Human Factors Occupational Study

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This document provides an overview of the human factors occupation at the US Department of Transportation (DOT), Research and Innovative Technology Administration (RITA), John A. Volpe National Transportation Systems Center

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1. Introduction

This is a report of the Human Factors Occupational Study (Task 0001AF-5) conducted by Custard Consulting, LLC for the Office of Human Resources of the Volpe National Transportation Systems Center during February through May 2012. The study was designed to assess and recommend near and long-term human resources (HR) solutions for the recruitment of human factors professionals for the Center.

2. Background

One of the Volpe Center's lines of business for all of its forty-plus years is focused on performing professional research, analysis, and development activities related to human factors issues in transportation. For most of that time, positions within the human factors organizational component were filled almost exclusively with engineering psychologists. Over the past ten years, the organization has expanded recruitment to additional professional occupations which typically can include a human factors focus (e.g., industrial engineering and operations research), in an attempt to reach a wider pool of candidates with a human factors background. However, the field of human factors has evolved to embrace aspects of several additional disciplines, e.g., kinesiology, biomedical engineering, and computer science, so that it is becoming increasingly difficult to classify and recruit for these positions within the context of the Federal HR management system, which does not have a specific job series for human factors work.

The Federal personnel system is built upon the series of a position. Positions are classified in accordance with the definition and standards of the series, which then determines the qualifications that an employee must have to perform the work and associated compensation. Series are organized within occupational families, e.g., the Engineering and Architecture Group. Positions are typically associated with one series, however the system provides for multidisciplinary classifications when the position can be filled by someone from more than one occupational background, for example either a computer engineer or a computer scientist.

The Volpe Center has used this multidisciplinary approach in classifying human factors positions in recent years, but since the human factors occupation draws from a wide variety of disciplines, it is becoming cumbersome and somewhat hit or miss when trying to identify all the official series that could potentially be used to fill a position, assuming the principle focus is human factors. In addition, research indicates an increasing number of schools are now offering degrees in human factors, which include courses in engineering, psychology, biomechanics, and computer science. These programs often do not include sufficient coursework in any one discipline to satisfy the Office of Personnel Management (OPM) basic educational component of

the qualifications standards for Federal professional series, yet they provide excellent preparation for many human factors positions.

The Human Factors and Ergonomics Society (HFES) web site provides a thorough listing of undergraduate and graduate level human factors degree programs in the United States and Canada. Experience has indicated that limiting recruiting to a narrow range of series, e.g., industrial engineering and psychology, has resulted in highly-qualified candidates being eliminated from consideration. Consequently, there are occasions when a well-qualified human factors professional from another Department of Transportation (DOT) Operating Administration (OA) does not qualify for the Volpe Center's position because the individual's underlying degree was not identified in the multidisciplinary series of the position. Alternatively, applicants with degrees in the traditional series (e.g., operations research, GS-1515), but without human factors experience, will meet the basic qualifications requirements of the position. However, they are, in general, screened out when they are evaluated against the qualifications (e.g., human factors experience or education) for the position. Overall, the approach is inefficient for the hiring manager, HR specialist, and applicants and often not as effective as it could be.

The private sector is not constrained by the same system of classification and qualification requirements, so they typically recruit for human factors professionals with degrees in human factors engineering, human–computer interaction, cognitive psychology/science, and/or a related field. As there is no Federal occupational series for human factors engineering/science, the Volpe Center and other DOT OAs recruit for some combination of Engineering Psychologist, GS-0180, Engineer (General, GS-0801, Aerospace, GS-0861, and/or Industrial, GS-0896), Operations Research Analyst, GS-1515, and Social Scientist, GS-0101.

The Volpe Center's Office of Human Resources, working with the Center for Human Factors Research and System Applications (RVT-80), identified this issue, i.e., the classification of human factors professionals, as needing further study to determine if there is a better approach to meet the organization's requirements for high-caliber human factors professionals in an efficient and effective manner.

3. Task Scope

The goal of this occupational study is to identify recommendations for near- and long-term solutions to address the human factors classification and recruitment challenges faced by the Volpe Center, as an independent organization and within the context of the DOT human factors community as represented by the DOT Human Factors Coordinating Committee (HFCC). The study has four components:

1. Research human factors and develop a definition to use in benchmarking and discussions;

2. Create a benchmarking survey instrument;

3. Benchmark other government organizations with human factors work or positions to enhance knowledge of human factors HR practices; and

4. Develop near- and long-term recommendations to support recruitment of a highly qualified human factors workforce for the Volpe Center.

The results of this occupational study are included below.

4. Internet Research

The scope of the study started with identifying a common definition of human factors work.

> **Definition:** Human factors is concerned with the application of what we know about people, their abilities, characteristics, and limitations to the design of equipment they use, environments in which they function, and jobs they perform.[1] The HFES identifies approximately 4500 members in the United States and internationally, reflecting a relatively small applicant pool for human factors positions.[2]

Although the field of human factors has been recognized since World War II, it has yet to be identified as a separate occupation by the Bureau of Labor Statistics (BLS) Current Employment Statistics (CES), although the BLS itself recognizes human factors work by using parenthetical (Human Factors) titling for some of its positions, for example, General Engineer (Human Factors), GS-801-13.[3]

Human factors work has been traditionally aligned with the field of psychology (cognitive, behavioral, research, and engineering) and industrial engineering. As the evolution of human factors work has brought aspects of related disciplines under its occupational umbrella, degree programs have sprung up in more than the traditional psychology or industrial engineering programs. An internet search revealed degree programs that are specifically identified as Human Factors and that typically involve a multidisciplinary curriculum. They may be located in the Engineering, Arts and Sciences, or Computer/Information Technology departments. They may be called Human Factors Engineering, Human Factors Psychology, Cognitive Systems Engineering, Human-Computer Interaction, Human Factors and Ergonomics, Industrial Engineering with emphasis in Human Factors, or some similar variation.

[1] From the Human Factors and Ergonomics Society (HFES) web site.
[2] From the Human Factors and Ergonomics Society (HFES) web site.
[3] US Department of Commerce, Bureau of Labor Statistics web site.

Titles used by private sector organizations are similarly diverse, ranging from Cognitive/ Behavioral Psychologist to Usability Engineer/Specialist to Human Factors Engineer. Human Factors and Usability Engineer are perhaps the most prevalent, but both are used in a multidisciplinary manner and may be filled by an engineer, psychologist, or scientist. Usability Engineer/Specialist is often associated with web design and other computer applications that have a broad spectrum of users.

A review of job postings shows that organizations are looking for individuals with degrees, but, as stated previously, they are quite flexible in identifying several human factors related degrees as meeting minimum qualifications. Anecdotally, there is a sense that government contractors are having some difficulty filling human factors positions, and there appears to be a shortage developing among west coast technology companies.

5. Benchmarking Survey Results

The survey instrument (Appendix 1) was developed with input from the RVT-80 management team. There were twenty primary questions asked within five areas: organizational context, classification, qualifications, retention, and need for a new occupational series. Persons to be interviewed (Appendix 2) were identified by the RVT-80 management team and came largely from the DOT HFCC. Interviews were conducted with human factors subject matter experts; HR professionals were not interviewed for the purposes of this study.

Fourteen interviews took place between March 16 and April 10. Nine interviewees worked within the following DOT modal administrations:

- Federal Aviation Administration (FAA)
- Federal Highway Administration (FHWA)
- Federal Motor Carrier Safety Administration (FMCSA)
- Federal Railroad Administration (FRA)
- Maritime Administration (MARAD)
- National Highway Transportation Safety Administration (NHTSA)
- Research and Innovative Technology Administration (RITA)

The remaining interviews were from five agencies/organizations:

- National Transportation Safety Board (NTSB)
- Department of Defense, Office of Naval Research (DoD/ONR)
- Nuclear Regulatory Commission (NRC)
- Transportation Research Board (TRB)
- Human Factors and Ergonomics Society (HFES)

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Following is a high level summary of the responses to the survey.

Context

- The biggest employers of human factors professionals within DOT are the FAA and the Volpe Center. As of June 2012, Volpe has about thirty-five human factors professionals. FAA has more than thirty-five, but the exact number isn't known as human factors professionals work throughout the organization and can't easily be tracked due to various series used to classify the positions. A guestimate would be between thirty-five and seventy employees. NHTSA, FRA, MARAD, FMCSA, and FHWA each employ from zero to six.
- No organization has had success in achieving race and ethnic diversity. There is good representation of females within the population.
- Most employees have advanced degrees in cognitive/behavioral psychology. The FAA also employs human factors professionals who come from an aerospace engineering background. The overwhelming preference is for advanced degrees. Many human factors positions are at the headquarters (HQ) level and are responsible for major agency programs that require a high level of expertise and standing within the human factors community, so that a PhD is preferred.
- The biggest change in the human factors occupation over time is the expansion of computers/automation into all aspects of work and the growing recognition of the value of human factors in more aspects of human-machine interactions and systems performance. However, most don't think the occupation has changed insofar as the underlying human factors functions are the same. There are many more venues in which human factors are being applied.
- The biggest problem in maintaining a high caliber human factors workforce is the challenge of the Federal hiring process.
- No organization has studied the occupation.
- The study represents a small sample involving human factors work in transportation and does not address human factors work being performed in other large government sectors, specifically, the Department of Defense (DoD), and the Department of Homeland Security (DHS). Additionally, the study does not address human factors work being performed in other government agencies where the human factors work is subsumed within other professional positions, without designation of either organizational or position human factors responsibilities.

Classification

- Most organizations classify human factors positions as professional and interdisciplinary to reflect the multidisciplinary nature of the work and professional education

requirements and to ensure recruitment produces highly qualified human factors candidates.

- The series used within DOT are as follows:
  - Social Science, GS-0101 (FAA only)
  - Psychology, GS-0180
  - General Engineering, GS-0801
  - Aerospace Engineering, GS-0861 (FAA only)
  - Industrial Engineering, GS-0896
  - Operations Research, GS-1515
- Some organizations use parenthetical titling to increase the emphasis on human factors competencies, for example Industrial Engineer (Human Factors).
- No organizations use the Miscellaneous Administration and Program Series, GS-0301.
- Career ladders vary, but most appear to be able to aspire to non-supervisory GS-14 positions.
- Positions covered by the study tended to be involved in the following:
  - Applied Research
  - Test and Evaluation
  - Program Management (oversight of contractors performing R&D)
  - Transportation Safety inspection/investigation/regulations

Qualifications

- The Volpe Center is the only organization that regularly recruits human factors positions below the GS-12/13/14 levels. The HQ positions typically function as agency experts and work in very small organizations, so they are not in a position to hire and develop junior or mid-level employees. The FAA Technical Center, which employs twelve human factors professionals (all psychologists), generally recruits at the GS-12/13 level, and uses selective factors to screen out non-qualifying candidates.
- All agencies require that candidates have formal training in human factors and prefer advanced degrees, preferably PhDs. The various DOT modes tend to seek candidates with familiarity with their particular mode of transportation.
- Since most agencies hire experienced human factors professionals, candidates for positions come from across the spectrum of employers…academia, private sector, government contractors, and other government agencies.
- Most organizations leverage strong professional and academic networks that support recruitment. There were just two uses of recruitment bonuses. The Volpe Center uses a broad range of recruitment outreach techniques including attendance at job fairs, invitations to visit the Volpe Center, and active networking by all the human factors

employees and managers. Several organizations have used paid advertising and/or purchased licenses to post jobs and access resumes on the HFES career website.

- New employees tend to choose to work for the organizations because of the importance of the mission, the ability to have an important impact, and the practical (vs. theoretical) aspect of the work.
- Despite a general dissatisfaction with staffing processes, agencies have had success in filling human factors positions with highly qualified candidates. Several interviewees indicated human factors is a relatively small community and they all network in advance of the formal job announcement, some better than others.
  - The FAA does experience difficulty in filling human factors positions in remote locations.
- In addition to expertise in human factors, agencies are looking for well-rounded candidates with excellent communications skills (oral and written), project management skills, and the ability to work in a team environment. Research organizations require skill in experimental design.
- A few cases were identified in which qualified candidates were excluded from consideration. In one case, the HR organization would not credit a degree in human factors as meeting the qualifications for a position classified as a psychologist, GS-0180. In others, it was a matter of not announcing the position as multi-disciplinary, so that the candidate didn't meet the basic qualifications of the series chosen. In some of those cases, the agency cancelled the vacancy and re-announced with a multidisciplinary classification.
- There was the sense that numerous candidates applied who were clinical psychologists or engineers with limited or no human factors backgrounds, but just one instance where these applicants made it into the best qualified group.
- Interviewees felt that what worked best for attracting high caliber candidates was networking within the human factors community and having interesting missions to be performed. At the Volpe Center, they also mentioned having HR specialists who are well versed in how to recruit within the Federal HR systems.
- The overall recruitment process is taking too long at the Volpe Center and needs improvement. The perception of managers is there is more lag time for positions to be posted and certificates to be referred since the Volpe Center is required to use the Delegated Examining Unit (DEU).
- Areas in the recruitment process needing improvement elsewhere in DOT include:
  - More systematic approaches to recruiting human factors professionals. In organizations with small human factors staffs and/or with hiring managers who are not human factors professionals, there is insufficient recruitment activity to build and maintain a competence within hiring managers and HR staff to recruit

effectively and efficiently. (An informal group within the FAA is undertaking efforts to develop guidelines for non-human factors hiring managers.)

  - Interdisciplinary classification leads to a more cumbersome recruitment process. Some DOT organizations require separate vacancy announcements for each series and one has recently required that the jobs be announced sequentially! Additionally, the DOT DEU limits the use of interdisciplinary positions to three series, which may, as discussed above, limit the success of the recruitment effort by screening out candidates who would qualify under another series.
  - Interdisciplinary classification also leads to inconsistent treatment of applicants across the government and within the same agency. Since few use the same combination of series, an individual may qualify for one position and not for an essentially similar position.
  - Some of those interviewed would love to be more involved in identifying the best qualified candidates and several would like to be able to require advanced degrees.

- There was <u>not</u> a sense that human factors positions within DOT or the transportation enterprise were fundamentally different than other human factors positions. Depending upon the position, there will be a need to have knowledge of some aspect of transportation and in most cases this can be taught on the job, but not in every case.
  - As an aside, in one interview with an FAA employee, the employee revealed that while historically they have sought aviation experience in addition to human factors skills, her work with the HFCC opened her eyes to the relevance of human factors knowledge applied in different transportation modes.

<u>Retention</u>

- Retention was not a significant problem for the organizations interviewed. There was a smattering of losses due to a number of reasons… promotion, desire for hands-on work, retirement, family moves, etc. In one case they experienced almost complete turnover in a short period of time, but most of this was due to retirements and one death.

<u>New Series</u>

- Nearly all surveyed liked the idea of a single human factors series. Reasons for wanting a single series include:
  - Hiring would be less cumbersome;
  - It would sharpen the filter through which candidates apply;
  - It would better convey to applicants the nature of the work;
  - It would capture the full range of human factors professionals and inform non-human factors psychologists, engineers, etc. that the position is not for them; and

  - A government-wide human factors series would provide a better linkage to graduate programs in human factors.
- There was no consensus on whether or how to provide for specializations within the series.
- OPM is not aware of any human factors studies underway in the Federal government.

6. Findings

The Volpe Center is doing as well or better than any of the Federal organizations surveyed in recruiting and hiring staff for its human factors organizations. This stems in part from the relative size and maturity of the human factors organization and its close working relationship with the HR staff. The size and stability of the organization provides regular recruiting opportunities, which in turn provides the experience needed to identify the optimal approaches for recruiting high caliber human factors staff. Working closely with an HR specialist who is well versed in the flexibilities and integration of the various HR system elements helps ensure quality results.

The amount of hiring at the Volpe Center justifies participation in job fairs. Use of student positions and recruiting at lower levels strengthens relationships with academia so that human factors professors actively support the Center's recruitment efforts, and allows the Center to employ graduate students as Student Trainees, then convert them upon completion of the graduate degree. And participation with various human factors professional associations and involvement with a variety of sponsoring organizations provides opportunities to network and keep an eye out for potential future hires. Some strategies employed by other organizations that the Volpe Center may wish to consider include:

  - The HFES online Career Center offers job-posting and résumé-searching features for employers seeking candidates for human factors/ergonomics positions. This service is provided for a fee, so it should be used strategically to get the most benefit for any expenditure.
  - Develop a list of human factors organizations/contacts, e.g., HFES subcommittees, TRB subcommittees, for mailing job announcements and recruitment material.

The lack of standardization to classifying human factors position within the DOT and government-wide is inefficient and can lead to the loss of consideration of highly qualified candidates. At the Volpe Center, classification of human factors positions has evolved to using as many as three series (Psychology, Industrial Engineering, and Operations Research) as the key multi-disciplinary strategy for successful recruitment of human factors positions. However, there is evidence this strategy does not generate a sufficiently broad

applicant pool of human factors professionals, or, as indicated earlier, otherwise qualified human factors professionals don't meet the OPM minimum educational requirements to qualify. At a minimum, it excludes some general and aerospace engineers employed in other parts of the DOT. Use of general series within occupational families, i.e., those ending in 01, with titles that include the term "Human Factors" may reduce some of the inefficiencies and/or improve effectiveness in reaching the appropriate candidates. In the long-term, however, the government would benefit from the approach taken by the private sector to use a readily identifiable title, e.g., human factor engineer or human factors psychologist and allow for a variety of relevant educational degrees to meet minimum qualifications.

Is there a case for a new series specifically for human factors professionals? The wide variety of approaches taken to classify and fill human factors positions identified in this study suggests the current system isn't working well for this evolving occupation. The structure of the classification and qualifications systems creates on-going challenges in reaching highly-qualified candidates for its human factors positions. While the individuals surveyed have been able to meet their hiring needs with highly qualified candidates, this often requires duplicative efforts to ensure that qualified candidates are not excluded because of the selection of series. However, development of a single agency or government wide single series for human factors professionals is a significant undertaking requiring substantial agency resources and the endorsement/support of the DOT Human Resources organization. Given the small size of the human factors workforce within DOT, it may be difficult to make this resource intensive activity a priority.

7. Recommendations

- Short-term
    1. Modify the approach to classifying human factors positions. Classify most human factors positions as multidisciplinary in the following manner:
        - Engineering Psychologist (Human Factors), GS-0180
        - Human Factors Engineer, GS-0801
        - Operations Research Analyst (Human Factors), GS-1515
        - Human Factors Scientist/Specialist/Analyst, GS-0101
    2. Make strategic use of the HFES career center which provides for job posting and/or resume searches. This would make sense when recruiting for multiple positions. It may also be possible for the DOT to purchase an annual license that allows multiple users.
    3. In keeping with this recommendation, the Volpe Center and/or DOT should consider sponsoring a human factors student group under the auspices of the HFES, creating an increased candidate pool.

4. Where appropriate, leverage OPM qualification standards for professional positions (GS-11 and above)[4] involved in research to require a graduate degree as the minimum qualification requirement for human factors positions involved in research. This approach may require the development of instructions for the DOT DEU.
5. Where appropriate, investigate and implement the use of selective placement factors for candidate screening when human factors positions are advertised.
6. The use of subject matter experts in DEU rating and ranking, as described by the DOT Delegated Examining Executive Agent's "hurdles" process, would allow for consideration of human factors experience in a more meaningful fashion and potentially result in a higher number of qualified candidates.

- Long-term
    1. Through the HFCC, conduct DOT–wide workforce planning to strengthen the critical supporting capability of human factors. This would include standardized approaches and guidance to classification, recruitment, and development of the human factors workforce.
    2. Working through the HFCC, collaborate with DOT HR to pursue options for a new series or single agency qualification standard for human factors positions.

Questions regarding this study should be referred to Ms. Susan Custard at susanc@custardconsulting.com.

Appendices

1. Survey instrument
2. Interview list

[4] Office of Personnel Management Qualifications Standard for Professional and Scientific Positions