sub-construct. Although a higher Cronbach's Alpha score is always better, the general rule of thumb is that a Cronbach's Alpha score of 0.70 and above is good and is considered to be a strong correlation among the items in that sub-construct indicating that they are reliably measuring the intended area.

Table 4

Descriptive Statistics by Sub-constructs (Public Service Motivation)

Sub-constructs	Mean	Standard Deviation	Cronbach's Alpha
Commitment to Public Interest	2.36	0.74	.73
Civic Duty	2.39	0.82	.85
Self-Sacrifice	2.44	0.81	.76
Overall Average	2.40	0.79	

Note. Sample size (N) = 73.

Table 5

Descriptive Statistics by Sub-constructs (Job Design)

Sub-constructs	Mean	Standard Deviation	Cronbach's Alpha
Task Characteristics			
Work Schedule Autonomy	2.61	1.01	.81
Decision Making Autonomy*	2.46	0.99	.82
Work Methods Autonomy	2.56	1.07	.85
Task Variety	2.07	0.86	.76
Task Significance*	2.36	0.93	.80
Task Identity	2.63	1.01	.76
Feedback From Job*	2.49	0.90	.77

Knowledge Characteristics			
Job Complexity	4.29	1.15	.77
Information Processing	1.86	0.93	.80
Problem Solving	2.15	0.90	.71
Skill Variety	1.96	0.76	.71
Specialization	2.15	0.70	.72
Social Characteristics			
Social Support	1.92	0.78	.77
Feedback From Others	2.56	1.07	.85
Work Conditions*	2.54	0.92	.76
Equipment Use	2.66	0.96	.70
Rollup Task Characteristics	2.45	0.72	
Rollup Knowledge Characteristics	2.49	0.49	
Rollup Social Characteristics	2.48	0.63	
Overall Average	2.46	0.88	

Note. Sample size (N) = 73.

As detailed previously in the Sample Selection Procedures section, the sample of 73 survey respondents was reached in four different ways. To be specific, the first three ways – via emails and various social media contacts – were executed first. Then to increase the number of responses, I solicited responses via Amazon Mechanical Turk. The concern with this approach is that, in spite of the robust weed-out questions and other means of confirming the sample population, those two disparate approaches may have yielded inconsistent results. Thus, I performed a two-group t-test in order to compare those groups.

Each of these groups contained approximately half of the responses (specifically 36 in the first grouping and 37 from the MTurk group), and because Qualtrics captures a latitude/longitude location and IP address for each response, I was able to confirm that no two responses were from identical sources and that there were no overlapping or duplicate entries. Because the sampling methodology was completely random, the resultant data is normally

distributed. Therefore a two-sample t-test can be used to compare the means of these two groups.

I used a typical null hypothesis (H0) for a t-test which states that the means for the two groups are statistically the same. If there is no significant difference in the means of the two groups, then the data from each group can be combined into a single larger population for purposes of statistical analysis.

I ran the two-sample t-test in SPSS on every variable. The results indicate that the difference in means between the two sample populations are not significantly different, and the null hypothesis could not be rejected. This justified combining the two groups for further analysis. Although all variables were evaluated in the t-test calculations, for brevity, Table 6 shows only the results for the four independent variables that impacted the regression analysis that follows.

Table 6
Selected results from the independent two-sample t-test

Sub-constructs	t-test for Equality of Means (t)	Significance (2-tailed)	Mean Difference
Decision Making Autonomy*			
Equal variances assumed	-0.14	0.89	-0.03
Equal variances not assumed	-0.14	0.89	-0.03
Task Significance*			
Equal variances assumed	0.44	0.66	0.10
Equal variances not assumed	0.44	0.66	0.10
Feedback From Job*			
Equal variances assumed	-2.26	0.03	-0.46
Equal variances not assumed	-2.25	0.03	-0.46

Work Conditions*			
Equal variances assumed	0.10	0.92	0.02
Equal variances not assumed	0.10	0.92	0.02

Stated another way, since the two-group t-test results could not reject the null hypothesis, both groups could be considered statistically similar enough to be used in the regression analysis that followed.

Categorical Variables. In the survey, it was also important to collect demographic data from each respondent. This included categories of descriptions such as their gender, race, age, as well as the STEM field most related to their job. These data were used in the regression analysis. To perform statistical regression analysis on variables that represent categorical data, I transformed the categorical responses into "Dummy Variables." These dummy variables act like a "switch" to turn each parameter on or off in the multiple regression equations. Table 7 defines each of the categorical variables collected for this study. For Gender, there was an option to select "Other", however no respondents chose that option. For STEM Field, the respondents were asked to answer with a specialty that was professionally closest to their job. Only the top five fields were used in the analysis. Each dummy variable was run through multiple regressions. When that variable was being analyzed, it was assigned a value of "1". It held a value of "0" otherwise.

Table 7

Definition of Independent Categorical Variables

"Dummy" Variable	Description
Race	
White	Caucasian and peoples of European origin
Black	Black and people of African origin

Hispanic	People of Latin and South American origin
Asian	People of Asian origin
Other	Anything not listed already or a combination
Gender	
Male	Identifying as a man
Female	Identifying as a woman
STEM Field	
Systems Engineering	Discipline that focuses on integration of complex systems
Electrical Engineering	Discipline that focuses on application of electrical theories
Computer Science	Discipline that focuses on the principles and use of computers
Mechanical Engineering	Discipline that focusses on design and development of machinery
Software Engineering	Discipline that focuses on design and development of software systems

Phase 2 Qualitative Data Analysis

Following completion of the phase 2 interviews, Qualitative Data analysis was composed of several elements: transcription of the interviews, forming a simple data dictionary of categories, and, finally, reviewing the transcripts to highlight codes and phrases to fit into those categories.

Transcription of the interviews was a time-consuming two-step process. First of all, I recorded all the interviews in the Zoom application and used the organic Zoom transcriber tool. This tool did only an adequate job of transcribing the audio. It had two major flaws – there was jargon and hard-to-understand speech that did not get transcribed properly; and, the tool inserted time markers apparently randomly during the session. To overcome these flaws, I manually reviewed each interview and corrected the transcription text, removing the timestamps and updating the jargon. The final product was a readable reference of each interview.

Once the transcriptions were completed, I built an Excel spreadsheet with categories of motivation techniques and challenges on one axis and the interview identifiers on the other axis. Each of the main categories was taken from literature, as detailed in Table 1. Key words, referred to as "codes," describing each category were then added to the spreadsheet to create an informal data dictionary (see Table 8). These key words acted as triggers and identifiers such that when I reviewed each transcript, I was able to highlight these words and phrases and bin them in the appropriate category on the spreadsheet. I captured the essence of that text into the spreadsheet. I also wrote a General Sentiment that I got from each interview (last row of the spreadsheet). The sentiment statement is my judgement from each person about their attitude towards another government job. It is not based on a stated answer, nor does it offer any specific data for comparison. But it can serve to provide my perspective on the emotional content and intent from each person. For example, one interviewee did not want to be assigned overseas until their child graduated high school, and appealed to their supervisor to assist with this. The words that person chose, convey the intensity of that person's feelings about this issue. The sentiment statement may assist the reader to more fully appreciate the impact of having a supervisor who did not adhere to those wishes.

Table 8

Motivation themes used in data dictionary

Motivation Themes	Key Words
Competitive Pay and Benefits	Pay banding, bonuses, non-monetary perks, salary, etc.
Bureaucracy	Red tape, paperwork, processes, etc.
Human Resources	Hiring authority, hiring timelines, separation packages, etc.
Career Options	Promotion ceilings, salary limits, based on other than seniority, etc.
Personnel Development	Pay for performance, staff retraining, performance appraisals, supervisor feedback, etc.
Motivating Factors	Patriotism, self-sacrifice, politics, etc.

Limitations of the Study: Department of Defense Focus

The limitations of this study are three-fold: positionality, scope, and scale. First of all, my position as a technical manager within the Department of Defense (DoD), helped me speak with credibility to my interviewees. We easily and freely used jargon and short-hand phrases (i.e., acronyms) that only someone familiar with the government would use. That said however, the fact that I am focused on getting results that impact my government colleagues and me was not a secret to the interviewees. Thus it is possible that they answered my questions and described their situations in a way that they thought I *wanted* to be told. Also, the fact that these respondents voluntarily agreed to be interviewed and released their email address to me, meant that they wanted to talk. The two-step recruitment process described above likely led to a form of qualitative selection bias with regard to the interview group. Individuals had to be motivated to spend even more of their time talking with me, which may indicate that they felt more strongly about their reasons to leave the government than the average survey respondent. Though I find it highly unlikely that the interviewees were concerned at all about my feelings toward them enough to change their responses because of my position.

Although STEM professions exist in other branches of the federal government and certainly within other departments of the Executive Branch, my sample frame was drawn entirely from former DoD employees. This limitation in scope was not intentional, nor desired. It was simply a reality of who I was able to get to respond to my survey link.

As for scale, the potential population is probably several hundred thousand former government STEM employees. This number obfuscates the fact that I only achieved 73

legitimate survey responses. Although this is still statistically relevant, being pragmatic, I know that many people are overwhelmed with surveys and questionnaires, as well as social media requests to join various events. Electronic media burnout is a real phenomenon and likely impacted the number of people who were willing to respond to my survey. More data is always better. However, I doubt a larger number of survey responses or interviews would have shed any additional light on the areas under consideration in this study.

CHAPTER FOUR

Findings and Analysis

This study focused on the motivations and complexities of former federal government civilian employees who worked in STEM fields. In philosophical terms, it roughly followed a post-positivist approach to understanding why those employees left their government jobs, employing both quantitative and qualitative methods. Granted, the experiences were unique to each person – a construction of those who answered the survey and participated in the interview (implying constructionist tendencies). However, post-positivism assumes that respondents own observations and experiences were biased and based on perceptions and feelings at the time. Based on Guba's four criteria of trustworthiness, Shenton offered strategies and provisions that could be employed to improve the trustworthiness of the results, specifically the qualitative findings (Shenton, 2004). Thus, I used multiple approaches to infuse trustworthiness into this work.

As a reminder, there are four research questions based on existing literature that guided the collection and analysis methods. Those questions are:

1. What are the most frequent factors (i.e., sub-constructs) that influence years of federal government service?

2. Which Job Design (JD) sub-constructs had the most and least influence on years of federal service?

3. Which Public Service Motivation (PSM) sub-constructs had the most and least influence on years of federal service?

4. How did the experiences of government STEM employees who left government service affect their decision to leave?

This chapter will detail the findings of the statistical analysis, including descriptive statistics and regressions, as well as the qualitative analysis that was performed on the data. The results show which independent variables, called sub-constructs, had the most influence on a former employee's motivation to stay in their government position as identified by the dependent variable (Years of Service).

Quantitative Results

The first phase of this explanatory sequential study was used to address the first three research questions and consisted of an electronic survey garnering responses from 73 participants. The responses were based on a six-point Likert scale that ranged from 1= strongly agree to 6 = strongly disagree indicating the respondents' feelings about the given statement. Phase 1 statistical results included capturing categorical ("dummy") variables, descriptive analysis, as well as various forms of regression analysis. First, I will present the findings of the categorical variables, then the results of each of the quantitative research questions will be addressed in the next sections.

Analysis of Categorical Variables

Independent categorical variables (also known as "dummy" variables) were used to collect demographic data on the survey respondents. These data included race, gender, and STEM fields. Race and gender tend to be sensitive questions for respondents to answer and were therefore presented at the end of the survey. For both categories, respondents were allowed to select "Other" if that seemed appropriate to them. As shown in Table 11, several respondents used this option for Race, but none chose this for Gender. With a total sample of 73 responses, this spread of racial and gender participants is as expected.

Race. In this category, results are listed in Table 9. Demographic data available on the Office of Personnel Management website from 2017 (the most-recent year available on that site) shows that the diversity of this study generally reflects the racial composition of the Executive Branch. The similarity to government makeup indicates that this study has a good cross-section of racial diversity.

Gender. Responses to this category were solely based on self-identification by the respondent. Besides Male and Female, they had the choice of "Other" in the survey, however no one selected that option. Reading the results listed in Table 9, it shows that the male respondents to this survey outnumbered the females more than a factor of two. Although the government certainly has more male employees, the percentage tends to be a little closer together. Again referencing OPM in 2017, males made up 57% of the Executive Branch employees versus the 70% of respondents in this study. This study, therefore, tends to skew toward male respondents which is likely due to the requirement for having a STEM background.

STEM field. This question on the survey was an open-ended short answer item. The respondents could list their STEM field however they felt it was best stated. For statistical purposes, SPSS is case sensitive. So a "computer science" response is recorded differently from "Computer Science". I manually combed through the data to combine answers into groups of like STEM areas. Thus, a response of "systems engineering" would be grouped with "System Eng" or "Sys Eng" and similar. From Table 9, it is clear that the biggest group of respondents to this survey had a Computer Science specialty. Still, there are many other technical areas represented, with the top five responses listed in Table 9. Other areas not listed in the table because they only had one or two responses each, include communications

engineer, geographer, network engineer, cybersecurity, meteorology, biology, and aerospace engineer.

Table 9

Independent Categorical Variable Statistics

"Dummy" Variable	Total Responses	Percentage
Race		
White	49	67.1%
Black	13	17.8%
Hispanic	4	5.5%
Asian	5	6.9%
Other	2	2.7%
Gender		
Male	51	70%
Female	22	30%
STEM Field		
Systems Engineering	7	9.6%
Electrical Engineering	6	8.2%
Computer Science	24	32.9%
Mechanical Engineering	4	5.5%
Software Engineering	7	9.6%

Notes. Sample size (N) = 73. STEM field shows top five responses.

Research Question 1: Descriptive results

The first research question was specifically designed to collect descriptive statistics from the Independent Variables. Descriptive statistics are used to characterize known quantities about the population. This characterization primarily involves the mean and standard deviation, but may also include mode, skewness, and other measures of variability. For this study, the means and standard deviations for every variable are found in Tables 4 and 5. In table 10, I pulled out the means and standard deviations for the four independent

variables that had the greatest impact on the dependent variable during the regression analysis, which is explained in the next section. As a reminder, on a six-point Likert scale, the lower the response value, the more the respondent agreed with the survey questions. Specifically, a response of 2 = Agree and 3 = Somewhat Agree. Therefore, since the mean values fell between 2 and 3, it implies that overall the respondents only mildly concurred with the intent of that sub-construct.

Table 10

Selected Means and Standard Deviations

Sub-constructs	Mean	Standard Deviation
Decision Making Autonomy*	2.46	0.99
Task Significance*	2.36	0.93
Feedback From Job*	2.49	0.90
Work Conditions*	2.54	0.92

Note. Sample size (N) = 73.

Research Question 2: Job Design Regression Results

As stated in Chapter 3, both stepwise linear and non-linear regression analysis was performed on every independent variable. Of the 16 variables associated with Job Design, only 4 showed a significant correlation ($p < 0.05$) with the dependent variable. Table 11 shows the regression results for these 4 variables. R-squared for this model was .33, which although is only a weak to moderate indication of correlation, was the strongest of all the regression runs.

Table 11

Selected Regression Coefficients and Significance

Sub-constructs	B	Significance

Decision Making Autonomy*	-0.95	<0.001
Task Significance*	-0.92	0.005
Feedback From Job*	1.21	<0.001
Work Conditions*	1.08	0.005

Note. Sample size (N) = 73, R-squared = 0.33, Adjusted R-squared = 0.29

Taking each of these independent variables separately, and explaining the meaning of the coefficients, will demonstrate the relevance of each.

Both Decision Making Autonomy and Task Significance had "negative" coefficients. Since the Likert scale was chosen to be 1 = Strongly Agree with the survey statement, having a negative regression coefficient is a "good" thing, and results in an inverse relationship with the dependent variable. This means that if the independent variable decreases in value (i.e., gets closer to 1 = Strongly Agree), the dependent variable (years of government service) will increase. Looking at the first variable in Table 10, for each step the Decision Making Autonomy variable decreases, it increases the years of government service (the dependent variable). Specifically, if Decision Making Autonomy decreases by 1 unit, years of government service has an associated increase of 0.95 years.

This is similar for Task Significance – if it decreases by 1 unit, years of government service has an associated increase of 0.92 years.

However, the data show an opposite relationship with the Feedback from Job and Work Conditions variables. Both of these independent variables had a positive regression coefficient which is not a good relationship due to the Likert scale on this survey. In the cases of these variables, since the coefficient is positive, it moves in direct relation with the dependent variable. Therefore, if the independent variable decreases by 1 unit, the dependent variable will also decrease. Looking specifically at Feedback from the Job, if the value

decreases by 1 unit, then the years of government service will likewise be associated with a decrease of 1.21 years. Similarly, for Work Conditions, if the value decreases by 1 unit, then years of government service will be associated with a decrease of 1.08 years.

Interpretation of results. There were four independent variables from the Job Design construct that showed any significant correlation to the dependent variable. They are Decision Making Autonomy, Task Significance, Feedback from Job, and Work Conditions. As described above, when there is a positive unit change in the survey result, then each of these variables has a significant effect on the Years of Government service. Specifically, Autonomy and Task Significance increase the number of years someone will stay in the government, while Feedback and Work Conditions each decreases the number of years. These results are directly aligned with Herzberg's Motivation-Hygiene theory. As discussed in Chapter 2, Herzberg would consider working conditions and information gained from the job itself to be "Hygiene" factors. These factors, if taken to an extreme, would have a negative effect on motivation. The regression results from these two variables are demonstrating what Herzberg meant in his hygiene factors. Although these items are easily controllable by a manager, they do not positively motivate a worker, which results in degraded performance. On the other hand, Herzberg indicates that Task Significance and Decision Autonomy are intrinsic incentives and therefore good motivators. The data in this survey confirms that.

Research Question 3: Public Service Motivation Regression Results

In a similar fashion to question 2, all three of the Public Service Motivation (PSM) independent variables were run through both linear and non-linear stepwise regression analysis in SPSS. None of the independent variables showed any significant correlation to the dependent variable.

Interpretation of results. When I was analyzing the lack of significance in the PSM variables, it finally dawned on me why there was no correlation found. The epiphany I had reminded me of an expression from the 1980's, "Duh!" This means "no kidding!" and "isn't that obvious!?" The reason this colloquialism comes to mind is that my target population for this study was people who have already left government service. If they have already departed, then they clearly have no motivation to stay. And, specifically, this survey asked them to consider the time just before they left government employment. This would have been the time that these people had the lowest motivation probably of their whole careers. Thus, it is of no surprise that their PSM scores showed no correlation to their years of service.

To be fair, there are other ways that a person may serve the public interest. And the PSM tool does not explicitly ask about working in a government role. However, because every one of the respondents was likely quite jaded from their public service experiences (as we will see in the qualitative results), their desire to stay in a government organization was undoubtedly negligible resulting in scores of minimal significance.

Qualitative Results

The final research question was designed to capture the nuances of decision making as it pertained to employees leaving government service. As expected, there are many factors that played a role in the lives of the group that I interviewed for this study. Their perspectives follow.

Research Question 4: Qualitative Analysis Results

To best understand how certain experiences affected the motivations of the participants of this study, I chose eight people to interview. The parameters of these interviews are listed in Appendix C. Most of the conversations lasted around an hour which

allowed for covering many questions in detail. In reviewing the transcripts, I captured and

paraphrased relevant statements from these conversations in a spreadsheet (Appendix D). The

interviews revealed that the decision to leave government employment was complex and not

driven by any single factor. The statements in Appendix D relate to specific quotes from the

interviews. These quotes were either positive in nature or negative relative to their

motivational impact on the interviewee. Thus, when the interviewer made a positive

statement, the meaning of that statement was regarded as pushing the person to stay in the

government. While words with a negative intent, infer that the statement would work to

influence the individual to leave their government job. My goal was to determine which of

several mechanisms previously identified in literature and the survey had the greatest

influence, and therefore, where a leader might look to determine if a worker is considering

leaving. I will specifically address Personnel Development, Motivating Factors, Pay and

Benefits, Bureaucracy, and Human Resources.

Personnel Development. Of the six mechanisms derived from literature and the

survey results, the one area that got the most total comments, both positive and negative, was

'Personnel Development.' Broadly, this category included statements about employee training

or retraining, appraisals and feedback, autonomy and empowerment, and generally how the

employee felt about working in the job they were in before leaving the government. I will first

discuss negative sentiments expressed by the interviewees before reflecting on some of the

positive feedback the interviewees shared.

Negative experiences with Personnel Development. The reason this category had the

most entries in the spreadsheet is that every interviewee had one or more comments about

their supervisor and the effect that person had on their decision to leave their job. Negative

statements formed the bulk of these entries. For example, Interviewee E related that his supervisor never saw him and really could not mentor or guide him professionally. He said, "You had to come back you know every couple months. There's like a snapshot sort of touch base meeting and how are things going. So it was more of a managed by exception sort of situation." For this interviewee, because his manager did not provide good counsel on career options, once he completed a highly competitive government training course and decided to take a job outside the government, he was told to return his graduation certificate! This added insult to injury and cemented his resolve to separate from the government.

In Interview G, a woman of color felt that her supervisor was a bully. She described her feelings this way:

> I clearly am not an idiot. I clearly have the education background. I clearly know how to lead a group of engineers. On one of the largest programs in the Navy. That whole group. And I was treated as if I wasn't good enough to be in the position. So, I was treated as if you're nothing. So I'd go home every day and cry.

It was this hostile work environment that ultimately convinced her to follow another career dream outside the government.

This category of negative responses about supervisors included several statements about unfair evaluations, bias, and not taking action for the betterment of their workforce. Nearly all respondents had something critically negative to say about their supervisors.

Positive experiences with Personnel Development. Although most comments were negative, positive experiences are those that serve to convince a person to stay in their government job. On the positive side, for example Interviewee B remembered having a tremendous amount of autonomy in her work. She said,

It was one of the things I loved and I hated. I was operating in such a very interesting

shade of grey that a lot of times no one knew where I was supposed to be or had a

sense of what I ought to be doing. So I had a lot of freedom and flexibility.

The independence in her government job was quite appealing and a clear motivator for her to

remain in the government.

Another example of Personnel Development having a positive influence occurred after

Interviewee H had told his supervisor about becoming frustrated in his present assignment. He

said, "my agency, my home supervisor, he was very supportive and we really wrapped our

heads to try to figure out a way, you know, to get me into a more fulfilling job." This type of

affirming management interactions helped that person stay longer.

Overall, the qualitative analysis showed a dominance of negative sentiments among

the interviewees revealing that this group felt unsupported by their management. And this lack

of support significantly influenced their decision to leave their government job.

Motivating Factors. The mechanism with the second most comments was called

'Motivating Factors.' In this catch-all category, people talked about quality of life, working

conditions, mental health concerns, politics, patriotism, and the effect those issues had on their

psyche before they left their government job. Similar to the previous mechanism, influence

from these topics ranged from negative to positive in this category also, with negative

comments being those that tended to push people away from their government jobs, and

positive ones providing influences to stay.

Negative experiences with Motivating Factors. Interviewee B had entered

government service because her son was going to join the military and she wanted to help as

much as possible. Unfortunately, her son was killed in a non-military related hiking incident

which caused her to seriously reconsider her life, assess her mental health, and review her position in the government. During the interview, she reflected on it this way:

> On a personal note, though, my younger son was hiking in Colorado right around this time and he fell and he died. And I just really had a little bit of an epiphany of what do I want to do if I've got limited time to be doing it on this earth, where do I want to be and what do I want to be doing. And at that point, the government did not have golden handcuffs around me.

This personal tragedy and the mental health issues stemming from it obviously negatively impacted her desire to continue working for the government.

Interviewee H was influenced by the need to remain geographically stable due to his aging parents. When he could not find a government job in the city he needed to stay in, he felt compelled to take a position outside the government.

> The new career management style was such that they wanted you to be in your job from two to eight years. I had just passed the six-year point. That's what got me looking. We came out here specifically to care for my wife's parents, when the time came. And when we came out here, that was not anywhere a near-term thing. But now my father-in-law passed away when he was 87 and my mother-in-law was 86, now she's 87. They were both in great health and now they're not. It ended up being a long-term thing.

The fact that he could only find a different job in the government in another city conflicted with his need to stay geographically stationary. This resulted in him leaving the government in order to take a job in the right locale.

One interviewee placed a lot of emphasis on quality of life matters. Interviewee C, specifically said

> How much longer do I want to do this? And the commute was bad, and the money was okay but not amazing and the quality of life was okay but not amazing. I lived in a condo. Like, I didn't have a yard. I don't have space because I didn't want to trade my commute for space because then you can never enjoy your space because you're always in the car.

More of her story was that she was looking to raise a family and even get pets. She wanted a job that offered a better balance of living space and distance to work.

Positive experiences with Motivating Factors. This category called 'Motivating Factors' had a few positive comments also. For example, Interviewee D felt it was his patriotic duty to work on highly classified and technical projects with very smart people in order to make a positive impact to the security of the country. He described it this way:

> Right, it was more of our patriotic sense of duty, the opportunity to work on, you know, highly technical stuff and supposedly make a positive impact. But being on the cutting edge of technology and what, you know, computer network operations is all about. Working with smart people too. That's a very big key. Because I want to be the dumbest person in the room. I want to be challenged by other people so that way I have room to grow.

This category also included non-supervisory feedback. These included praise received from co-workers or others, which oftentimes conflicted with supervisory feedback. This praise, therefore, helped hold the person in the job longer. Interviewee A, specifically,

received reinforcement about his performance from co-workers and other groups who were not his direct supervisor. He remembered

> Letters that I received, you know, stuff like that. And what I was doing, I certainly didn't feel I was average. And so my feeling was backed up with, kind of like, praise from other people. Because I was sought after by several groups. That also kind of reinforced my, you know, my thought that I was a little bit more than average.

> Overall, the analysis showed a general negative trend in this category. Even though there were some interviews that indicated a reasonable work-life balance and no real mental health concerns, most of the interviewees found significant challenges in their quality of life while in the government. Furthermore, it follows that if someone was having difficulty with their supervisor (from the previous category), then it likely also precipitated negative issues in this category also.

Pay and Benefits. As the name implies, this category covered more than simply salary. Included in this group would be any influences afforded by days of leave, tuition assistance, bonuses, and other perks. Even with all those potential popular topics, this category ranked third in the list. This ranking is in general alignment with Herzberg's view that Pay is a "Hygiene," or extrinsic, influence. Its effectiveness would follow behind intrinsic motivators such as Personnel Development and quality of life. It turned out that most of the interviewees' comments about pay and benefits were generally positive. Meaning that most respondents indicated that they were satisfied with the compensation provided by their government positions, and except for one male participant, pay was not a big influencer in their decisions to leave the government.

Negative experiences with Pay and Benefits. In government work, there is a cultural understanding that civilian employees should continue to earn more money the longer they perform duties in the government. However, because pay at the federal level is controlled by Congressional budget actions, there is also an expectation that government workers will eventually reach a point where their salaries are capped or limited. That discrepancy often leads to disappointment with government pay. In this study, only a single person indicated that he left his government position due to too little pay. Interviewee E described it like this:

> They offered me more money than I was making in the government at the time. It was, I don't know, probably 5% pay raise. I didn't have a means to get a promotion I don't think. I mean I didn't have a means to get a pay raise [in the government]…And then they [the company] came back and said okay, we're going to give you a bigger pay raise. And so, okay, I'm probably priced out of the government market now.

It turns out that this individual had a young family at that time, so salary was the biggest hurdle for him to overcome and quickly pushed him to accept the offer being discussed in the previous quote.

Another important issue was the idea that starting salaries for engineers was competitive, but at some point, those salaries diverge from industry norms. It is at that point that government engineers could be enticed away from their government job. Interviewee F, a male person of color, observed this divergence before he chose to leave the government. He said,

> I mean compensation is a big thing, and those jump pretty good for the first three years. It was actually comparable starting off, when you combine that with the benefits, the way actually at the time I started too the benefits scaled well. Until the

hard reality of limited positions unfolded. And so that's when it starts to drop off

compared to industry.

This same person also realized that the gap continues to widen as the person gets closer to

retirement. He chose to leave for an industry position after only a few years as a government

engineer.

The government typically compensates for a lower salary (compared to similar

engineering positions in industry) with well-funded benefits. There are few companies that

offer a retirement pension, low-fee medical coverage, education assistance, and other perks

found in the government. However, one area that the government lags behind industry is

offering days of leave, particularly for maternity and paternity situations. Interviewee C

pointed this out as being an influence for her decision to leave the government. She said,

We're talking about starting a family. So how's that gonna work? I thought, good

question, because guess what the federal government also didn't have: maternity leave.

Right, so in order for me to have my child, I would have had to save up all my leave.

It's like do you know to get six weeks of paid time off to have a baby, you know it's

five years. You have to five years without taking a single vacation day. Isn't that

atrocious?!

She went on to mention the possibility of having to take leave without pay to have a second

child in a reasonably close period of time. In her case, there were other influences too; but the

lack of maternity leave was clearly important to her.

Positive experiences with Pay and Benefits. As stated previously, in this study most

interviewees did not rate Pay and Benefits as a big influence on their decision to leave

government service. Comments heard frequently across many interviewees were, "Pay was

never a big deal." And, "Benefits were very generous." As well as, "My agency offered paid time for exercise." Thus on balance, although pay and benefits were mentioned by all the participants, it was generally in a good light that was a main influencer on their decision to leave the government.

Bureaucratic process and Human Resources. The final two categories, Bureaucratic processes and Human resources issues, are traditional and perennial challenges in the government. In my study, however, they ended up at the bottom of the prioritization of mechanisms that influenced the interviewees to leave the government. Dealing with the bureaucratic processes and human resource timelines were certainly mentioned in a few interviews. But these two categories were the only two that did not have entries from all the interviewees. In other words, some conversations never discussed them. This lack of coverage does not indicate that they were not contributing factors and could not be improved. It simply demonstrates their relatively low importance and lack of influence overall for participants in this study.

Interpretation of Results. The interviews generated a tremendous amount of nuance that was not discernable from the survey results alone. The overall evidence pointed to interviewees putting greater emphasis on non-financial issues (e.g., being mentored and cared for) rather than being paid more. Interviewees wanted to hear about their performance from their supervisor and they wanted to be recognized for their contributions more than they wanted a raise. And they were more willing to tolerate bureaucratic processes if they felt respected and part of a team.

These results directly support theories proposed by Maslow and Herzberg. Once the lowest levels of Maslow's hierarchy are met (the physiological and safety levels are

accomplished by sufficient salary), then pay drops away as a motivator and Herzberg's factors of advancement and recognition become much more influential. Seven out of the eight interviewees would have come back into the government if their supervisor had shown concern and support for them.

Summary of this Chapter

In this chapter, I reported on my data from a modest but germane sample size of 73 participants as part of a hard-to-reach population of individuals who had previously left government jobs. Their responses showed statistically relevant results indicating that the two most influential factors that will positively affect how long a person would stay in a government position were Autonomy and Task Significance.

I followed the survey with eight interviews, which offered a more nuanced understanding of career decision-making that is distinct for each person's experiences. The interviews also revealed that a desire for personal growth and supervisor attentiveness play significant roles in whether a person will leave their government job.

CHAPTER FIVE

Conclusions / White Paper

In this study, I set out to answer four research questions relating to STEM retention and the number of years someone remains in the US federal government. I approached these answers by collecting data from an understudied population of former government employees. Chapter 1 laid out the history and the case why this is an important area to investigate. Chapter 2 reviewed relevant literature and historical theories. Chapter 3 detailed my methods. And, chapter 4 presented the findings. Now in chapter 5, I will provide concluding thoughts and some specific recommendations for government leaders that could help manage STEM workers in the future.

Conclusions

In the Preface of this study, I set the tone for the research assuming a role as a manager of talented STEM workers who get "poached" away from government jobs and into positions with other industries or companies. It makes sense to return to that concept now to determine what impact this research may have.

I used existing and proven survey tools to measure Public Service Motivation and the impact on various factors of Job Design on how long a person might work for the government. As described previously, there was an unexpected result showing that nothing in the PSM results had significance to the number of years a person would work in the government. This surprised me initially because I hypothesized that people who worked for the government would have some desire to demonstrate their loyalty to the nation, and could likely be influenced by managers who "wave the flag" of national service. Once I realized that my

population had already left government service, it made sense that the PSM construct would not result in any findings.

I believe the Job Design construct worked as expected. I was hoping that more of the JD factors would demonstrate significant correlation, but the four that did have significance were quite telling. Although I provided some interpretation in Chapter 4, I feel it is necessary to add a little more consideration here about JD in the specific case of STEM workers. Academically, the JD factors should all be considered as positive influences. This means that traditionally, an improvement in the JD survey responses, should reflect positively on the years of service. But it seems apparent from my study results, both quantitative and qualitative, as well as years of personal observations of STEM workers that they are truly intrinsically motivated. They don't need Feedback either from a Supervisor or from the Job itself to know they have performed well. In fact, many of these highly competent individuals may find cognitive dissonance in trying to reconcile their own performance from feedback that may be based on external, likely irrelevant, factors. For example, many companies rely on counting lines of software code or number of computer modules completed. Unfortunately, these numeric metrics discount the quality needed to ensure first pass yield is high and rework is low. I have seen first-hand the amount of pride a computer programmer takes in writing their code. Thus, any external measure that contradicts this mentality will significantly impact that programmer and will eventually decrease their performance overall.

Additionally, long gone are the days of male software coders wearing "stuffy" button-down white shirts and ties, while sitting at computer desks in large open workspaces. Although technical collaboration is still very important in today's sophisticated work environment, the conditions vary tremendously. In fact, I believe the results of this study show

that it is not important what the work environment is. Collaboration can take place in many ways, both in person and virtually. And STEM workers will find their own work environments that are conducive to getting their job done. This could mean working from an office, working from home, or possibly working from a corner coffee shop. In all these cases, although the work environment matters, it is completely controlled by the STEM worker to their best advantage.

Therefore it is in these particular ways for government STEM workers, that the results described in Chapter 4 support traditional motivation theories, such as Maslow and Herzberg. The conclusion here means that, although specific cases will vary, in general, government workers will likely follow traditional patterns of behavior as they wrestle with the idea of moving out of the government to another job. Therefore, government human capital managers can look to some typical actions to improve productivity and retention rates in current workers. Further however, there are nuances to peoples' lives that must be taken into consideration in order to have the most effective retention strategies. Those nuances, those special situations, can only be known by co-workers who are close to the individual. That means the person with the most knowledge and most influence will be the individual's first line supervisor. Therefore, that is where additional energy must be spent if the government will have effective human capital policies in place.

Recommendations

My recommendations for improving the retention of STEM personnel in the government fall into two main categories – those that follow directly from the results of this study, and those that are influenced by my own experiences.

First of all, this study clearly showed both quantitatively and especially qualitatively that supervisors are key to retaining STEM workers in the government. Thus, focusing on the conclusion of improving first line supervisor involvement in effectively managing STEM personnel leads to various implementable actions. These actions are intended to provide STEM managers the tools and skills necessary to retain key STEM personnel – tools and skills both personally and in policy.

The following recommendations are not prioritized and will likely need to be implemented in combinations. The first three are direct results of this study, while the others bring in good ideas that were suggested to me during the interviews and from personal observation during my career.

Improve, standardize, and monitor supervisor training. Being a supervisor is a critical position to influence and support STEM workers. It is a hard job, and one that not many people come to with the background necessary to be effective. But effective management techniques can be taught and learned. Rightly so, organizations expect a lot from their first-line supervisors; yet they are expected to continue performing other duties often while required to perform evaluations, awards, and mentoring. Companies and government agencies should afford managers the time to learn soft skills and techniques useful to their role. Supervisors should be allowed time to read and take courses both virtually and in person about management and leadership. Additionally, an organization needs to invest in the success of these supervisors by paying for off-site classes, expert speakers, and continuing education to ensure their supervisors are performing at their peak.

Plus, supervisors should be monitored regularly and given feedback about their role as a supervisor. Ideally, a standardized rubric can be created for the organization such that

supervisors know what characteristics they should be exhibiting in order to be considered a successful manager.

Implement a talent management and certification program. Talent management is an area that the government is generally lacking. There are many training methods and courses offered in every area of government employment; but a government-wide talent management program that includes succession planning and preparation does not exist. There are many tools in the commercial marketplace that can assist and provide good models for government agencies to follow. Or the Office of Personnel Management (OPM) could award a contract to a company to provide a standard tool across the government. Some of the biggest commercial names in this area include: Cornerstone OnDemand, SAP, Oracle, and many others. Each application has different customizable features that can be tailored to the government's needs.

This recommendation could be implemented in phases. There are already some government jobs that utilize talent management tools. These should be considered pilots that can provide lessons learned for expanding the capability more broadly.

Store and analyze exit interviews. When an individual decides to leave their job – whether it be for promotion or poor performance; due to their own choice or management reassignment – they should be asked to complete a standard governmental survey. Questions on such a survey would center around the reasons for their departure and try to tease out whether there were any negative circumstances surrounding this move. These data would be used to create a database of exit interviews, both quantitative and qualitative, that would be gathered at a local level and then passed to OPM for archiving. This database can be continuously monitored and analyzed in order to optimize human capital strategies when

negative retention trends are spotted. Furthermore, it would serve a psychological purpose to ensure a departing employee gets "heard" on their way out.

Components of a good exit interview survey design would have a few characteristics:

- It must be succinct – a person leaving the organization will not complete a lengthy questionnaire.

- It must be flexible – needs to relate to the government as a whole and then ask questions specific to that person's circumstances.

- It must ask about reasons for departure – inquire about work environment, culture, compensation, training, etc.

- It must ask whether there were external concerns – people leave jobs for many reasons, some reasons may not be reconcilable in their current position. But most people could probably be retained if the organization had been given a chance to react.

- And, finally, it must ask for recommendations for improvement – if the departing individual has constructive ideas, it is a good approach to ask for them on the way out. A better approach, of course, would have been to implement these good ideas before the person departed.

Incentive pay for managers. Governmental managers work hard, often performing other duties in addition to the manager role. Typically, they are not paid more for taking on this position. It is simply compensated at the same GS paygrade as other managers. The GS pay structure needs to include bonuses or "incentive pay" for managers; it is hard work when done properly and yet there is no financial incentive for anyone to take on the extra duties. The question was raised by several interviewees of why anyone would want to become a supervisor, which incurs significant additional responsibilities, but no additional

compensation. As was discussed in the findings of this study, the critical influence wielded by first-line supervisors cannot be understated and should be rewarded.

Incentive pay for STEM professions. Incentive pay or career bonuses may also be effective for certain STEM fields. The study showed that Computer Science was a recurring STEM major, however, other specialties may require targeted pay increases to ensure the brightest minds continue to work in the government.

Institute unlimited paid time off (PTO). Unlimited paid time off, also referred to as an open leave policy, is a popular perk offered by information technology companies that is now being adopted into more of the mainstream large companies. The government should consider implementing an open leave policy too. This is a trend in certain industries where employees can take as much time off as they can convince their supervisor to allow. This acts as an incentive benefit that would continue to keep governmental positions on par with industry competitors.

Give additional discretion to reward performance. The "Pay Pool" is the annual ranking that government employees endure that attempts to equate pay for performance. Generally, these pay pools do not generate enough difference between employees to really reward exceptional performers over mediocre ones. The policy and process results in everyone getting a little bit of financial reward, rather than substantially rewarding top performers. The pay pool process needs to be funded better to allow for greater rewards in the form of raises and bonuses for proven top performers.

Increase the role of Human Resource representatives. In many cases around the government, Human Resources representatives only serve to ensure policy is followed, but has no knowledge or even a stake in filling a vacancy with the highest quality and best fit

candidate. This is typically because the HR department is external to the hiring authority office. In commercial companies, particularly large IT and engineering firms, the HR representative is often as knowledgeable and technical as the engineers on the team. The HR rep is instrumental in choosing or retaining an employee who does not just fill a billet, they also are a good fit for the team. Civilian Human Resource departments should play a major role in hiring and retention of STEM personnel to bring the government on par with common practices and best business processes.

Future Research Opportunities

This study paved the way for continuous research into human resource practices and policies affecting STEM personnel. There are several logical follow-on studies that could be accomplished that would grow the body of knowledge.

- Build a complete database of former government workers and continue to refine the understanding of why they left the government. Essentially, this is a continuation of this same study but with more participants to confirm and refine the statistical findings in this study.

- Mine the data from an exit interview database to determine trends and other influences on STEM workers.

- Pursue a longitudinal study that tracks individuals through their careers in the government.

- Consider performing studies focused on age (millennials, Gen Z), gender differences, or COVID-19 workforce impacts.

White Paper

I.   **Purpose**. This study was intended to collect quantitative and qualitative data from former government STEM employees with the goal of determining why they left their government jobs and if their final command had wanted to keep them, what levers would have been most effective.

II.   **Background**. Since 1990, the number of government personnel has been shrinking while the technological complexities of government systems has been growing. This indicates the need to maintain an appropriate number of government workers with the requisite technical background to perform inherently governmental tasks – generally having to do with contracts, requirements generation, product acceptance, and testing. Because STEM-trained personnel are in high demand outside the government, this study assumed that people in these positions inside the government would be needed to stay. Furthermore, when STEM-trained team members depart, it takes time to identify and build up new talent to fill the gap left behind.

This study is grounded in psychological motivation theory, principally as proposed by Maslow and Herzberg. It also applied subsets of motivation theory specifically directed at Public Service Motivation and Job Design. These two areas (PSM, JD) formed the basis for the survey (quantitative) and the interviews (qualitative) that were used to collect data in this study. With a sample size of n=73, the statistical analysis showed significant correlation between years in government service and employee autonomy and task significance. From the interviews, we learned that overwhelmingly these former government employees would likely have stayed in the government if their supervisors had mentored them properly, had provided adequate performance feedback, and in general had cared about them more.

III.   **Discussion**. Quantitatively and qualitatively, it is clear that retention of STEM talent fundamentally resides with their immediate supervisor. If the supervisor is aware of the employee's needs and challenges, then the supervisor could make appropriate modifications such that the employee would not leave.

IV.   **Recommendations**. Focusing on the conclusion of improving first line supervisor involvement in effectively managing STEM personnel leads to various implementable actions. These actions are intended to provide STEM managers the tools and skills necessary to retain key STEM personnel – tools and skills both personally and in policy.

The following recommendations are not prioritized and will likely need to be implemented in combination with other ones.

- Improve and standardize supervisor training, and monitor supervisors to ensure they are performing their management duties effectively.
- Implement a government-wide talent management program that includes succession planning and preparation.
- Create a database of exit interviews, both quantitative and qualitative data, that would be gathered at a local level and then passed to OPM for archiving. This database could be used to manipulate human capital strategies when negative retention trends are spotted. Furthermore, it would ensure a departing employee gets "heard" on their way out.
- Change the pay structure to include bonuses or "incentive pay" for managers; it is hard work when done properly and yet there is no financial incentive for anyone to take on the extra duties.
- Incentive pay or career bonuses may also be effective for certain STEM fields. The study showed that Computer Science was a recurring STEM major, however, other specialties may require targeted pay increases to ensure the brightest minds continue to work in the government.
- Consider providing unlimited leave. This is a trend in certain industries, particularly in Information Technology companies, where employees can take as much time off as they can convince their supervisor to allow. This acts as an incentive benefit that would continue to keep governmental positions on par with industry competitors.
- The "Pay Pool" is the annual ranking that many government employees follow that attempts to equate pay for performance. Generally, these pay pools do not generate enough difference between employees to really reward exceptional performers over mediocre ones. Change the pay pool process to allow for greater rewards in the form of raises and bonuses.
- Human Resource departments should play a major role in hiring and retention of STEM personnel. In many cases around the government, the HR rep only serves to ensure policy is followed but has no knowledge or stake in filling the vacancy with a good fit candidate.

V.   **Conclusion**. My observations as a technical manager and the results of my study into STEM-talented former employees add clarity to an opaque window into the retention of the STEM workforce. More planning and talent management policy needs to be focused specifically on STEM workers so that the US government can keep pace with the highly sophisticated systems and processes in the future.

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APPENDICES

Appendix A: Survey Instrument

The survey instrument started with this Excel file which was derived from Public Service Motivation (PSM) and Job Design questionnaires. The items listed in this attached file were then copied and pasted into a Qualtrics format to be used online by survey participants.

Survey
Instrument.xlsx

Appendix B: Semi-Structured Interview Question Guide

Interview Guide
STEM Retention in US Government

Guiding Research Questions:
- ◼ **What motivates STEM employees to leave the US Government?**
- ◼ **What "levers" might a supervisor/manager have to retain highly qualified STEM employees?**

I.   Introductions
  a. The purpose of my research is to better understand what motivates STEM employees to leave with the US Government. Ultimately, to affect Human Capital Policy and learn what "levers" I may have as a Supervisor/Manager to retain highly qualified STEM employees.
  b. All my data is held in strict confidence. Although no data will be reported or shared in an open way, there is one person besides me who will know or could learn the identities of respondents. The only person is my dissertation advisor. I can provide protection of your name, if desired, by using a pseudonym. Do you desire that protection?
  c. There was no provision made for you to review the transcript of our conversation or my study report. Let me know if you want to read it once it is done.
  d. There is no compensation for conducting the interview. You have the satisfaction of knowing that I mentioned this in front of the CNO, and perhaps some of my findings will make their way back to us in the form of additional management techniques for retaining high-quality STEM employees.
  e. If you do not feel comfortable answering any specific question or if you wish to end the interview at any time, simply say so. Everything is completely voluntary.
  f. Thank you!

II.   Semi-structured Interview Questions
  a. Personal Information / Job Background
        i.   Please describe your post-high school education. What degrees do you have and in what subjects? I don't need to know years.
        ii. How long did you work for the government?
        iii. What did you do for the government?
        iv. Would you describe your current job as a STEM position? Why or why not?
  b. Job Satisfaction

      i.   Using a simple scale from Not at all Satisfied to Completely Satisfied, describe your current level of satisfaction with your job.

      ii.   What characteristics of your job do you enjoy?

      iii.   What characteristics of your job do you NOT enjoy?

      iv.   How do you feel about your pay and compensation?

      v.   What are your thoughts about the support provided to you by your leadership – including resources, facilities, supplies, etc.?

      vi.   Talk to me about your work-life balance.

      vii.   What would you change about your current job to make it more satisfying for you?

c. Job Motivation

      i.   Describe how you feel about coming to work each day.

      ii.   How do you understand that your position contributes to the overall function/mission of the organization?

      iii.   What kind of career progression is available to you? What changes would you recommend?

      iv.   What would you like to see different about the training opportunities made available?

      v.   How much autonomy do you have to perform your job?

      vi.   What would you change about your current work situation to make it better?

d. Job Alternatives

      i.   Were you recruited to a position outside the government?

              1.   If YES, what was your thought process at the time?

      ii.   Why did you choose to leave the government?

      iii.   What incentives would you like to see made available to government STEM employees?

III.   Conclusion

a. Thank you, again, for participating. Is there anything else I should know about what motivates a government worker and mechanisms for better retention practices?

Appendix C: Interview Details

Interview Identifier	Date	Length (minutes)	Self-identified Race	Self-identified Gender	Approximate Age
A	1/13/2021	63	Hispanic	Male	40
B	1/23/2021	52	White	Female	57
C	1/24/2021	71	White	Female	45
D	2/20/2021	33	Asian	Male	45
E	2/15/2021	61	White	Male	54
F	2/28/2021	50	Hispanic	Male	41
G	4/1/2021	60	Black	Female	42
H	4/2/2021	53	White	Male	48

Appendix D: Qualitative Interview Analysis

Qualitative
Analysis.xlsx

Appendix E: Institutional Review Board Approval Letter

University
of San Diego®

Mar 12, 2018 9:37 AM PDT

Jeffrey Myers
Sch of Leadership & Ed Science

Re: Expedited - Initial - IRB-2018-338, Retention of STEM personnel in US Government

Dear Jeffrey Myers:

The Institutional Review Board has rendered the decision below for IRB-2018-338, Retention of STEM personnel in US Government.

Decision: Approved

Selected Category: 7. Research on individual or group characteristics or behavior (including, but not limited to, research on perception, cognition, motivation, identity, language, communication, cultural beliefs or practices, and social behavior) or research employing survey, interview, oral history, focus group, program evaluation, human factors evaluation, or quality assurance methodologies.

Findings: None

Research Notes:

Internal Notes:

Note: We send IRB correspondence regarding student research to the faculty advisor, who bears the ultimate responsibility for the conduct of the research. We request that the faculty advisor share this correspondence with the student researcher.

The next deadline for submitting project proposals to the Provost's Office for full review is N/A. You may submit a project proposal for expedited or exempt review at any time.

Sincerely,

Dr. Thomas R. Herrinton
Administrator, Institutional Review Board

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