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Work Schedule Manager Gap Analysis: Assessing the Future Training Needs of Work Schedule Managers Using a Strategic Job Analysis Approach

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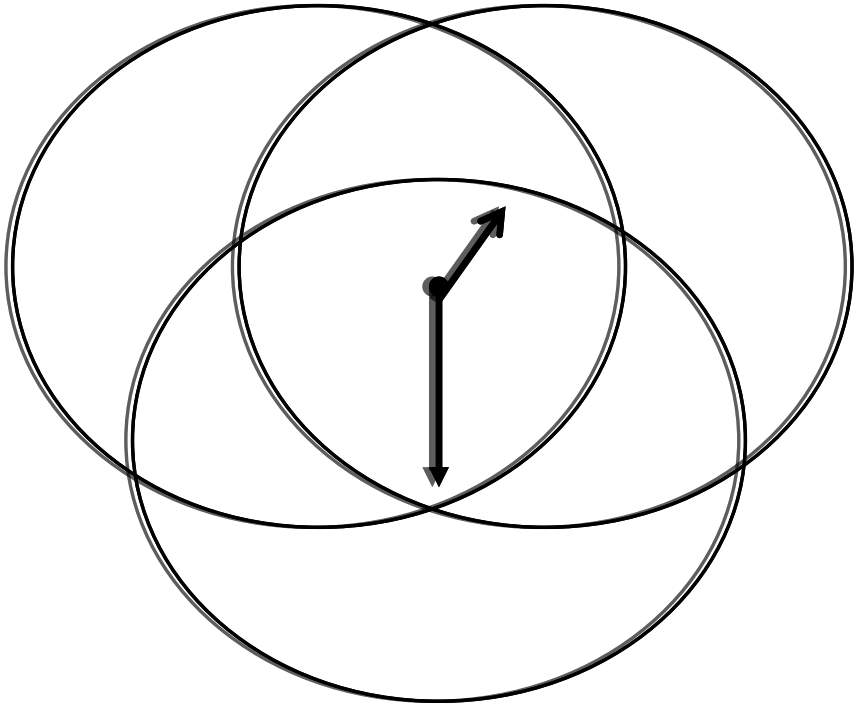

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13. ABSTRACT

This report documents the results of a strategic job analysis that examined the job tasks and knowledge, skills, abilities, and other characteristics (KSAOs) needed to perform the job of a work schedule manager. The strategic job analysis compared information from subject matter experts (SMEs) about best practices in work scheduling to job incumbents' reports of current practices in their scheduling job duties. Data were collected through interviews and surveys with 17 SMEs in academia and consulting and 16 job incumbents within 11 organizations representing a wide array of industries. Gaps between the job tasks and KSAOs that should be important for future work schedule management and the job tasks and KSAOs currently used in work schedule management were assessed both quantitatively and qualitatively. The results pointed to a need for additional training in understanding how work scheduling affects employee health, safety, and performance. In addition, scheduling managers should be better informed about ergonomic schedule designs and empowered to evaluate their scheduling systems so as to identify and address problems with the system. The report discusses the critical gaps in job tasks and KSAOs and how those gaps should be ameliorated through the development of a certification for work schedule managers.

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1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)	10,000 square meters (m^2) = 1 hectare (ha) = 2.5 acres
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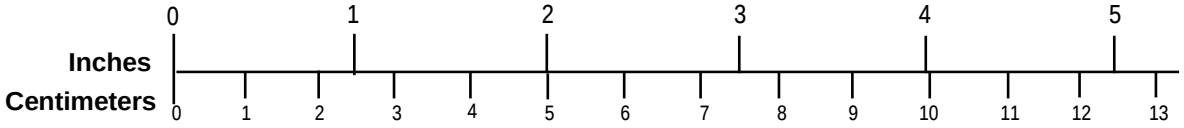

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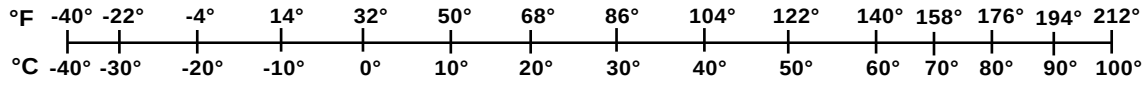

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The views expressed herein are those of the authors and do not necessarily reflect the views of the Volpe Center, the Research and Innovative Technology Administration, FRA, or the U.S. Department of Transportation.

Contents

Executive Summary

More than 21 million wage and salary workers, or almost 18 percent of the U.S. workforce, currently work other-than-day work schedules (McMenamin, 2007). Research has shown that poor schedule design can have negative implications for worker performance, safety, and health, and as a result cost U.S. businesses approximately $206 billion per year (Broughton and Ogilvie, 1992; Tepas, 2001; Kerin and Aguirre, 2005). Yet the vast majority of supervisors and managers who perform shift work scheduling and management have no formal training in the human factors of sleep, the health and safety impacts of shift work, or the array of methods and formulas for designing and managing low stress-high productivity work schedules and shift rotations (Kryger, Roth, and Dement, 2000). An apparent gap exists between research and practice when it comes to work schedule management, and that gap needs to be documented and addressed in industry.

As part of its efforts to investigate new approaches to work scheduling and fatigue management, the Federal Railroad Administration's (FRA's) Office of Research and Development sponsored this preliminary assessment of the need for advanced training in work schedule management and potential for subsequent development of a certification for scheduling managers. Although there may be substantial differences in the mechanisms associated with managing work schedule operations in general, and fatigue in particular, the nature of the problems is very similar across occupational classifications. Therefore, this phase of research sought to document the job tasks and knowledge, skills, abilities, and other characteristics (KSAOs) common to work schedule managers across a broad array of industries that operate multiple and/or around-the-clock work shifts.

The fundamental goal of this research project was to investigate and identify the gaps between the job tasks and KSAOs that work schedule managers should have and what they currently have. This was accomplished through the implementation of a strategic job analysis comparing information from subject matter experts (SMEs) about best practices in work scheduling to job incumbents' reports of current practices in their scheduling job duties.

In Phase 1, future-oriented job task and KSAO information was collected from 17 SMEs with high-level knowledge of shift scheduling best practices and with experience implementing schedule changes in organizations. Ten industry experts were interviewed in a panel discussion format, and each brought at least 10 years (yr) of experience consulting for organizations that operate around-the-clock. Seven academic experts participated in one-on-one telephone interviews and were chosen based on a track record of publishing and presenting research related to the health and safety of shift workers. In total, 6 job tasks, 14 types of knowledge, 14 skills, 12 abilities, and 12 other characteristics were identified as critical for work schedule managers.

In Phase 2, current job task and KSAO information were collected from job incumbents in various types of industries that operate around-the-clock. Individual in-person interviews were conducted with 16 job incumbents from 11 different organizations. The job incumbents worked in the fields of transportation, public utilities, health care, hospitality, public safety, and manufacturing.

The research team used a mixed methods approach to determine an overall assessment of the gaps between SMEs' and job incumbents' reports of important job tasks and KSAOs in work schedule management. The assessment considered quantitative ratings of importance and qualitative differences in importance based on a content analysis of interview transcripts. Each job task was given one of three labels: minimal gaps, moderate gaps, or significant gaps exist. The KSAOs were divided into one of four tiers based on ratings of importance (higher tiered KSAOs were rated as more important) and then categorized into one of the three gap levels mentioned previously.

Results suggest that the most significant gaps in job tasks concern addressing the particular demands of shift work. Assisting employees with managing shift work schedules and monitoring performance and safety to determine whether there are shift-related safety risks are key responsibilities that should be managed by shift work schedulers in an organization. Employees and organizations need an internal resource to aid them in managing and understanding the challenges of shift work. Current work schedule managers may not have the knowledge or tools to carry out these activities.

Critical (tier 1) KSAOs demonstrating significant gaps can be divided into two categories: knowledge concerning the inputs needed to design work schedules and characteristics needed to understand and manage the health and safety risks associated with shift work. Although SMEs and job incumbents agreed that these KSAOs were very important, most of the job incumbents we interviewed did not demonstrate the level of scheduling design or health and safety knowledge that SMEs indicated should be required. However, there were a few exceptions. Two of the job incumbents interviewed reported having specialized training. Training beyond what was acquired on-the-job assisted both of these scheduling managers in carrying out their job responsibilities, albeit in different ways. Yet training is neither standardized nor easily accessible to all scheduling managers at this time.

The gap analysis of job tasks and KSAOs revealed a common theme: additional training is needed to aid work schedule managers in understanding how the design of work schedules can impact employee health, safety, and performance. The incumbents interviewed were fully capable of maintaining work schedules and making minor changes to scheduling to account for absenteeism, turnover, or overtime needs. However, they may not be qualified to identify problems in the schedule design and/or make changes to the system to address those problems. SMEs reflected that schedulers and their employing organizations appear to be underestimating the importance of proper schedule design.

Nonetheless, caution should be used when extrapolating these results to the entire population of employees with work scheduling job duties. Only a few scheduling managers were interviewed for this study. In addition, there were relatively few statistically significant differences between empirical ratings of importance. Conclusions are based on holistic observations of the quantitative and qualitative data collected and should be used to provide guidance for future studies and training development efforts. Additional research is necessary to identify training and certification needs in specific occupations, especially considering the identified need for substantial industry-specific knowledge in work schedule management.

Another consideration when moving forward with a work schedule manager certification program is that different levels of training need to be developed to target varying levels of

skill development. SMEs indicated that scheduling expertise varies based on industry, type of operation, and the size of an organization. Variations in expertise were also evident across job incumbent interviews. Work schedule management training is needed at all levels, from first-line supervisors to the next generation of shift work consultants. Addressing the training need at different levels requires different kinds of programs, ranging from short-term seminars to graduate-level training.

Overall, SMEs expressed enthusiasm for the development of a certification program and confirmed the need for greater levels of expertise in work scheduling. Many also expressed interest in assisting with the development of training curricula. Job incumbents were helpful and cooperative, and confirmed that work scheduling is often not a streamlined process. Training, technology, schedule designs, and even “rules of thumb” differ greatly within and among organizations. The outcomes of this project suggest that training work schedule managers involves finding a balance between company needs and occupational health and safety concerns and helping managers navigate that balancing act.

1. Introduction

More than 21 million wage and salary workers, or almost 18 percent of the U.S. workforce, currently work other-than-day work schedules (McMenamin, 2007). The global economy is fast becoming a 24-hour (h) society of work and activity. The steady increase in these nontraditional and 24/7 work schedules over the past century has resulted in less work flexibility, extended workdays, and irregular work hours in many industries. Research shows that the failure to address these scheduling issues properly can result in productivity losses, increased worker stress, higher levels of chronic fatigue and sleep deprivation, increased illness, and higher accident injury rates (Broughton and Ogilvie, 1992; Tepas, 2001). Furthermore, a recent economic analysis conducted by *Circadian Technologies* estimated the corporate cost of implementing poorly designed work schedules at approximately $206 billion per year for U.S. businesses (Kerin and Aguirre, 2005). Not only is the corporate workforce involved in managing work schedule operations, but so too are many state and federal agencies, such as state police, FRA, and the military.

Many companies, industries, and government agencies have attempted to ameliorate these negative consequences by instituting fatigue management and educational programs, developing fatigue management tools, and implementing other fatigue countermeasure strategies. However, fatigue is generally considered the outcome of multiple factors, including work schedule arrangements, and is often regarded as a cause of poor performance and increased accident risk, rather than a symptom of a more system-based problem. This is an important distinction, because the development of training or tools to address one part of fatigue is unlikely to address the root of the problem, nonergonomic work schedule design, in any systematic way. Although a rich and mature body of literature exists on issues surrounding the different aspects of fatigue and its relationship with proper work schedule design and staffing analyses, this common body of scientific knowledge is largely inaccessible to those who need it most. More often it has been distilled and used primarily by management-consulting organizations, typically on a reactive basis to help correct an identified and specific problem related to fatigue.

Although there is a current trend to develop competency-based training for individuals who schedule shift workers, this training is predominately focused on fatigue management issues, not ergonomic work scheduling. No uniform training exists for individuals who are responsible for managing work schedule operations. The vast majority of supervisors and managers who perform shift work scheduling and management have no formal training in the human factors of sleep, social impacts of shift work, health and safety risks, or the array of methods and formulas for designing and managing low stress-high productivity work schedules and shift rotations (Kryger, Roth, and Dement, 2000). Furthermore, to our knowledge, no published studies provide a detailed and thorough analysis of the job requirements, skills, abilities, and knowledge required to perform shift work scheduling. In fact, there is no entry for “work scheduler” or “shift scheduler” in the O*NET Occupational Information Database. Most organizations combine the responsibilities for staffing, schedule design, and the general management of work schedule operations with other management or administrative duties.

Although substantial differences may exist in the mechanisms associated with managing work schedule operations in general, and fatigue in particular, the nature of the problems is very similar across occupational classifications. Proper staffing levels and a tailored, ergonomic work schedule that fits the worker population and type of operation are the fundamental building blocks necessary to minimize consequent issues of fatigue in the workforce. It is therefore considered crucial that those responsible for managing complex operations that involve multiple round-the-clock work schedules receive the training and tools necessary to perform this job properly.

1.1 Background

In August 2004 a meeting of government stakeholders was convened to review and build on a prospectus to determine the means, methodology, and viability of creating a certification for work schedule managers. The goal of this program is to create "champions" of scheduling best practice principles within 24/7 industries and government agencies. Meeting attendees agreed that the first step in the development of this certification was to document the need for a certification in around-the-clock industries. This documentation is crucial for justifying the funding requests for this program.

The proposed certification program is targeted at managers and first-line supervisors across various work contexts who are responsible for the scheduling of multiple shifts. The goal of this program is to provide scheduling managers with the fundamental knowledge and tools to assess scheduling concerns and needs regarding their specific 24/7 operations, be it schedule design, implementation, staffing, shift relief, fatigue awareness and management, legislation and legal issues, or lifestyle training.

To understand the necessary knowledge and skills these managers should possess, the government committee initiated a project that would gain insight about these topics from an identified group of work scheduling experts and job incumbents. The information collected from these groups would lay the proper foundation for developing the proposed certification program curriculum.

The initial step in developing this credential was to perform a job analysis for those positions and people who are responsible for managing work schedules and other shift work operations. Job analysis refers to a category of methodologies for capturing the various work tasks that encompass a job and the KSAOs required to carry out those tasks.

A strategic job analysis was conducted in two phases. The first phase consisted of information gathering from identified SMEs in the field of work scheduling and shift work research and consulting. These data reflect the job tasks and KSAOs the SMEs believe should be necessary to manage fatigue and work schedule operations effectively. The second phase consisted of interviews with job incumbents, those people who are employed in existing positions with responsibilities for staffing, scheduling and managing work schedule operations. This information was used to identify the current KSAOs used to carry out work scheduling job functions. A gap analysis was then conducted to compare information from SMEs to that obtained from job incumbents and identify commonalities and gaps in KSAOs. Finally, we provide recommendations as to the KSAOs that should be targeted in the development of training requirements for a work schedule manager credentialing program.

1.2 The Research Team

This project was a collaborative effort incorporating individuals from different disciplinary and methodological backgrounds affiliated with the University of Connecticut, the University of Nebraska–Lincoln, the John A. Volpe National Transportation Systems Center (Volpe Center), FRA, and two independent consultants. Team members included faculty and graduate researchers in industrial and organizational psychology with expertise in job analysis and quantitative research methods, a faculty member in industrial engineering with experience in researching sleep and fatigue issues at work operations, a methodologist in counseling psychology with expertise in mixed methods and qualitative research and a graduate research assistant with prior experience conducting qualitative research, applied human factors researchers in fatigue issues in the transportation industry, a private consultant in fatigue mitigation in round-the-clock work scheduling, and a private consultant in educational certification and credentialing. A complete list of the people involved in this project is presented in Appendix A.

2. Strategic Job Analysis

The methodology used for the current job analysis study is consistent with recommendations provided by Brannick and Levine (2002) for conducting a combination job analysis (C-JAM), and recommendations from Singh (2008) for developing a strategic, forward-looking job analysis framework.

The C-JAM is a type of hybrid job analysis that uses multiple kinds of data collection procedures to acquire information about job requirements and worker requirements. C-JAM focuses on developing task statements about the job, identifying the KSAOs needed to perform the job, and then rating both the tasks and KSAOs based on their importance for job performance.

A strategic job analysis, as defined by Singh (2008), is a purposeful, systematic process of collecting current and future work-related aspects of a job. The strategic job analysis approach breaks from traditional job analyses by defining job tasks and KSAOs required for a job as the job is *predicted to exist in the future*. Singh's approach to conducting a strategic job analysis also incorporates a gap analysis, whereby present KSAOs are compared with future KSAO needs to determine whether significant differences exist that will need to be addressed in the future by making changes to such things as training requirements, selection procedures, or job design.

The current project lends itself well to a combination of both methodologies. In Phase 1, future-oriented job task and KSAO information was collected from SMEs with high-level knowledge of shift-scheduling best practices and with experience in implementing schedule changes in organizations. In Phase 2, current job task and KSAO information was collected from job incumbents well-qualified to address the current state of shift schedule management in various types of industries that operate 24/7.

2.1 Preliminary Research: Job Task Development

A member of the project team with extensive work scheduling experience was directed to brainstorm 30–100 activities that a worker would need to successfully schedule shift workers. The SME developed a list of 52 tasks during this activity. Two additional members of the project team familiar with job analysis techniques sorted through the list of job tasks and categorized them into four distinct job task groups: 1) scheduling, 2) work monitoring, 3) reporting and recordkeeping, and 4) communication and training. Task statements were then developed based on the four job task groups. Additional iterations resulted in two additional task statements. The scheduling job task group was divided into two separate tasks: one related to work-schedule development and the other to day-to-day schedule maintenance activities. In addition, subtasks from the other three job task groups were reorganized to create a new task related to establishing policies and programs that addresses the particular demands of shift working. Thus, a final list of six broad job tasks was developed, with more specific subtasks listed as examples underneath each general task statement. The six broad job task statements and exemplar subtasks are listed in Appendix B.

2.2 Phase 1: SMEs

2.2.1 Panel Discussion with Consultants

On May 15, 2007, 10 consultants specializing in shift work scheduling practices were invited to the Volpe Center in Cambridge, MA, to participate in a panel discussion concerning current practices and future needs in shift work scheduling. The consultants were chosen to participate in the panel because each brought at least 10 yr of consulting experience with various organizations that operate around-the-clock. Their consulting duties typically consisted of implementing environmental (including schedule system) changes to optimize operational functioning and organizational performance. The participating consultants' names and affiliations are listed in Appendix C1.

The daylong meeting began with a discussion of current shift work scheduling practices so as to establish that a need exists for the position of a work schedule manager in 24/7 industries. The consultants were then asked to participate in a job analysis activity designed to identify the KSAOs necessary to perform the job of a work schedule manager. The meeting concluded with a discussion of the next steps that must be taken by government and industry to create and train employees for work schedule manager positions. The recommendations suggested by panel participants are presented in Section 4.1 of this report.

The job analysis activity began by providing the consultants with a copy of the preliminary list of six job tasks and initiating discussion of whether the job tasks fit within their conceptualization of a work schedule manager. Each task was examined individually, and any proposed changes were documented on a flip chart by one of two activity leaders (also members of the project team). Although there was agreement that the six proposed tasks encompassed the broadly defined job of a work schedule manager, some wording changes were suggested and implemented to better clarify the scope of each of the job tasks. The revised wordings are presented in Appendix C2, along with an explanation regarding the intent behind any word changes that were made.

Consultants were then divided into three break-out groups and assigned two of the six job tasks identified above. Each group was then given approximately 40 minutes (min) (20 min per job task) to brainstorm the KSAOs needed to perform each of their assigned job tasks. Definitions and examples of KSAOs were provided to participants (see Appendix C3) to facilitate the brainstorming of KSAOs. After 40 min had passed, the groups reconvened in the central meeting room to discuss the KSAOs identified for each job task. All panel participants were encouraged to ask questions and suggest additional KSAOs during the discussion. The outcomes of this activity, a list of KSAOs by task, are reported in Appendix C4.

2.2.2 Interviews with Academic Researchers

Interviews over a period of 6 months (mo) from July 20, 2007 through January 23, 2008 were conducted with seven shift work experts in academia. The academic experts were chosen based on a track record of publishing and presenting research related to the health and safety of shift workers. Areas of expertise included sleep, circadian physiology, long work hours, irregular work schedules, fatigue, alertness, abnormal sleep/wake schedules, and use of medications and sleep quality. The interviews were completed over the telephone using a semistructured format and averaged 1 h in length. The participating interviewees' names and affiliations are listed in Appendix D1.

Each interview was divided into two primary discussion areas. In the first half of the interview, interviewees were asked a series of questions about the KSAOs needed to perform the job of a work schedule manager. Each interviewee was provided with the list of revised job tasks (established during the SME panel discussion) before the scheduled interview and directed to consider those tasks when brainstorming KSAOs. The questions the interviewers used to direct the discussion and the resulting KSAOs identified across all seven interviews are presented in Appendix D2.

The second half of each interview was devoted to a general discussion of the difficulties of managing work schedules in a 24/7 environment and suggestions for how a certification program could be developed and sustained. The discussion resulting from each of the interviews varied greatly as a result of the diverse backgrounds of the academicians. As such, some questions were attended to in depth by some interviewees and less so by others. The interviews are summarized in Section 4.2 of this report.

2.2.3 Followup Survey with SMEs

The lists of KSAOs developed during the SME panel discussion and subsequent SME interviews were combined and reduced to a master list. All duplicate entries were eliminated, and some entries were reworded for clarification purposes.

In total, 6 job tasks, 14 types of knowledge, 14 skills, 12 abilities, and 12 other characteristics were identified as critical for work schedule managers (see Appendix E1). The research team then used this information to create a Web-based survey designed to prioritize the established job tasks and KSAOs.

Job tasks were rated on two dimensions: task difficulty and criticality of performance. Respondents were asked to rate their perceptions of how difficult it is to complete each task on a seven-point scale from (1) *extremely easy* to (7) *extremely difficult*. For each task, respondents were also asked to rate the extent to which completing the task incorrectly would result in negative consequences (criticality) on a five-point scale from (1) *extremely negative consequences* to (5) *no negative consequences*.

KSAOs were rated on two dimensions: level of importance and whether formal training would be useful. Respondents were asked to rate the extent to which it is important for a work schedule manager to possess each KSAO on a five-point scale from (1) *not at all important* to (5) *extremely important*. Respondents were also asked to indicate whether each KSAO could be taught within the context of a formal, standardized training program with a (1) *yes* or (2) *no* response.

Survey participants were also given the opportunity, via open-ended questions, to suggest additional job tasks or KSAOs that were not addressed in the survey and to provide general feedback about the job tasks and KSAOs needed by work schedule managers. A summary of the feedback is provided in Section 4.3 of this report.

All of the SMEs who participated in either the panel discussion or an interview were invited to participate in the web-based survey hosted by surveymonkey.com. In total, 9 out of 16

SMEs participated, resulting in a response rate of 56 percent (see Appendix E2 for a copy of the survey).

2.3 Phase 2: Job Incumbents

Phase 2 built on the data collection efforts of Phase 1 by studying the perspectives of job incumbents, or practicing work schedulers. Scheduling is a necessary component of any job that requires multiple shifts; the job tasks associated with scheduling cut across many different industries. Thus, we used a maximal variation sampling strategy to gather information from a diverse range of industries. Maximal variation sampling is intended to capture and describe themes that cut across an array of cases (Patton, 2002; Creswell, 2008). Characteristics that potentially define the sample are identified to categorize the cases. In this project, organizations were targeted for participation to capitalize on industry differences. Specifically, we sought to interview employees in organizations representing broad industry categories of operations, service, and processing. In operation industries, work scheduling is dependent on staffing requirements and is commonly managed by using bid systems. In service industries, work scheduling is determined by the needs of society, typically resulting in fluctuating schedules or proportional staffing. In processing industries, work scheduling is determined by the demands of continuous equipment operation, typically resulting in round-the-clock schedules 7 days a week. Operation industries were sampled through interviews in transportation (n = 2) and public utility maintenance and power generation (n = 2), and service industries were sampled through interviews in health care (n = 2), hospitality (n = 1), public safety (n = 3), and public utility service and dispatching (n = 3). Processing industries were sampled through interviews in manufacturing (n = 3).

Interviews were conducted with 16 participants from 11 different organizations over a period of 4 months, from October 2, 2008, to January 26, 2009. Nine interviews were conducted by members of the research team from the University of Nebraska–Lincoln and seven were conducted by members of the research team located at the University of Connecticut. The research team developed and pilot tested an interview protocol for use in all interviews, consisting of an information sheet, preinterview questionnaire, an in-person interview questionnaire, and a postinterview survey (see Appendices F1–F4).

Permission for this study was granted through the University of Nebraska–Lincoln's and University of Connecticut's Institutional Review Boards. The information sheet was distributed to participants before the interview to constitute informed consent, and consent was verified orally before starting the interview. Participants also completed a preinterview questionnaire before their scheduled in-person interview to provide the interviewers with a brief overview of their scheduling responsibilities.

2.3.1 In-person Interview

The semistructured in-person questionnaire consisted of 22 main questions and inquired about the participant's job duties, their organization's scheduling process and their roles in that process, training, and the KSAOs that they used in their positions. Before starting the interview, the participant verified that he or she is currently responsible for some aspect of shift work scheduling in the company. Each participant was given a thorough explanation of the study and encouraged to ask questions. During the interviews, researchers probed for more detailed information relating to the knowledge, skills, abilities, training, and job processes of schedulers. Two researchers were present at each interview, with one asking the questions

from the protocol whereas the other probed further as needed. The interviews lasted approximately 1 h each and were audio recorded. A breakdown of the demographic characteristics of the job incumbents is presented in Appendix G1, and a summary of job incumbents' responses to the interview questions is available in Appendix G2.

2.3.2 Postinterview Survey

After completing the individual interview, participants completed a paper-and-pencil survey designed to assess the importance of each of the KSAOs identified by SMEs in Phase 1 of this research project (see Appendix F4). This survey was similar to the follow-up survey administered to SMEs. However, incumbents were only asked to rate KSAOs on the dimension of importance. In addition, the instructions varied slightly, asking incumbents to indicate the extent to which they perceived each KSAO to be important to have in *their* job in particular. Job incumbents rated importance using the same 5 point scale as was administered to SMEs, with response options ranging from (1) *not at all important* to (5) *extremely important*.

3. Gap Analysis

3.1 Methodology

The research team used a mixed methods approach to investigate the gaps between what experts indicate as the necessary KSAOs for work schedulers and what job incumbents indicate are important in current practice. Mixed methods research is defined as a project in which both quantitative and qualitative data are collected, analyzed, and mixed to best understand a research problem (Tashakkori and Teddlie, 2003; Creswell and Plano Clark, 2007). Mixed methods design is conducive to this research problem for several reasons. First, a need exists to understand the experiences of work scheduling from the perspectives of practicing schedulers. Second, qualitative data allow for a more complete, indepth description of schedulers' points of view. Third, the collection of both quantitative and qualitative data increases the ability to both identify the gaps quantitatively and describe the gaps qualitatively, allowing for a more complete picture and increasing the utility of the results for suggesting recommendations for practice.

3.1.1 Qualitative Data Analysis

Qualitative data analysis can be described as a "systematic search for meaning" (Hatch, 2002). This form of inquiry typically focuses on a relatively few number of cases to develop an indepth understanding of the research question (Creswell, 2008). Data analysis consists of preparing and organizing the data (i.e., transcripts), reducing data into themes through coding and condensing the codes, and representing the data through discussion or figures (Creswell, 2007). Thus, analysis is an iterative, inductive process in which findings emerge from the specific to the general (Hatch, 2002). Qualitative interviews allowed the participants' to describe, in their own words, what KSAOs they feel are used in their positions.

Professional transcriptionists prepared verbatim transcripts of each interview. The interviews were combined to produce an extensive qualitative database about the work schedule process in practice. The 16 interviews were combined for a total of 294 single-spaced pages in the database. The transcripts were imported into MAXqda2007, a qualitative data analysis software package that facilitates the analysis of open-ended, unstructured data.

The list of specific KSAOs deemed important for schedulers from Phase 1 (SME data collection) informed the primary coding scheme for the interview analysis. Using a strategy of topic coding (Richards and Morse, 2007), the primary content analyst read each transcript and then analyzed the data line-by-line and coded all discussions and applications of the KSAOs found within the transcripts. After every two interviews, a secondary analyst reviewed the coding and interpretations to ensure coder agreement. Any feedback or alterations to the interpretations were recorded in the code memos, and codes were discussed until 100 percent agreement was reached. Once all the interviews were coded and discussed, the primary analyst reviewed the codes to identify emergent themes and categories. The coding scheme was compared with the new data throughout the analysis procedure. Codes in previous interviews were reviewed to ensure that they conformed to the current conceptualization of the code. If not, they were either removed or assigned to another code if applicable.

The codes were developed into summary tables of KSAOs. The summary tables included columns for the code's name in the software, a bulleted overview, and participants' quotes. The overview emphasized the diverse perspectives present in the interviews by highlighting themes that cut across different participants and industries. The quotes were used to provide direct evidence of the KSAO in the participants' own language. The summary tables can be found in Appendix H.

In this study, several validation procedures were used to ensure that the qualitative findings accurately represent participants' realities (Creswell and Miller, 2000). Peer review was conducted between the primary and secondary analysts and the larger research team to ensure that coding criteria were used consistently. Data collection and qualitative analysis occurred concurrently and data collection ended when analysis suggested a point of data saturation: little new information was revealed with each subsequent interview. Multiple methods of data collection were used with interviews and surveys. Finally, direct quotes accompany the results of the content analysis to provide additional evidence that the findings represent participants' words.

3.1.2 Quantitative Data Analysis

The responses to the surveys administered to SMEs and job incumbents were entered into an SPSS database. Means and standard deviations were calculated for each KSAO by group (SME or job incumbent). T-tests for independent samples were conducted to determine if there were significant differences between the mean importance ratings provided by SMEs as compared to job incumbents (using $\alpha = 0.05$).

Research has shown that the order of collecting quantitative and qualitative data may influence the responses given by participants (Vitale, Armenakis, and Field, 2008). In this project, the job incumbent survey was administered at the conclusion of the interview so as not to bias the open-ended responses in the interviews. As a result, job incumbents' survey responses may be susceptible to inflation because the survey followed indepth discussion of the incumbent's scheduling job duties. To account for this possibility, each group of attributes (KSAOs) was rank ordered by participant group (SMEs or job incumbents). Within-group rankings can tell us which attributes are considered more important than others for each group of participants, regardless of mean differences between groups.

Three additional types of information were incorporated into the gap analysis to provide a more robust picture of the value of each of the KSAOs assessed in this study. First, SMEs were asked to provide information regarding the trainability of each of the KSAOs. This information was used to determine whether each KSAO would be valuable to incorporate into the curriculum for a training program or certification protocol. For instance, a KSAO may be ranked as very important; however, it may not be an attribute that is conducive to training. Second, the content codes derived from the qualitative interview data were transformed into quantitative information by counting the number of times that each KSAO code was applied across the 16 job incumbent interviews and the number of interviews where each KSAO code appeared (Tashakkori and Teddlie, 1998; Onwuegbuzie and Teddlie, 2003). These variables were also compared with the data collected from SMEs. Third, qualitative gaps between the two groups were identified based on their discussions. This qualitative comparison provides additional insight into the different perceptions behind the identified gaps.

3.2 Results and Discussion

3.2.1 Job Tasks

The job tasks are presented in their final form and listed in order of importance in Appendix I. Note that importance is determined as a combination of level of difficulty and likelihood of negative consequences if the task is performed incorrectly (difficulty + criticality). Qualitative observations from the job incumbent interviews are also summarized to indicate the extent to which the job incumbents interviewed were responsible for each of the identified job tasks.

Finally, an overall assessment was made with regard to the level of gap that exists between SMEs recommendations and job incumbent practices for each job task. This assessment takes into consideration importance ratings provided by SMEs and observed differences in importance based on interviews with SMEs and job incumbents. Each job task is given one of three labels: minimal gaps, moderate gaps, or significant gaps. A summary of these findings is presented next.

Significant Gaps

Job Task: Coordinate with management to establish policies and programs that are sensitive to the particular demands of shift work schedules.

This task was rated high on importance by SMEs. However, only two job incumbents discussed developing policies or programs to meet the particular needs of their shift working employees. Both incumbents talked about using treadmills to assist employees in staying alert during overnight shifts. One of the two incumbents also investigated making lighting changes to improve employee alertness on overnight shifts and indicated that he distributes a monthly shift work newsletter to aid employees in managing their irregular shift schedules.

Job Task: Review work production, employee performance, and accident reports in conjunction with shift schedules for potential shift-related trends and take action as necessary.

Very few job incumbents indicated that they personally monitored performance and safety information for shift-related trends. Two incumbents who held positions higher up in management than a typical first-line supervisor indicated that they had access to work production, performance, and safety data. Another incumbent indicated that there was a person in the organization who specifically developed reports on aggregated scheduling data.

Moderate Gaps

Job Task: Design and implement work schedules for employees, in accordance with staffing requirements and employee workload and availability.

This task was rated highest on importance by SMEs, yet only 3 out of 16 job incumbents interviewed reported having a role in the design and development of the actual scheduling system that is in place in their unit. However, most job incumbents were responsible for making decisions about who worked in a particular area or on a particular shift, and decisions were made on the basis of staffing requirements. In organizations where staffing needs were not stable, staffing was typically determined

by either a software program forecasting staffing needs or a coworker responsible for determining production demands for the day.

Job Task: Maintain records of employees' work schedules and time cards and prepare reports as needed.

All of the incumbents kept records of scheduling information. However, very few appeared to be responsible for reporting on that information.

Minimal Gaps

Job Task: Implement schedule changes as necessary because of turnover, absenteeism, employee leave requests, and fluctuating workloads.

All of the job incumbents who had direct responsibility for scheduling workers implemented schedule changes on a regular basis. Most made these changes autonomously, without need for approval from the next layer of management.

Job Task: Monitor work hours to ensure that staff members comply with administrative policies and procedures, safety rules, union contracts, and government regulations.

Most job incumbents indicated that they were responsible for monitoring work hours as part of their regular managerial duties. Two incumbents also specifically mentioned that they were responsible for monitoring adherence to safety rules in the workplace.

Overall, it is suggested that the most significant gaps in job tasks concern addressing the particular demands of shift work. Assisting employees with managing work schedules by offering training programs or aiding in policy development and monitoring performance and safety to determine whether shift-related safety risks or performance decrements are key responsibilities that should be managed by work schedulers in an organization. Employees and organizations need an internal resource to aid them in managing and understanding the challenges of shift work. Most current work schedule managers do not have the knowledge or tools to carry out these activities.

Moderate gaps also exist for designing work schedules and preparing reports addressing the effectiveness of those schedules over time. Some of the job incumbents interviewed discussed the need to make daily changes to their work schedules, often requiring that workers be called in or held over to work overtime. Additional training regarding schedule designs, staffing, and evaluation may assist these managers in making changes to the scheduling system such that intensive daily maintenance is unnecessary. However, carrying out such tasks is currently outside of the domain of their work responsibilities.

Implementing schedule changes and monitoring work hours encompass the primary work responsibilities of the majority of the work schedulers we interviewed. Thus, there appear to be minimal gaps between what schedulers are doing and what they should be doing with regard to those two tasks. However, the extent to which those tasks are performed effectively relies heavily on bridging the significant and moderate gaps that exist across the other four tasks identified. Schedule maintenance can be reduced and streamlined with effective work schedule designs. Incorporating government-, union-, or organization-mandated restrictions to

work hours with scheduling software can also reduce the paperwork involved in monitoring work hours and allow scheduling managers to focus their efforts on evaluating their work schedules and on assisting their employees with managing shift work.

3.2.2 KSAOs

Data informing the results of the KSAO gap analysis are presented in Appendix J. We examined the information collected and assessed KSAO gaps in multiple ways. First, SMEs and job incumbents may have differed on how important they believe a particular attribute is for performing their job. To address this, the previously identified KSAOs were divided into four categories, or tiers. The tiers were determined by the mean ratings of importance provided by SMEs and job incumbents, whether the KSAO was deemed appropriate to target with formal training by SMEs, and whether there were differences between SME and job incumbent perceptions of importance. The four-tiered category system allows us to determine which KSAOs are agreed on as important, where there are differences in levels of perceived importance, and which KSAOs are less of a priority than others. In addition, the fourth tier separates out those KSAOs that may be important but are not necessarily appropriate to target within the context of formal training. For instance, tier 4 KSAOs may be associated with personality characteristics and can be important to consider when selecting work schedule managers. Alternatively, these KSAOs may need to be learned on the job through hands-on experience. The criteria used to categorize each KSAO into one of the four tiers are listed below:

Tier 1: Critically Important and Trainable KSAOs

- Must achieve an average importance rating of 4.00 (very important) or higher from both SMEs and job incumbents
- Must be considered appropriate for training by at least 50 percent of SMEs

Tier 2: Important and Trainable KSAOs with Intergroup Disparities

- Must achieve an average rating of 4.00 or greater from one group of participants (SMEs or job incumbents)
- Must be considered appropriate for training by at least 50 percent of SMEs

Tier 3: Moderately Important and Trainable KSAOs

- Must achieve an average rating between 3.00 and 3.99 from both SMEs and job incumbents
- Must be considered appropriate for training by at least 50percent of SMEs

Tier 4: Important KSAOs, Training Not Applicable

- Must achieve an average rating of 3.00 or higher from both SMEs and job incumbents
- Must be considered appropriate for training by less than 50percent of SMEs

No single KSAO had an average rating below 3.00 (somewhat important), and thus, each KSAO falls into one of the four tiers described above. This is not particularly surprising given that the list of KSAOs was developed by SMEs, and is intended to be representative of the KSAOs that may be important for the target job. The fact that all of the KSAOs achieved an

average score of 3.00 or greater is consistent with our expectations and suggests that the original list is a valid representation of important KSAOs.

Each KSAO was analyzed using t-tests for independent samples to determine if there were statistically significant differences ($p < 0.05$) between the mean importance ratings from SMEs as compared with the mean importance ratings from job incumbents. We also note that the KSAO importance ratings for each of the two groups had significantly different variances, as determined by Levene's test, and equality of variances could not be assumed. Thus, all t-tests were run using the more conservative assumption of inequality of variances. KSAOs demonstrating significant mean differences between SME importance ratings and job incumbent importance ratings are marked with an asterisk (*) in the tables presented in Appendix J. Significant differences in mean ratings may suggest a critical KSAO gap that should be addressed and attended to in future training development efforts.

The results of the t-tests indicated statistically significant differences among means for one knowledge characteristic, five skills, two abilities, and two other characteristics. However, we found that when there were statistically significant differences, job incumbents were more likely to have rated the characteristic higher than SMEs. This was an unexpected finding, as we anticipated that KSAOs not frequently used on the job would be rated less important by job incumbents as compared with SMEs. Additional analyses and examination of the data suggest that job incumbents used the rating scales somewhat differently than SMEs. The standard deviation for each mean rating was generally lower for the job incumbent group than the SME group. Many of the observed differences in standard deviations were also statistically significant, as indicated by Levene's test of equality of variances, mentioned previously. In addition, evidence points to restriction of range for the job incumbent group; job incumbents consistently used the low end of the rating scale less frequently than SMEs, and used the high end of the scale more frequently. Only 35 percent of all KSAOs were rated as a 1 or 2 by at least one job incumbent, as opposed to 62 percent of all KSAOs rated by SMEs. In addition, 12 percent of KSAOs were rated 4 or higher by all job incumbents, as compared with 6 percent of all KSAOs rated by SMEs. Thus, the finding that job incumbents rated KSAOs higher than SMEs may be a statistical artifact, given differences in standard deviations and restriction of range.

Although there were not as many statistically significant differences as expected, there may still be detectable differences between KSAOs ratings by examining within-group rankings of importance. Within-group KSAO rankings can be thought of as an indicator of relative importance or the importance of each KSAO compared with other KSAOs. We were particularly interested in examining rank differences in knowledge characteristics, because only one knowledge characteristic evidenced a statistically significant difference between mean importance ratings. We believe this additional step was necessary given differences in standard deviations and the observation that job incumbents more frequently used the higher end of the rating scale. Within-group ranks were determined by ordering each list of KSAOs from highest mean rating to lowest mean rating for the job incumbent and SME groups separately. When two attributes had the same rating, the attribute with the lower standard deviation was ranked higher, because lower standard deviations indicate greater within-group agreement. When two attributes had the same mean rating and standard deviation they were given the same ranking. As a result, we could establish and compare ordinal lists of attributes from most important to least important, and minimize the impact of range restriction and

unequal variances. For instance, although knowledge of staffing analysis was rated similarly by SMEs and job incumbents (4.00 and 4.18, respectively), staffing analysis was ranked considerably higher by SMEs (ranked second most important knowledge attribute) than by job incumbents (ranked eighth most important), resulting in a rank difference of 6. In other words, SMEs ranked staffing analysis six places higher than job incumbents relative to all other knowledge attributes.

Nonetheless, we use caution when interpreting the observed differences in ratings and rankings because of the relatively low empirical differences. The quantitative analyses were conducted with small sample sizes; thus, there is reduced power to detect significant differences between ratings. Moreover, participants were not permitted to review their rankings, which might have changed once they realized how their ratings translated into ranks. The procedures used to assess KSAO importance also varied slightly between the two groups of participants. SMEs rated KSAOs weeks after their initial interviews, whereas job incumbents rated KSAOs immediately following their interviews. It is possible that the overinflation evident in job incumbent ratings was because that KSAOs were rated immediately after a lengthy discussion of the incumbents' job duties and scheduling responsibilities.

Gaps may also exist independent of empirical differences in perceived level of importance. Although both SMEs and job incumbents find a particular attribute to be important to have on the job, the qualitative analysis of interviews with job incumbents may reveal that said attribute is not often used on the job, and there is a clear need for additional training beyond that which most schedule managers currently receive.

Finally, an overall assessment was made with regard to the level of gap that exists between the KSAOs that job incumbents currently possess and future KSAO needs. This assessment takes into consideration differences in importance ratings and observed differences based on interviews with each set of participants. Each KSAO is given one of three labels: minimal gaps, moderate gaps, or significant gaps. The results of the gap analysis for each KSAO are provided below, grouped by gap assessment and importance tier. Note that the number in parentheses appearing after each KSAO indicates its original placement in the final list of KSAOs from Appendix E. More detailed information regarding the gap assessment is also provided in Appendix K.

Significant Gaps

- **Tier 1 KSAOs**
    - Knowledge of various designs used to schedule 24/7 work (e.g., fast/slow, forward/backward rotations) (1)
    - Knowledge of the impact work hours have on health, safety, and performance (2)
    - Knowledge of staffing analysis (7)
    - Skill in recognizing the warning signs of potential fatigue, health, and safety issues (8)
    - Ability to identify and manage risks (2)

- Passion for safety and health [6]

- **Tier 2 KSAOs**
  - Knowledge of the physiology of sleep as related to performance [3]
  - Knowledge of tools and technologies available for scheduling [6]
  - Knowledge of program evaluation [13]
  - Skill in troubleshooting schedule systems [7]
  - Ability to balance conflicting demands [7]
- **Tier 3 KSAOs**
  - Knowledge of employee training programs specific to shift work [10]
  - Knowledge of basic ergonomics and human factors [12]
  - Skill in using analytical/statistical applications [3]
  - Ability to self-evaluate to gauge success [3]
  - Well-connected with a community of schedulers [11]
- **Tier 4 KSAOs**
  - Sensitivity to different types of people [12]

Moderate Gaps

- **Tier 1 KSAOs**
  - Skill in problem solving [4]
  - Ability to recognize a problem and need for change [8]
- **Tier 2 KSAOs**
  - Skill in using technology [6]
  - Skill in working in teams [13]
  - Ability to ask the right questions and know where to find the appropriate answers [5]
  - Willing to compromise [9]
- **Tier 3 KSAOs**
  - Knowledge of policies and procedures concerning the design of an organization's schedule [8]
  - Knowledge of human resource systems [11]
  - Knowledge of the social implications of shift work [14]
  - Skill in converting complex topics to simple explanations [2]
  - Skill in managing collective agreements [12]
- **Tier 4 KSAOs**
  - Approachability [5]

Minimal Gaps

- **Tier 1 KSAOs**
  - Knowledge of industry-specific operations and regulations (e.g., OSHA, USDA, hours of service (HOS)) (4)
  - Skill in interacting with people (9)
  - Ability to think critically about problems (6)
  - Ability to express oneself clearly through speaking and writing (11)
  - Ability to cooperate (12)
- **Tier 2 KSAOs**
  - Knowledge of company policies and procedures, including interactions with unions and union contracts (5)
  - Knowledge of indicators of an employee's fitness for duty (9)
  - Skill in interfacing with multiple systems (5)
  - Skill in observation (10)
  - Skill in keeping detailed records (11)
  - Skill in leading people (14)
  - Ability to read and comprehend ideas in writing (10)
- **Tier 3 KSAOs**
  - Skill in communicating with various levels of an organization's hierarchy (1)
  - Previous involvement with shift work systems (2)
- **Tier 4 KSAOs**
  - Ability to think independently (1)
  - Ability to persuade others (4)
  - Ability to be flexible (9)
  - Integrity (1)
  - Honesty (3)
  - Discretion (4)
  - Patience (7)
  - Perseverance (8)
  - Commands respect (10)

The most critical (tier 1) KSAOs demonstrating significant gaps can be divided into two categories: knowledge concerning the inputs needed to design work schedules and characteristics needed to understand and manage the health and safety risks associated with shift work. Although SMEs and job incumbents agreed that these KSAOs were very important, most of the job incumbents we interviewed did not demonstrate the level of

scheduling design, or health and safety knowledge that SMEs indicated should be required. However, there were a few exceptions. One of the job incumbents we interviewed had a background in engineering and computer science. This person demonstrated a high-level understanding of the mechanics behind shift-schedule design. However, this person was also placed much higher in the organization than most of the other scheduling managers interviewed, was personally responsible for designing the current scheduling system, and had responsibility for overseeing and reporting on the schedules across all worksites in the organization. Another job incumbent interviewed had recently attended a seminar regarding work scheduling and fatigue management. This person had sought out the training without prompting and was the only incumbent to discuss health and safety in depth, take personal responsibility for distributing a shift work newsletter to employees, and initiate environment changes to help employees stay alert during the night shift. Specialized training assisted both of these scheduling managers in carrying out their job responsibilities, albeit in different ways. Training beyond that acquired on-the-job can clearly assist work schedule managers in performing their job duties more effectively. However, such training is neither standardized nor easily accessible at the current time.

Significant gaps were also apparent in terms of knowledge of sleep physiology, human factors, and shift work training programs, again addressing the health and safety components of shift work. Knowledge of evaluation and the ability to self-evaluate also emerged as a significant area to target for training. In addition, it was clear that more information about the available tools and technologies for scheduling would be beneficial for work schedule managers. The ability to balance conflicting demands emerged as an attribute required of all the job incumbents interviewed. In addition, balancing conflicting demands was rated as considerably more important by job incumbents than SMEs. This attribute was identified as an area where significant gaps exist because it may be undervalued by SMEs. Negotiation, cooperation, and compromise were all common themes across incumbent interviews and are attributes that are particularly beneficial for managing work schedules.

Although most incumbents indicated that they discussed scheduling issues with other supervisors in their organization or that there was a “go-to” person when someone had a question about scheduling software, there did not seem to be any indication that incumbents received assistance and advice from a community of schedulers. Training programs can address this issue simply by fostering communication between participating schedulers and providing an avenue for communication to continue well beyond the conclusion of the training. Although not necessarily conducive to training, having sensitivity to different types of people and their preferences was also targeted as an area where significant gaps exist between SME recommendations and job incumbent practices. There was a lot of variability between job incumbents with regard to their level of sensitivity, likely because of differences in personality and organizational policies. Although sensitivity itself may not be trainable, additional training with regard to the health, safety, and performance effects of shift work may increase awareness of the particular demands of shift work and result in scheduling policy changes that are more sensitive to shift worker needs.

Some of the common themes emerging among KSAOs with moderate gaps include problem solving, skill working with others (teams, subordinates, and unions), knowledge of the workings of the organization, and using technology. Minimal gaps were evident among KSAOs that are common to all types of management positions, such as leadership,

communication, flexibility, and integrity. In addition, almost all of the job incumbents interviewed were promoted internally and had previous experience working shifts. Many indicated that working irregular hours (either currently or in the past) assisted them with managing work schedules and negotiating employees' preferences with business needs.

4. Recommendations for Training Development

The following section highlights recommendations provided by SMEs in consulting and academia with regard to the future development of training for work schedule management. Each group of SMEs answered a number of key questions concerning their perceptions and experiences advising organizations about and/or researching work scheduling. SMEs also provided feedback regarding the final list of job tasks and KSAOs within the followup survey.

4.1 Consultant Recommendations

What do you see as the most important issues for managing work schedules in shift work operations across industries in the United States?

The general consensus from participants was that the management of work schedules is necessary from a fatigue and an organizational cost standpoint. Mismanaged schedules can lead to several problems that are not necessarily visible until the problems are serious and detrimental. Most organizations operate using a reactive approach to schedule management, thus there is little reason to change a schedule unless something occurs, such as a major accident, to drive the change. The consultants observed that organizations see no reason to change, because "if it's not broke, don't fix it." Furthermore, schedule changes may become difficult to initiate because of constraints stemming from the conflicting demands of employees, management, and sometimes unions. Driving change without the impetus of a major disaster is often met with skepticism and fear of the unknown. Organizations may not be able to distinguish a good schedule from a bad schedule until a problem occurs. Based on experience, the consultants also agreed that there is a general lack of understanding of the benefits of schedule optimization. Organizations are unaware that they are losing money and putting their employees at risk when operating with schedules that are inadequately staffed or improperly designed.

If there was a position within an organization that would fulfill the scheduling need, what kind of position would it be, and what kind of person would fill that role?

The consultants observed that although there are currently people in 24/7 organizations responsible for scheduling, they often lack formal training. Organizations may develop schedules on a shift-by-shift basis, such that each shift has its own person responsible for maintaining the schedule with little involvement from upper management to coordinate schedules across the organization. Some organizations do not even have a designated person overseeing their schedule, oftentimes because the same schedule is used year after year, with little regard or consideration of its effectiveness.

The consultants agreed that changes need to be made in terms of how scheduling is handled across 24/7 industries but had differing opinions concerning how such a change would manifest into a new position. All argued that the expertise required of a work schedule manager would vary based on industry and operation. Some industries must schedule around a whole host of restrictions, such as hours of service requirements, overtime allotments, and union contracts. Organizations that operate seasonally also have very different scheduling requirements than organizations that operate continuously. Thus, some companies may require a work schedule manager with a high level of expertise to respond to changing needs and conflicting demands. Other work schedule managers may only need to know the basics of

staffing and fatigue in 24/7 industries, because the schedules they maintain require little ongoing support. The consultants worried about training schedule managers to be responsible for change, because the process of designing a completely new schedule can be extremely complicated and may require external intervention. Instead, it was suggested that work schedule managers be responsible for maintaining schedules, making day-to-day changes, and acting as an internal troubleshooter who can identify problems before they occur, recommend changes, and advise upper management when external help is necessary because schedule problems are beyond their ability to fix alone. Overall, work schedule managers need to have tools at their disposal to create solutions and bring about change. As such, it is important that work schedule managers have a position within the organization where they can gain the trust of employees to identify problem areas, and the ear of upper management to recommend changes to set in place.

What are the next steps necessary to implement a certification program and train people for the job of a work schedule manager?

The consultants indicated that the next step beyond documenting the need for training will be to secure funding and recruit interested parties to oversee the certification process. Subsequent steps include developing the certification curriculum and outlining how the certification process will work. The consultants also suggested establishing an education and communication plan to make people and organizations aware of the opportunity for certification. Once an initial certification program is implemented, it will also be important to document changes occurring in organizations with certified work schedule managers. Structured scheduling benchmarks would provide empirical data demonstrating the benefits of certification training, and thus encourage more organizations across industries to invest in the process. Finally, the consultants suggested targeting the initial certification process at people in organizations who are currently responsible for managing work schedules, offering organizations the ability to train current employees to better manage their schedules. Starting with short-term training programs would aid in making organizations aware of the importance of managing work schedules properly, and the advantages of having a certified work schedule manager. The certification process could then build from the point of training current employees with day-long programs to the introduction of a long-term curriculum in colleges and trade schools specifically preparing people to obtain jobs as work schedule managers.

4.2 Academician Recommendations

What do you see as the most important issues for managing work schedules in shift work operations across industries in the United States?

In general, the academicians we interviewed reflected that successful scheduling is more than just about managing fatigue. Organizations should be seeking optimization of a variety of different factors when creating schedules to manage their staffing needs: the economic needs of the company, health and safety issues regarding fatigue and performance, and the acceptability of the schedule from the workers' perspective. Academicians also agreed that a work schedule manager should be someone who is located in the middle of the organizational hierarchy, not too high and not too low, but with enough positional authority within the organization to have the ear of management while still being able to relate to frontline workers. There were also some concerns relayed regarding the feasibility of installing a work schedule manager in smaller organizations. A small organization would not be able to afford a highly qualified work schedule manager and may need to continue to rely on outside

consultants. Overall, there was agreement that large organizations could benefit from the creation of a work schedule manager as a full-time permanent position because there continues to be a disconnect between scheduling best practices and current practices in shift work operations from an occupational health and safety perspective.

What initiatives are occurring or have occurred in Europe that we might use as a model for improving work scheduling in the United States?

The European academicians suggested that there are advances in Finland, Sweden, and the United Kingdom that may aid our progress in the United States. For example, the Working Time Directives in Europe require companies to allow their employees at least 11 h off between work cycles, at least 2 days of rest every 2 weeks (wk) and a maximum of 48 h of night work in 1 wk. In addition, European researchers have developed several different models for measuring fatigue risk. One such model, the Fatigue and Work Index developed for British Health and Safety, provides estimates of employee fatigue and risk when work schedule information is supplied. Researchers in Sweden have developed a course on shift work that can be tailored to administrators, labor unions, or front-line workers, and is designed to teach basic knowledge regarding the health and safety implications of shift work and various shift work scheduling practices. Some European countries are also implementing scheduling programs that allow for self-selection of work hours. In health care, for example, employees can interface with software allowing them to select their own work hours. The scheduling software checks that the schedule is fully staffed and prioritizes the filling of remaining shifts by assigning them to workers with the fewest self-scheduled work hours. The person in charge of the scheduling system is responsible for ensuring that the system is working properly and may modify the system to build in ergonomic constraints to the schedule. This alternative form of scheduling may reduce the daily workload of the scheduling manager but likely requires specialized skills that can be provided by a certification program.

What are the common pitfalls organizations run into when trying to manage work schedules?

Many common pitfalls regarding the management of work schedules were identified by multiple interviewees. Overall, it was agreed that most companies do not take scheduling-related health and safety issues, such as hazards associated with lack of sleep and circadian physiology, as seriously as they should. Companies sometimes push their workers too hard with oddly constructed shifts and little uniformity in scheduling across the organization. At the same time, employees may also unknowingly place themselves at greater risk by pushing for more work hours or greater numbers of consecutive days on the job at the expense of their health and safety. Union-labor negotiations can sometimes result in scheduling changes that meet worker demands and preferences without fully investigating whether those demands run counter to good health and safety practices. A lack of trust and communication between an organization and its employees can often lead to misunderstandings when schedule changes are initiated. Administrators and employees need to be re-educated to understand that good scheduling practices and employee buy-in are necessary to make any schedule change a success.

How should work schedules be evaluated? Using what metrics?

One interviewee suggested a series of questions that we as researchers should be asking as we investigate scheduling practices: "Why are organizations scheduling the way they are; how does it match to our understanding of human performance; and is it making them money?" The interviewees suggested several ways in which to measure and evaluate work schedules. Some took an organizational perspective, identifying economic concerns (e.g., staffing needs, productivity, number of recalls) and safety concerns (e.g., number of accidents, injuries, or models to predict risk), whereas others suggested developing metrics aimed at the worker (e.g., assessing attitudes about work schedules, turnover, medical history, and amount of useful time off provided). The specific needs and concerns of various organizations should guide which metrics are used in evaluation; however, it is clear that no matter what metrics are used they should capture both the perspective of the organization and the worker using multiple indicators of success.

How can the research community better connect with government and/or practitioners?

All of the academicians agreed that researchers are not as well connected to practitioners as they should be, especially in regard to work scheduling issues. One interviewee reflected that the area of shift work, in and of itself, is a broad field of study. Researchers in many diverse disciplines are studying shift work and each has their own unique terminology, making it difficult for collaboration within the research community and leading to confusion outside of academia. Those interviewed suggested that the research community needs to provide clearer but simpler messages about shift work issues. Shift work research should be prioritized and systematically supported so that it may be distilled into something that can be implemented by industry. Researchers also need to form more collaborative relationships with businesses to develop long-lasting relationships with practitioners and secure funding for continued research. Most of all, researchers need to find ways to better identify with industry stakeholders to make it "worth their while" to collaborate and contribute funding.

What should a certification program focus on to properly train work schedule managers?

We received many helpful suggestions from the academicians interviewed as to how to design the certification program for work schedule managers. There were very different suggestions as to the level of training that should be provided, ranging from a very basic level of certification whereby participants would be provided with scheduling models and criteria for implementing best practices in day-to-day schedule maintenance, to a more advanced professional certification similar to postgraduate coursework directed at people with backgrounds in industrial hygiene or occupational health and safety. The differences in suggestions provided by the interviewees suggest that developing a program with multiple, clearly-defined, levels of certification is the best course of action. One academician praised the idea of differing levels because it would allow people to work their way up through the various layers of certification and demonstrate increasing levels of achievement and proficiency.

Some of the content areas suggested as important for a certification program included training on factors that contribute to safety risks (e.g., fatigue, circadian phase, time on task, time of day effects, main sleep duration, and sleep quality), human factors issues and an understanding of individual preferences, identification of decision support tools and software

that are available for use when designing schedules, and screenings for sleep disorders. Many of the academicians suggested that training at lower levels of certification should not be too technical. Self-paced study was suggested as a possible option for lower levels of certification, with instructional modules available online that could be completed on a more flexible timeline than is typically allowed in structured coursework. It was also suggested that the program should require update courses and tests to keep individual certifications up-to-date and ensure that new knowledge is disseminated to practitioners. The National Institute for Occupational Safety and Health continuing education program was also mentioned as a potential avenue for reaching out to people in the field and introducing a scheduling certification.

What are the linchpins of success in developing a certification program for work schedule managers?

One of the major linchpins of success identified during the course of these interviews was that any certification needs to be highly tailored to take into account the type of industry for which a person will be creating schedules and a person's prior educational background to identify what level of certification is appropriate. The very basic levels of certification should boil down to basic principles and criteria that can be used across all industries and levels of expertise to improve scheduling quality and protect against common occupational health and safety issues. One interviewee suggested that testing is a key component to developing a certification: work schedule managers need scenario testing to learn how to solve problems. Multiple interviewees also mentioned developing a central place for work schedule managers to ask questions of more experienced experts, such that all schedulers involved in the program would benefit from access to the most up-to-date research available on shift work.

4.3 Feedback from Followup Survey

Many of the SMEs who completed the followup survey also provided comments about the job tasks, KSAOs, and overall scope of this research effort. These supplemental comments are summarized below.

- Except for simple changes, designing and implementing new solutions should not be part of what the scheduling manager should do. This requires change management and is likely beyond the scope of expectations. What the scheduler should do is: review the flow of data to payroll, ensure payroll errors are reviewed and corrected, compare workforce to workload with cost results, add new employees, remove employees, adjust skills, adjust employee preferences, change shift, task, crew, etc., for an employee, provide feedback/data to first-line supervision to support needs (performance reviews, employee counseling, etc.), run reports, estimate simple workforce staffing requirements, and more.

- Advancing work scheduling should include coordinating an annual learning process to gather, analyze, and assess confidential employee survey data tapping current schedule-related safety, health, and performance risks and liabilities—as well as suggested solutions—from an employee perspective. These data can then be integrated as part of a collaborative management/labor strategy to continually track, evaluate, and improve scheduling services.

- All the job tasks are well supported by computerized tools that can continually monitor and update in real time. Scheduling software can dramatically simplify the job of a work schedule manager.

- An important consideration in designing and assessing a certification program would be a broad estimate of the time to learn the necessary skills to complete each task. Recognizing that people vary in both existing knowledge base and learning aptitude could still be helpful to better inform curricula requirements. This should be included in the next steps for developing certification curricula.

- The key difference that managers face is between changing how equipment is run versus changing how employees work. The emotional side of change management in shift work operations creates a volatile environment much more complex than even the most difficult equipment engineering task. The consequences can be plant shutdown, unionization, and considerable lost productivity (and others).

- A considerable amount of time and dedication is involved in creating a master schedule. Training combined with an already strong analytical and social background may take 3–5 yr of time on the job. The magnitude of the effort required to do this right should not be underestimated. The implications can be in the tens of millions of dollars depending on the size of the organization. This scheduling issue can shut down an entire operation and should never be taken lightly.

5. Conclusions

Currently, work schedule management is not regarded as a stand-alone job position in most organizations. This study is a first attempt to define the position of a work schedule manager across industry types by identifying commonly needed job tasks and KSAOs. However, this research effort also recognizes that some job tasks and KSAOs are currently undervalued or underused by organizations in the management of work schedules. Thus, we have attempted to triangulate gaps in job tasks and KSAOs based on our discussions with two critical stakeholder groups: SMEs represented by shift work consultants and researchers, and job incumbents represented by workers currently responsible for scheduling duties.

The gap analysis of job tasks and KSAOs revealed a common theme: additional schedule management training is needed to aid work schedule managers in understanding how the design of work schedules can have an impact on employee health, safety, and performance. The incumbents interviewed were fully capable of maintaining work schedules and making minor changes to scheduling to account for absenteeism, turnover, or overtime needs. However, they may not be qualified to identify problems in the schedule design and/or make changes to the system to address those problems. The majority of the training that schedulers receive is currently on-the-job, often involving a short-term mentorship with another scheduler in their organization. There is very little standardized training even within organizations. Instead, bad habits and bad schedule designs may be propagated throughout the organization. Most incumbents learned how to manage their work schedules through trial and error. SMEs reflected that schedulers and their employing organizations appear to be underestimating the importance of proper schedule design.

However, caution should be used when extrapolating these results to the entire population of employees with work-scheduling job duties. Only a few scheduling managers were interviewed for this study, covering a very diverse range of occupations and job positions. In addition, there were relatively few statistically significant differences between empirical ratings of importance. Our conclusions are based on holistic observations of the quantitative and qualitative data collected and should be used to provide guidance for future studies and training development efforts. Additional research is necessary to identify training and certification needs in specific occupations, especially considering the identified need for substantial industry-specific knowledge in work schedule management.

Another consideration when moving forward with a work schedule manager certification program is that different levels of training need to be developed to target varying levels of skill development. SMEs in consulting and academia indicated that scheduling expertise varies based on industry, type of operation, and the size of an organization. Variations in expertise were also evident across job incumbent interviews. Work schedule management training is needed at all levels, from first-line supervisors to the next generation of shift work consultants; however, addressing the training need at different levels requires different kinds of programs. Supervisors and managers may need basic training that can be addressed with short-term seminars. On the other hand, master schedulers may require graduate level training and coursework to achieve certification.

Overall, SMEs expressed enthusiasm for the development of a certification program and confirmed the need for greater levels of expertise in work scheduling. Many also expressed interest in assisting with the development of training curricula. Job incumbents were helpful and cooperative and confirmed that work scheduling is often not a streamlined process. Training, technology, schedule designs, and even “rules of thumb” differ greatly within and between organizations. The outcomes of this project suggest that training work schedule managers involves finding a balance between company needs and occupational health and safety concerns and helping managers navigate that balancing act.

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APPENDIX A: Research Team

Research Team

Table A-1. Research Team (listed in alphabetical order)

Name	Title	Affiliation
Manijeh Badiee, M.A.	Counseling Psychology Doctoral Student	University of Nebraska–Lincoln
Janet Barnes-Farrell, Ph.D.	Industrial and Organizational Psychologist and Director of Industrial Psychology Applications Center	University of Connecticut
Michael Coplen, M.A.	Human Factors Program Manager	FRA
Tara DiDomenico	Engineering Psychologist	Volpe Center
Megan Euler, M.A.	Research Associate	University of Nebraska–Lincoln
Heidi Howarth, Ph.D.	Engineering Psychologist	Volpe Center
James Impara, Ph.D.	Consultant	Independent Consultant
Rachel Mahon	Transcriptionist	University of Nebraska–Lincoln
Stephanie Morrow, M.A.	Industrial and Organizational Psychology Doctoral Student	University of Connecticut and Volpe Center
David Nash, M.A.	Consultant	Independent Consultant
Vicki Plano Clark, Ph.D.	Educational Psychologist	University of Nebraska–Lincoln
Stephen Popkin, Ph.D.	Engineering Psychologist and Director of Human Factors Center of Innovation	Volpe Center
Janet Renoe	Research Associate	University of Nebraska–Lincoln
Terry Stentz, Ph.D.	Industrial Engineer	University of Nebraska–Lincoln
Kim Tatum	Transcriptionist	University of Nebraska–Lincoln
Ben Walsh, M.A.	Industrial and Organizational Psychology Doctoral Student	University of Nebraska–Lincoln

APPENDIX B: Preliminary List of Job Tasks

Preliminary List of Work Schedule Manager Job Tasks

1. Design and implement work schedules for employees, in accordance with staffing requirements and employee workload and availability.
   Example subtasks:
   - Develop shift schedule rotation
   - Communicate shift availability
   - Balance overtime with risk
   - Develop activity/rest cycles
   - Communicate between shifts/crews
   - Establish consensus building between shifts

2. Maintain records of employee's work schedules and timecards and prepare reports as needed.
   Example subtasks:
   - Maintain records of overtime
   - Maintain records of absenteeism
   - Validate payroll by hours actually worked

3. Implement schedule changes as necessary because of turnover, absenteeism, employee leave requests, and fluctuating workloads.
   Example subtasks:
   - Grant leave requests (vacation and sick)
   - Grant shift trading requests
   - Regulate shift turnover
   - Regulate proportional staffing by shift
   - Address last-minute overtime requirements
   - Establish overtime smart relief system

4. Coordinate with management to establish policies and programs that are sensitive to the particular demands of shift work schedules.
   Example subtasks:
   - Communicate to staff and educate on new programs
   - Monitor disciplinary action surrounding fatigue
   - Monitor stressors related to shift length
   - Establish circadian profiling
   - Establish shift work tolerance profile
   - Establish overtime smart relief system
   - Establish alertness/napping policy
   - Establish fitness for duty program
   - Establish work alertness program
   - Champion optimal shift scheduling

5. Monitor work hours to ensure that staff members comply with administrative policies and procedures, safety rules, union contracts, and government regulations.

   Example subtasks:
   - Monitor absenteeism/tardiness for abuse
   - Monitor adherence to Federal and State regulations
   - Monitor shift trading
   - Monitor transitions between shifts
   - Monitor start/stop times for shifts
   - Monitor break-schedule adherence

6. Review work production, employee performance, and accident reports in conjunction with shift schedules for potential shift-related trends and take action as necessary.

   Example subtasks:
   - Monitor trends in accidents and errors
   - Monitor shift performance and safety
   - Monitor medical claims for shift trends
   - Coordinate data analysis of shift-specific issues
   - Report productivity levels by shift
   - Report on staffing analysis per shift
   - Report performance benchmarks for shifts and crews

APPENDIX C: Materials from Consultant Panel Discussion

Consultant Panel Names and Affiliations

Table C-1. Names and Affiliations of Members of Consultant Panel

Name	Affiliation	Location
Silvano (Sal) Angelone	Circadian Technologies, Inc.	Stoneham, Massachusetts
Ted Baker, Ph.D.	Shiftwork Resources, Inc.	Boston, Massachusetts
Jack Connolly, Ph.D.	Shiftwork Consultants, Inc.	Long Island, New York
Jim Dillingham	Shiftwork Solutions, LLC	Needham, Massachusetts
John Frehse	Core Practice Partners, LLC	New York, New York
Jerry Krueger, Ph.D.	Krueger Ergonomics Consultants	Alexandria, Virginia
Andrew Lehrer, Ph.D.	24/7 Performance, LLC	Lexington, Massachusetts
Frank Pereira	The Capstan Group	San Rafael, California
Wayne Rhodes, Ph.D.	Fatigue Solutions International	Toronto, Canada
Jim Stam	24/7 Strategies Group	Wellesley Hills, Massachusetts

Revised Job Tasks from Panel Discussion

Job Task 1

Original Wording: Design and implement work schedules for employees, in accordance with staffing requirements and employee workload and availability.
Revised Wording: Monitor and manage work schedules for employees, in accordance with staffing requirements and employee workload and availability.

The first job task was revised from design and implement to monitor and manage work schedules. The focus group agreed that the primary job duty of work schedule managers would be to manage work schedules, rather than to create work schedules.

Job Task 2

Original Wording: Maintain records of employee's work schedules and timecards and prepare reports as needed.
Revised Wording: Evaluate efficacy of work schedules using common company metrics.

There was much debate over whether the second job task would be a responsibility of the work schedule manager. It was agreed that a work schedule manager would not be responsible for maintaining records because that is typically accounted for by a payroll department. Instead, a work schedule manager may be responsible for analyzing and evaluating work schedule records to determine whether the schedule is working effectively.

Job Task 3

Original Wording: Implement schedule changes as necessary because of turnover, absenteeism, employee leave requests, and fluctuating workloads.
Revised Wording: Recommend schedule changes as necessary because of turnover, absenteeism, employee leave requests, and fluctuating workloads.

The focus group participants suggested that the relative position of a work schedule manager in the hierarchy of an organization would provide for the ability to recommend schedule changes. However, it would be very unlikely that a work schedule manager would be in the position to actually implement schedule changes. Rather, the work schedule manager would act as a policy advisor for senior management.

Job Task 4

Original Wording: Coordinate with management to establish policies and programs that are sensitive to the particular demands of shift work schedules.
Revised Wording: Coordinate with management to establish policies and programs that are sensitive to the particular demands of shift work schedules.

The wording for job task four remained the same with one caveat: the focus group participants again believed it unlikely that a work schedule manager would be involved in the process of changing policies. The work schedule manager should be able to inform senior management about policies and programs but would not be responsible for creating said policies. Instead, work schedule managers should strive to stimulate the change process and recognize when outside help is needed to enact particular policy changes. In essence, the work schedule manager becomes the internal educator on the demands of shift work and brings that information to senior management.

Job Task 5

Original Wording: Monitor work hours to ensure that staff members comply with administrative policies and procedures, safety rules, union contracts, and government regulations.
Revised Wording: Monitor work hours to ensure that staff members comply with administrative policies and procedures, safety rules, union contracts, and government regulations.

The wording and understanding of job task five remained the same. Work schedule managers should be responsible for understanding the particular policies and procedures that govern their work schedules. Oftentimes managing a work schedule is about maintaining the best schedule possible for the organization while working within the constraints of administrative policies and procedures (e.g., hours of service mandates, labor laws, etc.).

Job Task 6

Original Wording: Review work production, employee performance, and accident reports in conjunction with shift schedules for potential shift-related trends and take action as necessary.
Revised Wording: Review work production, employee performance, and accident reports in conjunction with shift schedules for potential shift-related trends and take action as necessary.

The wording for job task six remained the same, with the understanding that this task also included an examination of the health and safety issues associated with shift schedules. This task suggests that work schedule managers would be responsible for monitoring shift-related trends in safety and performance for an organization.

KSAO Definitions

Knowledge – the degree to which employees have mastered a technical body of material directly involved in the performance of a job.

Skill – the capacity to performance tasks requiring the use of tools, equipment, and machinery.

Ability – the capacity to carry out physical and mental acts required by a job's tasks where the involvement of tools, equipment, and machinery is not a dominant factor.

Other characteristics – interests, values, temperaments, and personality traits suggesting what an employee is likely to do rather than how well an employee can do at peak performance.

Examples

Industrial Engineers:

- Knowledge of the practical application of engineering science and technology.
- Skill in judgment and decision making; considering the relative costs and benefits of potential actions to choose the most appropriate one.
- Ability to tell when something is wrong or is likely to go wrong.

Transportation Managers:

- Knowledge of the principles and methods for moving people or goods by air, rail, sea, or road, including the relative costs and benefits.
- Skill in time management; managing one's own time and the time of others.
- Ability to apply general rules to specific problems to produce answers that make sense (deductive reasoning).
- Willingness to work unusual work schedules.

First-Line Supervisors of Production Workers:

- Knowledge of techniques for maximizing the effective manufacture and distribution of goods.
- Skill in motivating, developing, and directing people as they work.
- Ability to communicate information and ideas in writing so that others will understand.

Preliminary KSAO List from Panel Discussion

Job Task 1: Monitor and manage work schedules for employees, in accordance with staffing requirements and employee workload and availability.

Knowledge

- Knowledge of various schemes or designs used to schedule 24/7 work (e.g., fast/slow, forward/backward rotations)
- Knowledge of the impact long work hours have on health, safety, and performance
- Knowledge of the physiology of sleep, including circadian rhythm, sleep architecture, sleep disorders, naps, chemical substances' effects on sleep
- Knowledge of industry-specific operations and regulations (e.g., OSHA, USDA, HOS)
- Knowledge of the work rules of the company, including unions, contracts, hours of service, overtime pay, and incentives
- Knowledge of company policies, procedures, and practices and how they relate to company values

Skills

- Skill in communicating with various levels of an organization's hierarchy and tailoring explanations of ideas to an appropriate level
- Skill in converting complex topics to simple explanations
- Skill with analytical/statistical applications
- Skill in solving problems

Abilities

- Ability to think independently
- Ability to identify and manage risks
- Ability to self-evaluate to gauge success

Other

- Integrity
- Previous involvement with shift work systems

Job Task 2: Evaluate efficacy of work schedules using common company metrics.
There was much debate over whether the second job task would be a responsibility of the work schedule manager.

Knowledge

- Knowledge of tools and technologies available for scheduling
- Knowledge of staffing analysis

Skills

- Skill interfacing with multiple systems and people to capture measures of productivity and other outcomes
- Skill in basic mathematical applications
- Skill building data-based reports

Abilities

- Ability to persuade others
- Ability to ask the right questions and know where to find the appropriate answers

Other

- Honesty
- Discretion

Job Task 3: Recommend schedule changes as necessary because of turnover, absenteeism, employee leave requests, and fluctuating workloads.

Knowledge

- Knowledge of the policies and procedures associated with the design of an organization's schedule
- Knowledge of industry or company-specific indicators of an employee's fitness for duty

Skills

- Skill in using the tools and technologies of a scheduling management system to track fluctuations in workload and usage of relief systems
- Skill in understanding perceptions of equity and solving problems in an equitable manner
- Skill in troubleshooting schedule systems to recognize when a system is broken and what is needed to repair it
- Skill in coordinating and negotiating with all levels of personnel within an organization

Abilities

- Ability to think critically about problems

Job Task 4: Coordinate with management to establish policies and programs that are sensitive to the particular demands of shift work schedules.

Knowledge

- Knowledge of union interactions with an organization, including the company's collective agreement
- Knowledge of the employee handbook
- Knowledge of employee training programs specific to the management of shift work

Skills

- Skill in tracking schedules and recognizing the warning signs of potential fatigue, health, and safety issues

Abilities

- Ability to balance conflicting demands, such as when the needs of the employees conflict with the demands of the organization
- Ability to be diplomatic when interfacing between management and employee goals
- Ability to recognize a problem and need for change
- Ability to persuade
- Ability to be flexible based on changing needs

Job Task 5: Monitor work hours to ensure that staff members comply with administrative policies and procedures, safety rules, union contracts, and government regulations.

Knowledge

- Knowledge of company policies and procedures, including company interactions with unions and union contracts
- Knowledge of applicable government rules and regulations
- Knowledge of company's human resource systems

Skills

- Skill in using technology
- Skill in interacting with people
- Skill in observation
- Skill in analyzing information and using logic to solve problems

Abilities

- Ability to read and comprehend ideas in writing
- Ability to express oneself clearly through speaking and writing so that others will understand
- Ability to lead others effectively
- Ability to be persuasive

Other

- Approachability

Job Task 6: Review work production, employee performance, and accident reports in conjunction with shift schedules for potential shift-related trends and take action as necessary.

Knowledge

- Knowledge of basic ergonomics and human factors
- Knowledge of mechanisms and components that affect job performance
- Knowledge of circadian physiology
- Knowledge of health and safety issues that relate to work
- Knowledge of current research related to shift work

Skills

- Skill in problem solving and investigation
- Skill with computer systems
- Skill in designing and managing data collection systems
- Skill in analyzing information and using logic to solve problems
- Skill in observation
- Skill in keeping detailed records
- Skill in mediating between management and employees

Abilities

- Ability to communicate well with others
- Ability to express oneself clearly through writing
- Ability to think critically

Other

- Passion for safety and health
- Patience
- Perseverance

APPENDIX D: Materials from Researcher Interviews

Academic Researcher Names and Affiliations

Table D-1. Researcher Names and Affiliations

Name	Title	Affiliation	Location
Torbjörn Åkerstedt, Ph.D.	Professor	Karolinska Institute	Stockholm, Sweden
Greg Belenky, Ph.D.	Research Professor	Washington State University	Spokane, Washington
Charles Czeisler, Ph.D.	Baldino Professor of Sleep Medicine	Harvard Medical School	Boston, Massachusetts
David Dinges, Ph.D.	Professor of Psychology in Psychiatry	University of Pennsylvania School of Medicine	Philadelphia, Pennsylvania
Simon Folkard, Ph.D.	Emeritus Professor	Swansea University School of Human Sciences	Wales, United Kingdom
Mikko Härmä, Ph.D.	Director of Human Factors at Work	Finnish Institute of Occupational Health	Helsinki, Finland
Michael Smolensky, Ph.D.	Professor of Environmental Sciences	The University of Texas Health Sciences Center	Houston, Texas

Preliminary KSAO List from Researcher Interviews

1. *What do work schedule managers need to know to effectively schedule shift work?*
   - Knowledge of the effects of shift work on health and safety
   - Knowledge of the relationship between sleep and performance, including circadian physiology and homeostatic regulation
   - Knowledge of specific company operations, regulations, industry policies, etc.
   - Knowledge of program evaluation
   - Knowledge of individual differences in shift work preferences and the social implications of shift work
   - Knowledge of the relationship between medications, sleep, and performance
   - Knowledge of staffing
   - Knowledge of shift scheduling principles
   - Knowledge of human factors

2. *What unique skills do work schedule managers need to have to schedule multiple shifts?*
   - Skill in integrating knowledge to solve problems
   - Skill in negotiating with different levels and parts of an organization (management, labor union, frontline employees)
   - Skill in managing collective agreements
   - Skill in managing questionnaires and interviews
   - Numerical skills
   - Skill in epidemiology and statistics
   - Teamwork skills
   - Skill in developing policies and policy documents
   - Interpersonal skills

3. *What unique abilities do work schedule managers need for scheduling?*
   - Ability to manage software and computers
   - Ability to identify areas of risk
   - Ability to talk to and relate to different levels and layers of the organization
   - Ability to cooperate

4. *Are there any other characteristics that work schedule managers should have to help them do well in their jobs?*
   - Balanced personality
   - Willing to compromise
   - Needs to command respect
   - Should be well-connected with a community of schedulers
   - Sensitivity to different types of people

APPENDIX E: Finalized KSAOs and Followup Survey

Final List of KSAOs

Table E-1. Finalized List of Knowledge Characteristics and Mapping to Original Wording

KNOWLEDGE		
	Finalized wording for KSAO	**Original wording from SMEs**
1	Various designs used to schedule 24/7 work (e.g., fast/slow, forward/backward rotations)	▪ Knowledge of various schemes or designs used to schedule 24/7 work (e.g., fast/slow, forward/backward rotations) ▪ Knowledge of shift scheduling principles
2	The impact work hours have on health, safety, and performance	▪ Knowledge of the impact long work hours have on health, safety, and performance ▪ Knowledge of mechanisms and components that affect job performance ▪ Knowledge of health and safety issues that relate to work ▪ Knowledge of current research related to shift work. ▪ Knowledge of the effects of shift work on health and safety
3	The physiology of sleep as related to performance	▪ Knowledge of the physiology of sleep, including circadian rhythm, sleep architecture, sleep disorders, naps, chemical substances' effects on sleep ▪ Knowledge of circadian physiology ▪ Knowledge of the relationship between sleep and performance, including circadian physiology and homeostatic regulation ▪ Knowledge of the relationship between medications, sleep, and performance
4	Industry-specific operations and regulations (e.g., OSHA, USDA, HOS)	▪ Knowledge of industry-specific operations and regulations (e.g., OSHA, USDA, HOS) ▪ Knowledge of applicable government rules and regulations ▪ Knowledge of specific company operations, regulations, industry policies, etc.
5	Company policies and procedures, including interactions with unions and union contracts	▪ Knowledge of the work rules of the company, including unions, contracts, hours of service, overtime pay and incentives ▪ Knowledge of company policies, procedures, and practices and how they relate to company values ▪ Knowledge of union interactions with an organization, including the company's collective agreement ▪ Knowledge of the employee handbook ▪ Knowledge of company policies and procedures, including company interactions with unions and union contracts
6	Tools and technologies available for scheduling	▪ Knowledge of tools and technologies available for scheduling
7	Staffing analysis	▪ Knowledge of staffing analysis ▪ Knowledge of staffing
8	Policies and procedures concerning the design of an organization's schedule	▪ Knowledge of the policies and procedures associated with the design of an organization's schedule
9	Indicators of an employee's fitness for duty	▪ Knowledge of industry or company-specific indicators of an employee's fitness for duty
10	Employee training programs specific to shift work	▪ Knowledge of employee training programs specific to the management of shift work
11	Human resource systems	▪ Knowledge of company's human resource systems
12	Basic ergonomics and human factors	▪ Knowledge of basic ergonomics and human factors ▪ Knowledge of human factors

13	Program evaluation	▪ Knowledge of program evaluation
14	The social implications of shift work	▪ Knowledge of individual differences in shiftwork preferences and the social implications of shift work

Table E-2. Finalized List of Skills and Mapping to Original Wording

SKILLS		
	Finalized wording for KSAO	**Original wording from SMEs**
1	Communicating with various levels of an organization's hierarchy	▪ Skill in communicating with various levels of an organization's hierarchy and tailoring explanations of ideas to an appropriate level ▪ Skill coordinating and negotiating with all levels of personnel within an organization ▪ Skill in mediating between management and employees ▪ Skill in negotiating with different levels and parts of an organization (management, labor union, frontline employees) ▪ Ability to be diplomatic when interfacing between management and employee goals ▪ Ability to talk to and relate to different levels and layers of the organization
2	Converting complex topics to simple explanations	▪ Skill in converting complex topics to simple explanations
3	Using analytical/statistical applications	▪ Skill with analytical/statistical applications ▪ Skill in basic mathematical applications ▪ Numerical skills ▪ Skill in epidemiology and statistics
4	Problem solving	▪ Skill in solving problems ▪ Skill in understanding perceptions of equity and solving problems in an equitable manner ▪ Skill in analyzing information and using logic to solve problems ▪ Skill in problem solving and investigation. ▪ Skill in analyzing information and using logic to solve problems. ▪ Skill in integrating knowledge to solve problems
5	Interfacing with multiple systems	▪ Skill in interfacing with multiple systems and people to capture measures of productivity and other outcomes
6	Using technology	▪ Skill in utilizing the tools and technologies of a scheduling management system in order to track fluctuations in workload and usage of relief systems ▪ Skill in using technology ▪ Skill with computer systems ▪ Ability to manage software and computers
7	Troubleshooting schedule systems	▪ Skill in troubleshooting schedule systems, in order to recognize when a system is broken and what is needed to repair it
8	Recognizing the warning signs of potential fatigue, health, and safety issues	▪ Skill in tracking schedules and recognizing the warning signs of potential fatigue, health, and safety issues
9	Interacting with people	▪ Skill in interacting with people ▪ Interpersonal skills
10	Observation	▪ Skill in observation
11	Keeping detailed records	▪ Skill in keeping detailed records
12	Managing collective agreements	▪ Skill in managing collective agreements
13	Working in teams	▪ Teamwork skills
14	Leading people	▪ Leadership skills ▪ Ability to lead others effectively

Table E-3. Finalized List of Abilities and Mapping to Original Wording

ABILITIES		
	Finalized wording for KSAO	**Original wording from SMEs**
1	Think independently	▪ Ability to think independently
2	Identify and manage risks	▪ Ability to identify and manage risks ▪ Ability to identify areas of risk
3	Self-evaluate to gauge success	▪ Ability to self-evaluate to gauge success
4	Persuade others	▪ Ability to persuade others ▪ Ability to persuade ▪ Ability to be persuasive
5	Ask the right questions and know where to find the appropriate answers	▪ Ability to ask the right questions and know where to find the appropriate answers
6	Think critically about problems	▪ Ability to think critically about problems ▪ Ability to think critically
7	Balance conflicting demands	▪ Ability to balance conflicting demands, such as when the needs of the employees conflict with the demands of the organization
8	Recognize a problem and need for change	▪ Ability to recognize a problem and need for change
9	Be flexible	▪ Ability to be flexible based on changing needs
10	Read and comprehend ideas in writing	▪ Ability to read and comprehend ideas in writing
11	Express oneself clearly through speaking and writing	▪ Ability to express oneself clearly through speaking and writing so that others will understand ▪ Ability to communicate well with others ▪ Ability to express oneself clearly through writing
12	Cooperate	▪ Ability to cooperate

Table E-4. Finalized List of Other Characteristics and Mapping to Original Wording

OTHER CHARACTERISTICS		
	Finalized wording for KSAO	**Original wording from SMEs**
1	Integrity	▪ Integrity
2	Previous involvement with shift work systems	▪ Previous involvement with shift work systems
3	Honesty	▪ Honesty
4	Discretion	▪ Discretion
5	Approachability	▪ Approachability
6	Passion for safety and health	▪ Passion for safety and health
7	Patience	▪ Patience
8	Perseverance	▪ Perseverance
9	Willing to compromise	▪ Willing to compromise
10	Commands respect	▪ Needs to command respect
11	Well-connected with a community of schedulers	▪ Should be well-connected with a community of schedulers
12	Sensitivity to different types of people	▪ Sensitivity to different types of people

Followup Survey Administered to SMEs

Page 1: Welcome to the Work Schedule Manager Job Analysis Survey

This survey is a followup to the interview and/or focus group that you participated in regarding the management of shift work schedules. The next few pages contain questions regarding the job tasks and knowledge, skills, abilities, and other characteristics (KSAOs) necessary to manage work schedules in 24/7 operations. We compiled the list of job tasks and KSAOs based on collective input from multiple interviews and focus groups. Your responses to this survey will provide us with important information regarding the relative importance of the job tasks and KSAOs that have been identified.

Participation in this survey is voluntary, and we will be happy to answer any questions you have concerning the study. If you have further questions about this project or if you have a research-related problem, you may contact Stephanie Morrow at Stephanie.Morrow@uconn.edu or Janet Barnes-Farrell at Janet.Barnes-Farrell@uconn.edu. If you have any questions about your rights as a research participant you may contact the University of Connecticut Institutional Review Board (IRB) at 860-486-8802. An IRB is a group of people that reviews research studies to make sure they are safe for participants.

The survey should take 15–20 minutes to complete. Thank you for taking the time to participate in this study.

Janet Barnes-Farrell, Ph.D.
Stephanie Morrow, M.A.

To navigate individual pages of the survey, you can use the Tab and PageUp/PageDown keys on your keyboard or the scroll bar on the right hand side of the screen. DO NOT use the Enter key on your keyboard to enter responses or navigate the survey. Please click the “Next“ button at the bottom of the page to continue with the survey.

Page 2: Job Tasks

The following is a list of the various job tasks that define the job of a work schedule manager. Some job tasks may be more difficult than others, and some may result in more negative consequences if not done properly. Please answer the following questions as they relate to the job tasks of a work schedule manager.

1) How difficult is it to complete this task? (Task difficulty)

- 1 – Extremely easy task
- 2 – Considerably easy task
- 3 – Somewhat easy task
- 4 – Average task
- 5 – Somewhat difficult task
- 6 – Considerably difficult task
- 7 – Extremely difficult task

2) To what extent would completing the task incorrectly result in negative consequences? (Consequence of error)

- 1 – Extremely negative consequences
- 2 – Very negative consequences
- 3 – Moderately negative consequences
- 4 – Somewhat negative consequences
- 5 – No negative consequences

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1. Design and implement work schedules for employees, in accordance with staffing requirements and employee workload and availability.
2. Maintain records of employee's work schedules and timecards and prepare reports as needed.
3. Implement schedule changes as necessary due to turnover, absenteeism, employee leave requests, and fluctuating workloads.
4. Coordinate with management to establish policies and programs that are sensitive to the particular demands of shift work schedules.
5. Monitor work hours to ensure that staff members comply with administrative policies and procedures, safety rules, union contracts, and government regulations.
6. Review work production, employee performance, and accident reports in conjunction with shift schedules for potential shift related trends and take action as necessary.

Please list any job tasks that you believe were not included above, but should be included in the job of a work schedule manager.

Do you have any additional comments regarding the listed JOB TASKS?

Page 3: Knowledge

Think about each of the following knowledge areas as they relate to the job and job tasks of a work schedule manager. Some knowledge areas may be more important than others. Some may be learned through formal training, whereas others can only be acquired through on-the-job training or experience. For each knowledge area, answer the following questions:

1) How important is it for a work schedule manager to possess this knowledge? (Importance)
   1 – Not at all important
   2 – Somewhat important
   3 – Moderately important
   4 – Very important
   5 – Extremely important

2) Can this knowledge be taught using a formal, standardized training program? (Formal training)
   1 – Yes
   2 – No

Knowledge of...
1. ...various designs used to schedule 24/7 work (e.g., fast/slow, forward/backward rotations)
2. ...the impact work hours have on health, safety, and performance
3. ...the physiology of sleep as related to performance
4. ...industry-specific operations and regulations (e.g., OSHA, USDA, HOS)
5. ...company policies and procedures, including interactions with unions and union contracts
6. ...tools and technologies available for scheduling
7. ...staffing analysis
8. ...policies and procedures concerning the design of an organization's schedule
9. ...indicators of an employee's fitness for duty
10. ...employee training programs specific to shift work
11. ...human resource systems
12. ...basic ergonomics and human factors
13. ...program evaluation
14. ...the social implications of shift work

Page 4: Skills

Think about each of the following skills as they relate to the job and job tasks of a work schedule manager. Some skills may be more important than others. Some may be learned through formal training, whereas others can only be acquired through on-the-job experience. For each skill, answer the following questions:

1) How important is it for a work schedule manager to possess this skill? (Importance)
   1 – Not at all important
   2 – Somewhat important
   3 – Moderately important
   4 – Very important
   5 – Extremely important

2) Can this skill be taught using a formal, standardized training program? (Formal training)
   1 – Yes
   2 – No

Skill in...

1. ...communicating with various levels of an organization's hierarchy
2. ...converting complex topics to simple explanations
3. ...using analytical/statistical applications
4. ...problem solving
5. ...interfacing with multiple systems
6. ...using technology
7. ...troubleshooting schedule systems
8. ...recognizing the warning signs of potential fatigue, health, and safety issues
9. ...interacting with people
10. ...observation
11. ...keeping detailed records
12. ...managing collective agreements
13. ...working in teams
14. ...leading people

Page 5: Abilities

Think about each of the following abilities as they relate to the job and job tasks of a work schedule manager. Some abilities may be more important than others. Some may be learned through formal training, whereas others can only be acquired through on-the-job training or experience. For each ability, answer the following questions:

1) How important is it for a work schedule manager to possess this Ability? (Importance)
   1 – Not at all important
   2 – Somewhat important
   3 – Moderately important
   4 – Very important
   5 – Extremely important

2) Can this Ability be taught using a formal, standardized training program? (Formal training)
   1 – Yes
   2 – No

Ability to...

1. ...think independently
2. ...identify and manage risks
3. ...self-evaluate to gauge success
4. ...persuade others
5. ...ask the right questions and know where to find the appropriate answers
6. ...think critically about problems
7. ...balance conflicting demands
8. ...recognize a problem and need for change
9. ...be flexible
10. ...read and comprehend ideas in writing
11. ...express oneself clearly through speaking and writing
12. ...cooperate

Page 6: Other Characteristics

Think about each of the following characteristics as they relate to the job and job tasks of a work schedule manager. Some characteristics may be more important than others. Some may be learned through formal training, whereas others can only be acquired through on-the-job training or experience. For each characteristic, answer the following questions:

1) How important is it for a work schedule manager to possess this characteristic? (Importance)
   1 – Not at all important
   2 – Somewhat important
   3 – Moderately important
   4 – Very important
   5 – Extremely important

2) Can this characteristic be taught using a formal, standardized training program? (Formal training)
   1 – Yes
   2 – No

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1. Integrity
2. Previous involvement with shift work systems
3. Honesty
4. Discretion
5. Approachability
6. Passion for safety and health
7. Patience
8. Perseverance
9. Willing to compromise
10. Commands respect
11. Well-connected with a community of schedulers
12. Sensitivity to different types of people

Please list any KSAOs that you believe were not included on these lists, but should be required of a work schedule manager.

Do you have any additional comments regarding the listed KSAOs?

You have reached the end of the survey. Please click the "Done" button at the bottom of the page to complete the survey and submit your responses.

APPENDIX F: Job Incumbent Interview Materials

Job Incumbent Preinterview Information Sheet

INFORMATION SHEET
University of Connecticut – Shift Work Scheduling Job Analysis

Introduction
Thank you for your interest in participating in this research project. The University of Connecticut is conducting a job analysis on shift work schedulers in a broad range of industries and organizations in the New England area. This research is funded by the Federal Railroad Administration (FRA), Washington, DC. The goal of this research is to draft an accurate job description for shift work schedulers. Participation in the study is completely voluntary. You are free to decide not to participate in this study or to withdraw at any time without adversely affecting your relationship with your employer or the investigators.

You will be interviewed in person by two members of the research team from the University of Connecticut. The interview will take approximately forty-five (45) minutes to complete and will be audio-recorded to ensure that we record your responses as accurately as possible. During the interview you will be asked about your job as it relates to scheduling workers in your organization, the process you use to create a work schedule, and any tools or information you use in the creation of a work schedule. At the end of the in-person interview you will be asked to complete a short post-interview survey. This document will ask for you to indicate whether specific knowledge, skills, abilities and other characteristics are of importance to do well in your job. Once the interview is completed your involvement in the study is over.

Attached to this information sheet is a *Preinterview Questionnaire*. This document will ask for you to provide the interviewer with your contact information, a description of your organization, your job, and basic demographic questions such as your age, gender and education. This document will take approximately ten (10) minutes to complete. Please complete the questionnaire before the interview, and will pick up the completed questionnaire at the time of the interview.

Confidentiality
You have a right to privacy, and the research investigators will take all reasonable measures to protect the confidentiality of your records. Your name has been recorded solely for the purpose of contacting you for the interview. Following completion of your interview, the audio recording of the interview will be transcribed by a professional transcriptionist and only your initials will appear in the transcription script, making it difficult to link your name with your responses to questions. Afterward, the audio recordings will be destroyed and the transcription will serve as the record of information from the interview. The individuals who interview you will be graduate students at the University of Connecticut, and are not employees of your organization. Investigators will have no access to your employment records. Your interview responses will not be given to your employer or supervisor. Your name and other identifying information will not be available to any person or group other than study investigators and a professional transcriptionist.

Risks & Benefits
This interview process does not involve any risks or inconveniences to you other than the time required to complete the interview. However, it is anticipated that the results of this study will help future shift work schedulers and organizations through the development of more productive, safer, and more efficient scheduling practices in a demanding shift work environment. Again, your participation is completely voluntary.

If You Need More Information
If you need more information or have questions about the interview, please contact the Principal Investigator, Dr. Janet Barnes-Farrell, at 860-486-5929 (janet.barnes-farrell@uconn.edu) or the other members of the research team, Stephanie Morrow (stephanie.morrow@uconn.edu) or Ben Walsh (benjamin.walsh@uconn.edu). If you have any questions about your rights as a research subject that have not been answered by the investigator or to report any concerns about the study, you may contact the University of Connecticut, Institutional Review Board (IRB) at 860-486-8802. An IRB is a group of people that review research studies to make sure they are safe for participants.

Job Incumbent Preinterview Questionnaire

Principal Investigators:	Janet L. Barnes-Farrell, Ph.D. Stephanie L. Morrow, M.A. Ben M. Walsh, M.A.	E-mail:	janet.barnes-farrell@uconn.edu stephanie.morrow@uconn.edu benjamin.walsh@uconn.edu
Office Telephone:	860-486-5929	Address:	University of Connecticut Psychology Department 406 Babbidge Road Unit 1020 Storrs, CT 06269

The University of Connecticut is conducting a job analysis on shift work schedulers in a broad range of industries and organizations in the New England area. This research is funded by the Federal Railroad Administration (FRA), Washington, DC. The goal of this research is to draft an accurate job description for shift work schedulers. Your responses to these interview questions are a vital contribution to this important research. **All responses will be strictly confidential**. Your cooperation is greatly appreciated.

Instructions:

- **Please complete this questionnaire and have a completed copy with you which we will pick up at the time of your interview.**
- **You may type your responses electronically in the gray highlighted areas. Remember to save the file after you have finished filling in the form to save your responses.**

Please provide the following information:

PERSONAL CONTACT INFORMATION	
Name:	_____
Phone Number:	_____
E-mail:	_____

COMPANY/ORGANIZATION CONTACT INFORMATION	
Company/Organization Name:	_____
Mailing Address:	_____
	_____
City, State, Zip:	_____

DESCRIBE YOUR COMPANY/ORGANIZATION

1. Please provide a brief description of the main business or operational activity of your company/organization or place of employment:

   _____

2. How many employees work at your work site? _____

3. Does your company/organization operate 24 hours per day, 7 days per week? ☐ YES ☐ NO

   a. If NO…what are your normal days and hours of operation? _____

4. Is your workforce unionized? ☐ YES ☐ NO ☐ DON'T KNOW

5. What is your official job title? _____

6. How long have you worked for your company/organization? _____ Years _____ Months

7. What department or group are you assigned to? _____

8. What is the job title and department of the person you report to?

   ***If you have an organizational chart that includes you and/or your department, please e-mail a copy with this preinterview sheet or have it available at the interview.**

9. How long have you been scheduling workers in your company/organization? _____ Years _____ Months

10. Is scheduling workers your main job activity or responsibility? ☐ YES ☐ NO

    ***If there are written policies, documents, or procedure pertaining to work scheduling that you use, please e-mail copies with this preinterview sheet or have them available at the interview.**

11. How many full-time and part-time workers are you typically responsible for scheduling?

    Full-time Part-time

12. How many hours per week do you typically spend on scheduling activities? _____ Hours/Week

DESCRIBE YOURSELF

13. What is your gender? ☐ Male ☐ Female

14. What is your age? _____ Years

15. Please indicate the highest level of formal education you have completed.

☐ High School Diploma or GED

☐ Associate's Degree

☐ Bachelor's Degree

☐ Master's Degree

☐ Doctoral Degree

☐ Other Please Describe: _____

END OF INFORMATION SHEET

Thank you for completing this pre-interview questionnaire. **All of your responses are strictly confidential.** We look forward to talking with you in more depth about your scheduling tasks during your interview.

Please have a completed copy of this form with you at the time of your interview.

Also, please have any documents, additional information, and other items related to your shift work scheduling tasks available at the interview. This will save time and make the interview more efficient. Thank you.

Job Incumbent In-Person Interview Questionnaire

Principal Investigators:	Janet L. Barnes-Farrell, Ph.D. Stephanie L. Morrow, M.A. Ben M. Walsh, M.A.	E-mail:	janet.barnes-farrell@uconn.edu stephanie.morrow@uconn.edu benjamin.walsh@uconn.edu
Office Telephone:	860-486-5929	Address:	University of Connecticut Psychology Department 406 Babbidge Road Unit 1020 Storrs, CT 06269

Instructions to Interviewer:

- Verify that you are interviewing a person who is responsible for shift work scheduling in the company/organization.

- Provide a thorough explanation of the study and answer all questions before beginning. Have a copy of the information sheet provided with the pre-interview questionnaire. Assure the interview participant of confidentiality before the interview is started and again at the end of the interview. Remind the subject that the interview will be recorded so that the research team can more accurately evaluate and analyze the responses.

- Have the completed pre-interview information sheet with you during the interview. Make sure you have studied the responses to the information sheet and reviewed any additional documentation provided. Some information may not have been enclosed with the pre-interview and needs to be available during the interview. Prepare to take copies of this additional information with you from the interview.

PRELIMINARY QUESTIONS AND VERIFICATIONS

INTERVIEWER: Hi. My name is _____. I am working with the University of Connecticut to study scheduling practices in industries that operate around-the-clock. Any information that you share with us is strictly confidential and your cooperation is voluntary. The interview should take about 45 minutes, and, if you agree, I would like to audio record your responses so that the research team documents your responses as accurately as possible. May I begin recording? *(Confirm participant is ready to begin the interview)*

****TURN ON THE RECORDER AND MAKE SURE IT IS RECORDING PROPERLY****

INTERVIEWER: I am _____ (name of interviewer). Today is _____ (give the date), and I am at _____ (name of organization) interviewing _____ (first name of interviewee) about (his or her) job as a shift work scheduler. I will be audio recording the interview in its entirety and I have turned the recorder on. I need to make sure that I have your consent to be interviewed for this research project and give you full assurance that your identity and all of your responses are completely confidential in accordance with the University of Connecticut Institutional Review Board (IRB) requirements for the protection of human research subjects. Do I have your permission and consent to proceed with the interview?

(*If the response is "yes," then proceed. If the response is "no," then stop the recording and terminate the interview*).

INTERVIEW QUESTIONS

SCHEDULING IN RELATION TO OTHER JOB DUTIES

INTERVIEWER: We understand that scheduling is often not a person's sole job duty at work. The following questions ask about your work scheduling duties in relation to the other job duties you are responsible for at work.

1. Approximately what percentage of your total job duties does scheduling account for? For example, if scheduling is your primary job duty, it might make up 90percent of your job. If scheduling is only a small part of your job duties, it might make up only 10percent of your job.

2. What other major job duties or tasks do you perform in addition to the scheduling of workers?

3. Who are the people that you are responsible for scheduling, what do they do?

4. How many other people schedule work in your organization? Can you give me a general sense of who in the organization is responsible for scheduling what groups of employees?

5. Who are you directly responsible to for your scheduling tasks and scheduling products? What is this person's job title and position in the organization? Where do they fit in the organization in relation to your position?

THE STRUCTURE OF YOUR WORK SCHEDULE

INTERVIEWER: We'd like to know more about the type of work schedule that you create.

6. Could you please name and describe the various work schedules that you create and use?

7. How do you determine how many workers must be scheduled for a particular shift or a particular area of activity or operation? For example, do you use proportional staffing?

THE SCHEDULING PROCESS

INTERVIEWER: Think about the steps you take to create a work schedule; the kinds of information you gather, the tools you use, and the people you interact with. The following questions are about understanding exactly what you do when you create a work schedule.

8. What are the basic steps you take to create a work schedule?

9. What special tools or technology (ex. software) do you use to create the schedule?

10. When you generate a work schedule, how many days of the week or how many weeks in a month does it typically cover?

11. How do you determine exactly which employees you schedule for a particular shift?

12. What other formal or informal information or documentation do you use when designing the schedule?

INTERVIEWER NOTE: Information inputs might include seniority, overtime, employee preference, bid position, voluntary, permanent vs. temporary status, rotation vs. fixed, restricted duty, sick leave and return from sick leave, etc.

13. How are employees and supervisors notified of a new or revised shift schedule?

14. What restrictions do you need to consider in creating or revising work schedules? Such as limits on hours worked per shift or overtime? (Such as federal or state laws or regulations)

15. **OPTIONAL QUESTION:** What kind of union contract rules or requirements must you take into consideration in creating or revising work schedules? Do you have a copy of these rules and requirements that we can review? If documentation is not available then please describe these requirements in as much detail as possible.

INTERVIEWER NOTE: Ask this question if the pre-interview information indicated that the workforce is unionized.

16. What issues, concerns, information, or data do you take into consideration when you need to call someone in to work? How is this decision made, and what are the details of the process of calling someone in to work?

YOUR TRAINING

INTERVIEWER: It is important to understand where, when, and how you learned to design work schedules. The following questions ask about you training experiences with regard to work scheduling.

17. What did you do before your current job? How did you get to be in charge of scheduling?

18. What kind of, if any, training have you participated in concerning scheduling? (e.g., a continuing education course)

19. What did it take and how long did it take before you felt fully trained and competent?

20. If you had to train someone else to do the job of scheduling, what kind of knowledge would they need?

21. What kind of skills would someone need to do the scheduling component of your job? Such as skills relating to technology?

22. What other abilities or characteristics make you good at what you do? For example, relating to communication or personality?

FINAL THOUGHTS

INTERVIEWER: Is there anything that we have not talked about or that you think we should know with regard to your job, shift work scheduling, or other issues important to understanding your shift scheduling job or the work schedules created?

INTERVIEWER: We have finished the discussion portion of the interview, but before we leave we have a short survey that we would like you to complete. The survey contains lists of knowledge, skills, abilities, and other characteristics that might be needed by employees who schedule shifts. We would like

you to read over these lists and indicate how important it is to have each of these characteristics for your job. It should take no more than 10 minutes to complete.

(Give postinterview survey to participant and answer any questions, if necessary)

INTERVIEWER (After Completion of Postinterview Survey): Thank you for participating in this research project. Again, your responses and our discussion during this interview are strictly confidential. If you have any additional questions or would like to talk to a member of the research team at any time please contact the principal investigator, Janet Barnes-Farrell, at 860-486-5929.

Job Incumbent Postinterview Survey

The following survey includes lists of knowledge, skills, abilities, and other characteristics that may apply to your job as a work scheduler. Please read the items and indicate how important they are in your job.

KNOWLEDGE

To what extent are the following knowledge areas important to have in your job? (Please circle the appropriate number; 1 = Not at all important and 5 = Extremely important)

Knowledge of…	Important for job?				
	Not at all	Somewhat	Moderately	Very	Extremely
1. ...various designs used to schedule 24/7 work (e.g., fast/slow, forward/backward rotations)	1	2	3	4	5
2. ...the impact work hours can have on health, safety, and performance	1	2	3	4	5
3. ...the physiology of sleep as related to performance	1	2	3	4	5
4. ...government regulations that apply to your industry	1	2	3	4	5
5. ...your organization's policies and procedures	1	2	3	4	5
6. ...tools and technologies available for scheduling	1	2	3	4	5
7. ...staffing analysis	1	2	3	4	5
8. ...policies and procedures concerning the design of your organization's schedule	1	2	3	4	5
9. ...indicators of an employee's fitness for duty	1	2	3	4	5
10. ...employee training programs specific to working shift schedules	1	2	3	4	5
11. ...human resource systems	1	2	3	4	5
12. ...basic ergonomics and human factors	1	2	3	4	5
13. ...methods for evaluating the effectiveness of a work schedule	1	2	3	4	5
14. ...the social implications of working different shifts (e.g., day versus night work)	1	2	3	4	5

SKILLS

To what extent are the following skills important to have in your job? (Please circle the appropriate number; 1 = Not at all important and 5 = Extremely important)

Skill in…	Important for job?				
	Not at all	Somewhat	Moderately	Very	Extremely
1. ...communicating with various levels of an organization's hierarchy	1	2	3	4	5
2. ...converting complex topics to simple explanations	1	2	3	4	5
3. ...using analytical/statistical applications	1	2	3	4	5
4. ...problem solving	1	2	3	4	5
5. ...interfacing with multiple systems	1	2	3	4	5
6. ...using technology	1	2	3	4	5
7. ...troubleshooting work schedule systems	1	2	3	4	5
8. ...recognizing the warning signs of potential fatigue, health, and safety issues	1	2	3	4	5
9. ...interacting with people	1	2	3	4	5
10. ...observation	1	2	3	4	5
11. ...keeping detailed records	1	2	3	4	5
12. ...managing collective agreements	1	2	3	4	5
13. ...working in teams	1	2	3	4	5
14. ...leading people	1	2	3	4	5

ABILITIES

Which of the following abilities are important to have in your job? (Please circle the appropriate number; 1 = Not at all important and 5 = Extremely important)

Ability to…	Important for job?				
	Not at all	Somewhat	Moderately	Very	Extremely
1. ...think independently	1	2	3	4	5
2. ...identify and manage risks	1	2	3	4	5
3. ...self-evaluate to gauge success	1	2	3	4	5
4. ...persuade others	1	2	3	4	5
5. ...ask the right questions and know where to find the appropriate answers	1	2	3	4	5
6. ...think critically about problems	1	2	3	4	5
7. ....balance conflicting demands	1	2	3	4	5
8. ...recognize a problem and need for change	1	2	3	4	5
9. ...be flexible	1	2	3	4	5
10. ...read and comprehend ideas in writing	1	2	3	4	5
11. ...express yourself clearly through speaking and writing	1	2	3	4	5
12. ...cooperate	1	2	3	4	5

OTHER CHARACTERISTICS

To what extent are the following characteristics important to have in your job? (Please circle the appropriate number; 1 = Not at all important and 5 = Extremely important)

	Important for job?				
	Not at all	Somewhat	Moderately	Very	Extremely
1. Integrity	1	2	3	4	5
2. Previous involvement with shift work systems	1	2	3	4	5
3. Honesty	1	2	3	4	5
4. Discretion	1	2	3	4	5
5. Approachability	1	2	3	4	5
6. Passion for safety and health	1	2	3	4	5
7. Patience	1	2	3	4	5
8. Perseverance	1	2	3	4	5
9. Willing to compromise	1	2	3	4	5
10. Commands respect	1	2	3	4	5
11. Well-connected with a community of schedulers	1	2	3	4	5
12. Sensitivity to different types of people	1	2	3	4	5

APPENDIX G: Job Incumbent Demographics

Job Incumbent Demographics

Industry	Job Title	Gender	Age	Education	Tenure	Tenure Scheduling	% of Job Spent Scheduling	How Long Until Fully Trained
Health Care (ER Nursing)	Clinical Manager	Female	50	Bachelor's	28 years	15 years	5%	2 months
Health Care (Surgical Nursing)	Nursing Director	Female	53	Master's	2 years	3 years	10%	3 months
Hospitality Service (Restaurant)	Restaurant Manager	Female	50	High School	18 years	15 years	20%	2 months
Manufacturing (Meat Processing)	Manufacturing Supervisor	Male	49	Bachelor's	29 years	4 years	15%	6 months
Manufacturing (Electric Equipment)	Manufacturing Supervisor	Female	56	Bachelor's	32 years	12 years	10%	6 months
Manufacturing (Electric Equipment)	Processing Scheduler	Female	55	High School	29 years	8 years	5%	1 month
Public Utilities (Power Generation)	Operations Supervisor	Male	38	Bachelor's	6 years	4 years	7%	Still learning
Public Utilities (Service Technicians)	Utilities Supervisor I	Male	50	High School	29 years	8 years	15%	Almost immediately
Public Utilities (Mechanical Maintenance)	Transportation Department Manager	Male	49	Associate's	27 years	8 years	25%	10 months
Public Utilities (Dispatching)	Utilities Supervisor III	Male	53	Associate's	35 years	7 years	10%	2 years
Public Utilities (Dispatching)	System Operations Center Supervisor	Male	46	Bachelor's	5 years	6 years	12%	Almost immediately
Public Safety (Fire & Emergency Response)	Captain	Male	42	Bachelor's	21 years	3 years	3%	Still learning
Public Safety (Corrections)	Captain	Male	42	Associate's	16 years	14 years	40%	6 months
Public Safety (Police)	Assistant Director of Public Safety	Male	51	High School	26 years	15 years	1%	8 months
Transportation (Passenger Bus)	Transportation Manager	Male	50	Some College	28 years	24 years	75%	Still learning
Transportation (Passenger Rail)	Superintendent of Operations	Male	53	High School	32 years	15 years	1%	6 months

APPENDIX H: Qualitative KSAO Content Analysis Tables

Qualitative KSAO Content Analysis Tables

Table H-1. Content Analysis of Knowledge: Key Themes and Quotations from Job Incumbent Interviews

KNOWLEDGE		
Knowledge	**Key Themes**	**Quotations from Interviews**

1. Various designs used to schedule 24/7 work (e.g.,, fast/slow, forward/backward rotations)	▪ Types of schedules
	  ▪ names of schedules used in field
	  ▪ standard vs. non-standard
	▪ Info related to shift
	  ▪ type (e.g., rotating)
	  ▪ shift duration
	  ▪ consecutive shifts worked
	  ▪ how shifts cycle
	▪ Selecting schedule conducive to organizational needs
		"I adapted a work schedule, and I believe it's called in our industry the DuPont schedule. It's a 12-hour, rotating shift that's comprised of 3 weeks of alternating day and night shifts three 12-hour shifts and four 12-hour shifts in a row with days off in between and it's a 28 day cycle…"
		"For us, being a public safety entity, like I said we're 24/7, 365, so we have to come up with a schedule that schedules people here year-round. There are a number of different schedules that public safety departments use to do that. We've chosen the 2–10s and 2–14s because it's conducive to what we need to have here."

2. The impact work hours have on health, safety, and performance	▪ Effect of schedule on health
	  ▪ physical (e.g., heartburn, caffeine effect, sleep schedule)
	  ▪ emotional
	  ▪ mental (e.g., home schedule)
	  ▪ psychological
	▪ How schedule influences performance
	  ▪ job satisfaction
	  ▪ productivity
	  ▪ abilities
	  ▪ people's moods at work
	▪ How work hours interact with safety
	  ▪ impaired abilities
	▪ Implementing solutions to reduce negative impact of work hours
	  ▪ "mix" long and short shifts
	  ▪ dissemination of info to employees
	  ▪ "take it a little bit easier" on certain shifts, e.g., night shift
	  ▪ allow workers time to decompress
		"…whoever does scheduling has to have a good understanding of what it's like to be for someone who does work those off shifts to have an understanding of what it does to your body and how it makes you feel if you don't have a decent schedule because it's a big part of what job satisfaction, safety, if you are chronically tired because your schedule is terrible potentially you could be putting yourself at risk, you could be putting your patients at risk."
		"But he [police chief] has said that he doesn't want to see all 12-hour shifts, he would like to see a mix in between…"
		"I think 12 hours and 13 hours is ok but I think you start to get at 14 and 15 hours we start losing some of your abilities."

3. The physiology of sleep as related to performance	▪ Education about sleep
	  ▪ dissemination of info to employees
	  ▪ learning industry standards & trends re: sleep
	  ▪ importance of sleep education
	▪ Consistency of sleep schedule
	  ▪ problematic to disturb sleep schedule
	  ▪ difficult to have inconsistent sleep schedule
	▪ Knowledge of sleep's importance
	▪ Knowledge of coping strategies with fatigue
		"We are also looking at…how companies are being held liable for workers falling asleep on their way home from work."
		"…if they get too acclimated to the night shift then it makes it that much harder to switch over to days…"
		"And [I] had an understanding I think of how important sleep is…"

4. Industry-specific operations and regulations (e.g., OSHA, USDA, HOS)	▪ Industry knowledge
	  ▪ products (e.g., equipment)
	  ▪ trade shows
	▪ Restrictions (e.g., federal & state law, city contracts)
	▪ Local trends that impact schedule
	  ▪ city becoming metropolitan
	▪ Knowing practices for similar organizations
		"…knowing meat in general would help as far as knowing what you're even doing…like you are at a pork plant, and these are the products."
		"You have to watch those and there is so much more equipment coming out, new technologies that when you go to the shows and the literature in the magazines that you comb through all the time you may see something new out there that would be a good fit for our area…"

5. Company policies and procedures, including interactions with unions and union contracts	▪ Union contract
	  ▪ shift restrictions (e.g., days in week, duration, overtime)
	  ▪ procedural restrictions (e.g., review schedule with employees, precedence of seniority, bidding process)
	▪ Machinery
	  ▪ capability
	  ▪ parts (e.g., types of breakers, availability of parts)
	  ▪ user qualifications
	▪ Operations
	  ▪ different jobs (e.g., dispatch)
	  ▪ areas of operation (e.g., production)
	  ▪ knowing organization as a whole
	  ▪ budget
	  ▪ services offered
	▪ Policies
	  ▪ calling into work
	  ▪ emergency
	  ▪ swapping people
	  ▪ promotions
	  ▪ accounting
	▪ Employee base
	  ▪ number of employees, departments
	  ▪ employee qualifications and certifications
	  ▪ average number of working years
	  ▪ ability to handle stress
	  ▪ skill level
	  ▪ hiring trends
	▪ Client base
	  ▪ number served, areas of service
	  ▪ client needs
	▪ Restrictions other than union
	  ▪ capital budget
	  ▪ court times
	▪ Hierarchy
		"But somebody could walk in here and be supervisor and not know the actual machines and stuff, and just through on the job training they could probably learn in that way. It's just a little more difficult when it comes to the scheduling because you're not, you don't immediately think of the flow of the material going through and how if you don't have somebody sitting here it's going to affect the whole line. So knowing the flow really helps."
		"I put down here the most important part is the technical part, knowing what the equipment is used for and all the systems that the equipment includes versus a bigger derrick versus an aerial device. You would have to know how the utility works, what the equipment usage is, the parts availability, the money restrictions that you are working underneath as far as operating budgets and capital budgets. That's really in mind the lowest part the technical part is most important to me."
		"Yeah just understanding the contract, you have to know the contract, the rules, the regulations, the dos, and the don'ts. I think that would be key I would say to someone is know the contract before you walk in there because the other side of the table they know the contract exactly."

6. Tools and technologies available for scheduling	▪ Knowledge of program they are using by hand
	  ▪ software (Accustaff, Duty Supervisor Manual Time Release Rest Period Matrix, shiftwork.com)
	▪ Basic knowledge of software capabilities (manipulate, put people in)
	  ▪ One located & selected program by doing
		"We use Accustaff as an organization. It's a software program, a scheduling program and basically the two advantages of it are is its computerized, so it's easy to read, and then the other one is it gives me numbers at the end so that you know I have a lot of people to schedule."

	Internet search
	▪ Know who to call for support
	▪ Need for training on the software
	  ▪ one received formal training
	  ▪ need to learn	

7. Staffing analysis	▪ Employee-related information
	  ▪ number of available employees (e.g., in general, for particular shift)
	  ▪ duties
	  ▪ job classifications
	  ▪ experience level
	  ▪ ability level/strength
	▪ Responding to business needs
	  ▪ matching number of shift workers with that day's business (e.g., patient census)
	  ▪ making sure to have backup person on call
	  ▪ changing times due to shifting needs
		"So we try to match up our officers with the amount of calls for service that we were having. We staff heavier from six at night to three in the morning than we do any other time of the day. Six at night to three in the morning I have a minimum staffing of seven officers over here and the rest of the time it's five."
		"If we only had 12 patients, we'd require three nurses, one nursing technician, and one secretary. This yellow line is our predicted average daily census on the unit and that means that we need five nurses, four nursing technicians, and like one and a half secretaries. And that's the same on evenings. Then nightshift they'd require four and three…Nursing is quite, we're benchmarked against both a productivity company and also there's also a database of national nursing quality indicators that our staffing is benchmarked against also."

8. Policies and procedures concerning the design of an organization's schedule	▪ Shift description
	  ▪ start and end times
	  ▪ number of workers per shift and what jobs they perform
	  ▪ shift cycles (e.g., fixed or rotating)
	  ▪ minimum number of staff per shift
	  ▪ proportional vs. volume-driven
	  ▪ responsibilities of each shift
	  ▪ implications of shift (e.g., bonuses or rewards for certain shifts)
	  ▪ pay differences associated with shifts(e.g., long hours equal higher pay rate, paid lunches)
	▪ Changes in schedule
	  ▪ calling in sick
	  ▪ scheduling vacations
	  ▪ notifying employees of changes
	  ▪ calling someone into work (e.g., minimum pay, voluntary)
	  ▪ factors in determining priority (e.g., seniority)
	▪ Restrictions
	  ▪ overtime
	  ▪ contract
	▪ Scheduler's role
	  ▪ give feedback
	  ▪ approve schedule
	▪ Procedures
		"A couple of my spreadsheets, well I think they all do, is driven also by capacities. So my spreadsheets that do have out for production, knowing that they can make 500 cases a shift, I don't schedule them 700 knowing that that's not feasible. So I mean I also have yes the working tool of capacities and packs per man hour and everything about to also put on an effective schedule."
		"Yeah basically once we have jobs what we do is advertise the issues and over a period we advertise the issue and let the employees bid the positions. After the employees see the bids a line of bids is read and after everybody bids a job they are ruled into that position and that's the cycle pretty much what we go through. And we do this cycle twice a year for the crew and basically that's what we do we pick the schedule, we put the jobs together, come to an agreement with the field, and then the CMS goes together to rule and agree on the couplets, we agree upon the couplets, we make the jobs, advertise the jobs, and we bid the jobs, and then we implement them on a certain day."

	▪ production schedules ▪ maintenance (scheduled and unscheduled) ▪ holiday, vacation, overtime, sick leave ▪ time in advance schedule gets done (e.g., 1 day ahead, 6 weeks) ▪ emergency (e.g., power outage) ▪ union procedures (e.g., bidding) ▪ theory behind procedures ▪ Scheduling inputs ▪ capacity (e.g., availability of equipment, packs per hour, police canines) ▪ minimum spread time between shifts ▪ restrictions on working alone ▪ overtime ▪ business demands (e.g., service calls, operational orders, corporate office needs) ▪ supervisor feedback ▪ employee preferences ▪ managing inputs	"Well, they need an infinite knowledge of what we do, especially from the needs of the department and also they have to be aware of all the contractual things in the union that need to be brought into the thought process when doing the scheduling."
9. Indicators of an employee's fitness for duty	▪ Qualifications and knowledge level ▪ requirements for machinery ▪ training ▪ experience level ▪ skill level ▪ capability ▪ familiarity with different jobs ▪ Health indicators ▪ general knowledge of how employees are affected by stress ▪ self-care outside workplace (e.g., eating habits) ▪ fatigue ▪ not under influence of drugs ▪ Other indicators (e.g., appropriate uniform)	"Basic understanding of people, what kind of stress they will be under depending on what their schedule is in terms of my job and my previous job as a lieutenant scheduling people I was looking at how tired are they, what skill level they are at, how capable are they in this particular post, is it new to them or something they've done for years, and those kinds of combinations."
10. Employee training programs specific to shift work	▪ Self-taught regarding schedule ▪ Attending seminar on shift scheduling ▪ Relying on previous experience and supervisor input	"Interviewer – So in essence nobody here taught you schedule? Job Incumbent – No. Interviewer – You really taught yourself? Job Incumbent – Yes." "…Circadian Technology is the company. I went to a seminar and got this hand book it was a three day seminar and it talked about numerous different shift schedules that are pros that are cons, what industries tend to use different types of shift schedules…"
11. Human resource systems		
12. Basic ergonomics and human factors	▪ Avoidance of repetitive tasks ▪ Consideration of ergonomics	"And there are sometimes that I have to rotate if it's a highly repetitive job…" "…it all depends on how you get to know the people and how to improve

		their training…"
13. Program evaluation		

14. The social implications of shift work	▪ Employee patterns in volunteering for shifts
	  ▪ frequency of asking for volunteers
	  ▪ overtime vs. voluntary
	  ▪ some shifts likelier to volunteer (e.g., second shift not as likely)
	▪ Employee absences
	  ▪ calling in vs. no show
	  ▪ frequency of people calling in sick
	  ▪ leaving before shift is over
	▪ Considerations in scheduling two employees together
	  ▪ how well they get along (e.g., bickering)
	  ▪ potential problems from two employees having worked together for a long time (e.g., poor communication, potential for error, bad habits, familiarity)
	▪ Implications of certain shifts
	  ▪ impact on social life (with second shift having social life is difficult)
	  ▪ some shifts require more employees
	▪ Preferences regarding shifts
	  ▪ preferring two consecutive shifts
	  ▪ consistency in wanting same shift
	  ▪ popularity/dislike for a certain shift (e.g., preference for days)
	  ▪ factors influencing preferences (e.g., hunting season, school, age, time with kids, interests, pay bonuses, desire for variety)
	▪ Impact of schedule
	  ▪ how schedule effects lifestyle
	  ▪ home, life, sleep
	  ▪ flexibility – can allow for second job
		"The only thing I do is check over to see if there are certain people, I have certain people who really shouldn't be close to each other because they are having personal issues and I have to keep them apart. So when I go through the ECAS I have to actually look and see where they are placed on a daily basis so they aren't close to each other."
		"Because we work second shift, and it's basically everybody else on like first they will have their social time they can leave work at three o'clock in the afternoon and they actually have a social life. Second shift people they [say] it's hard to have a social life at all."
		"I don't see how you could work a rotating shift and have kids running around the house screaming…it's hard having the younger guys who are on shift who have working spouses…And that's where the seven day stretch becomes so valuable. By the time we get to the end here they are pretty burned out."

Table H-2. Content Analysis of Skills: Key Themes and Quotations from Job Incumbent Interviews

SKILLS		
Skill	**Key Themes**	**Quotations from Interviews**
1. Communicating with various levels of an organization's hierarchy	▪ Communicating with the people they are responsible for scheduling ▪ notifying employees of schedule (e.g., phone, posting on board, verbal, physically handing it to them) ▪ strategies for asking people to come in outside of their work hours (e.g., calling people on list according to seniority, asking one shift to stay longer) ▪ answer questions related to schedule ▪ Communicating with supervisors ▪ having supervisor approve schedule ▪ relaying employee needs ▪ working closely with supervisor ▪ Reporting new information regarding schedule	"I try to be [a good communicator]. Communication to me is like it can be the greatest asset or the largest hindrance in completing the mission there is. You get to the root cause of most conflicts and it has to do with poor communication between the parties involved." "Sometimes we feel like we are really working our staff hard and corporate wants us to meet this percentage of labor and we say, yeah but can you give us a couple more percentages? You know what I mean? Let us put a little more labor on, just so we don't burn out our employees, you know?" "You have to have a good interpersonal because even though a lot of what I have talked about is paperwork, you have to talk to the people that are being transferred. You have to talk to people if there is a schedule change. You have to be able to do it in a way that they understand and it's not offensive or abusive or it's because I said so type of mentality."
2. Converting complex topics to simple explanations	▪ Explaining scheduling process and rationale behind it	"…because they don't want to see a mathematical formula, they want you to sit down and explain this is what we are going to do and be able to answer to them why are you going to do it that way, does it make sense for you to do it that way, how did you come to that conclusion."
3. Using analytical/statistical applications	▪ Mathematical skills ▪ developing assignment matrix ▪ Accounting	"Then once I have the number of bodies and I have the number of presses, which would be the 38, you can do basically a mathematical layout of one person runs…First, I have to figure out, like I know the available, I know I got a bucket of x amount of set ups, well mathematically I have to come up with how many presses they need to run. Once I have that number then all I got to do is just go through and cross out the ones that are priority." "Although my background in math fed right into that you know we talked about creating the shift relief factor and figuring out how many positions you need. It's all about understanding math…How different factors will affect it." "Math I would put right at the top and if you can't understand mathematical formulas and how changing one part of that formula will affect another part then there is no way you can set and design scheduling systems. You will fail, so that is key."
4. Problem solving	▪ Handling equipment failures ▪ Managing changes in employees' schedules ▪ taking time off (e.g., medical leaves)	"…I've given the job of the schedule to one of the leads and pretty much it's her job to take care of it cause it's like seven people. Well she brings it to me still because I can't figure this out look at it I

	▪ Handling changes in organization's scheduling demands
	  ▪ unexpected orders
	  ▪ random fluctuations in client needs
	  ▪ weather: expected (e.g., summer trends) and unexpected (e.g., storm)
	▪ Selecting optimal scheduling strategy
	▪ Knowing who to go to for help
	▪ factors in selecting who (e.g., familiarity with problem)
	▪ Balancing input and employee needs
	  ▪ consider work hours impact
	  ▪ consider inputs (e.g. federal and state laws)
		know you'll find how to make it work. And I don't know why it's pretty easy for me to look and say ok you need to move this person here, move this person there, then you'll get it all covered and then this will be they will have their days together. She says I don't know how you do it. So some of it is I think how you're made. I don't know. I'm not sure, it's a skill you might be able to teach but it might be more difficult for them."
		"You need to have the ability to solve problems objectively and uniquely…I'd say logical thinking, problem solving."
		"Basically it's our responsibility to take the current operating train schedules along with the rules out of the service rules and federal rules to make efficient train couplets and we try to do this by making the most efficient couplets and that's basically putting two trains together to make a job that will fit with employees."

5. Interfacing with multiple systems	▪ Combinations of different systems
	  ▪ products and machinery
	  ▪ software, other plants' processes, and shipments
	  ▪ operating schedules and laws
	  ▪ inventory and software
	  ▪ machinery and sales
	  ▪ department mission and organization's needs
	▪ Multitasking
		"He puts those on a press, in other words, he will say like press one, he will schedule this part number this part number and so many of each one. And he will put those in a priority order and he does that two or three times a week. He changes that because of the way our other plants order the parts. That effects how we produce our parts."
		"I just basically have reports from SAP that print with all the information as far as what we have on inventory, what other plants are making that are bring into the DC, and what our shipments would be. So that is basically my tool when I make my schedule."

6. Using technology	▪ Uses for software
	  ▪ run reports (e.g., number of patients, jobs that need to run)
	  ▪ managing inputs (e.g. look up orders, forecasting clients, overtime)
	  ▪ employees (e.g., assign duties to people, swap shifts, making online calendar accessible to employees)
	▪ Types of software
	  ▪ scheduling systems (e.g., Accustaff, shiftwork.com, Mitis, OpCrew)
	  ▪ spreadsheet (e.g., Excel)
	  ▪ database (e.g., Access)
	  ▪ other (e.g., MIS, Outlook, VisiPro, VSSPro, Microsoft)
	▪ Noncomputer related tools
	  ▪ phone
	  ▪ intercompany radio
	▪ Comfort level with technology
	  ▪ made job easier
	  ▪ received continuing education regarding software
		"Well that would be ECAS and then for the production schedules I have to our MIS program and the FAS programs to see what work is actually needed for that day. When products are due to see if there are certain orders and customize orders that have to be sent out that day."
		"…so what it does is it prints out numbers…so for 0700 it tells me on which days I have eight people coming in and which days I have six so I can se my holes pretty easily when I'm working on it. That way I know ok gosh I may need to find another nurse for this day and another nurse for that day and so its broken down that at 7 a.m. I have this many coming in, 9 a.m. I have this many coming in, 11 a.m., and so that way very quickly I am able to look and find where my holes in my schedule are so that then they can work."
		"…there was a lot of actual computer work to what I do. Our rosters which I maintain are spreadsheets if I didn't understand Excel well then I couldn't maintain them and keep them running…When they are asking for analysis that is done through, you are pulling out of an Access database and putting it into an Excel spreadsheet and producing charts, graphs,

		whatever they need at the time. So there is actually a heavy technological need for my specific position."
7. Troubleshooting schedule systems	▪ Making organization run more efficiently (e.g. reducing layover between runs and eliminating "dead head jobs")	"I am troubleshot for the last 20 years." "I've had very good luck in eliminated dead head jobs and making people work at both directions and getting all of this done."

8. Recognizing the warning signs of potential fatigue, health, and safety issues	▪ Health issues
	  ▪ considering shift-related physical activity
	▪ Fatigue
	  ▪ giving people enough time between shifts
		"But then you have to start shuffling those people around and you are trying to avoid putting somebody clear over on we'll call it row one and then clear over on row five. So that they don't have to walk 500 feet. So that's up to me as an individual to try to do the best job possible to keep their presses as close together as possible." "The problem was that our call volume increased to the point where the seven 12-hour nights, we were burning our people out, so we went to a more conducive schedule that doesn't burn our people out. It gives them enough recoil time in between their shifts, especially the night shifts, to not become fatigued and burn our person out."

9. Interacting with people	▪ People skills
	  ▪ support
	  ▪ interpersonal
	  ▪ listening
	  ▪ communication
	  ▪ helpful
	  ▪ taking things personal
	▪ Understanding of people
	▪ Knowledge of people
	▪ Resolving conflicts
		"Your people skills are probably one of your most important jobs" "So they have to know the people, the tribal knowledge of the people. Their personalities, their needs, a little bit about their home life of course…"

10. Observation	▪ Observe people ▪ Observe shift work	"Being insightful, having good observation skills as far as knowing the people who work for you so that when you are pairing these two people up for the next 2 years you have an idea what to expect out of that shift both from a technical side and from a personalities involved." "I am out there so I can actually support them and observe what is going on."
11. Keeping detailed records	▪ Constantly monitoring schedule (including materials and books) ▪ Keeping track of overtime and holidays ▪ Organizational skills and attention to detail	"So you have to keep track of everything. You have to keep track of your materials, your boxes, everything just so you can do the scheduling." "I mean you have to pay attention to detail." "You have to keep track of who you've given an extra holiday off. There's a lot of little things with scheduling of 24-hour people around the clock that even though the system could look at it, you really do need to keep track of."
12. Managing collective agreements	▪ Negotiating ▪ Responding to union requests ▪ Maintaining good relations with union contacts	"It's all experience and kind of what XXX said it's not rocket science to actually do the schedules and the couplets where you really gain your experience, knowledge, and expertise in scheduling is through the learning the negotiation process that management has to go through with the union leadership. That takes probably a greater skill than

		the actual development of schedules." "… what it boils down to is really being able to sit and negotiate and come out the room with an agreement. Sometimes you don't and we had this pass go around where you don't come to an agreement and you have to take the tact that listen this isn't a democracy I'm asking for your opinion and I'm asking your help but if you aren't going to work with me then we are just going to impose what we are going to impose and you do what you've got to do and we are going to do what we are going to do."

13. Working in teams	▪ Unity to achieve common goal
	  ▪ mention of "together"
	  ▪ negotiating
	  ▪ allowing others to take the lead
	  ▪ reviewing schedule
	  ▪ receiving routine updates as a team
	▪ Seeking & receiving feedback
	▪ Support & backup
	  ▪ complementary strengths
	  ▪ relying on other teams
	▪ Team members
	  ▪ leaders of the lines
	  ▪ in-house & outside schedulers
	  ▪ people getting scheduled
	  ▪ teams helping each other
		"…we are all in this together and as long as we work as a team there isn't anything that we can't achieve…"
		"…one of the things I learned was talk to the guys that work them; they are the ones that have the knowledge. I have a good idea but I want their input …"

14. Leading people	▪ Managing tasks & behaviors
	  ▪ subordinates report to scheduler
	  ▪ approve schedules
	  ▪ firm with other people
	  ▪ hold people accountable
	  ▪ staying "in control"
	▪ Teaching/instructing/advising
	▪ Delegating roles & responsibilities
	▪ Handling interpersonal issues
	  ▪ organizing people
	  ▪ knowing & understanding employee needs & preferences
	▪ Creating own rules
	▪ Motivating employees
	  ▪ building confidence
	  ▪ willing to substitute for employee
	  ▪ keep employee stress levels down
		"I don't want to put them into a situation again where they are set up for failure, because they don't know what to do. I try to give them all their information that they would need to perform this task and be successful at it."
		"I don't try to be a dictator in the position here."
		"We will start with that and I mean if I have a lot of choices, I will pick the strongest server."

Table H-3. Content Analysis of Abilities: Key Themes and Quotations from Job Incumbent Interviews

ABILITIES		
Ability	**Key Themes**	**Quotations from Interviews**
1. Think independently	▪ Developing new ideas/nonconventional thinking ▪ Taking initiative	"I had to have a lot of personal motivation to go out and gather it." "So in order to do that you had to be able to step completely out of the box of where anyone had been for the last 8 or 9 yr and completely rewrite what was done." "Me personally, since I'm the one who, I won't say designed it, but I'm the one who initiated it, set it up, the way we are going to use it…"
2. Identify and manage risks		

3. Self-evaluate to gauge success	▪ Ways shift workers are self-evaluating
	  ▪ regular review
	  ▪ consulting with contacts
	  ▪ determining shift worker and manager expectations
	  ▪ experimenting with new ideas
	▪ Knowing impact of scheduling processes on success
	▪ Changing inefficient or inadequate schedules
		"I can do that, I can sit here and make decisions but are they going to be the right ones or are they going to be with all the input that I could have gotten and all the information I could have gathered is the best way to do it and I feel that is."
		"We actually review shift relief and how it is going on a regular basis."
		"Like I said, our scheduling came out of a need to change because the schedule that we were previously on, wasn't going to work anymore…because of call volume, and it just wasn't a good schedule."

4. Persuade others	▪ Motivating employees to action
	  ▪ calling people into overtime
	▪ Who they are persuading
	  ▪ shift workers
	  ▪ upper management
		"I mean it all depends on you know you get to know the people and how to improve their training and how to get them to do things for you so you can put them in different spots and get the best for your buck if you want to call it that."
		"We did a presentation for the deputy of commissioner; they liked what they heard…"

5. Ask the right questions and know where to find the appropriate answers	▪ Ways to find right answers
	  ▪ software
	  ▪ colleagues
	  ▪ tech support
	  ▪ research
	  ▪ contact labor relations
	▪ Topics they are able to find answers to
	  ▪ accounting
	  ▪ software
	  ▪ budget
	  ▪ policy
	  ▪ labor
		"And helpful, because people will sometimes will ask questions like maybe they got dinged on their yields and they know because I know accounting they can come to me to get an answer, print them a report, look in the system, or look in specs."
		"We also will do audits for him, investigations if it comes up, like if someone at the union complains that the overtime was hired appropriately, he will send me in and I will go into the facility and research whether it's the following policy or not and then I respond directly back to him."

6. Think critically about problems	▪ Analytical/logical thought
	  ▪ looking at problem from different angles
	▪ Evaluating and improving efficiency
	  ▪ crew optimization
	▪ Wanting to know rationale
		"Ok. I sent out some of my crews also, which involved shift workers and you hit the nail on the head. There I had to start tweaking the system again and I had to get the Excel spreadsheet going and see what shift they were on and start filling their shifts because I didn't want to be depleted back here. Sure it's nice to help somebody else out, but we have our own stuff to take care of also. So I had to be selective on who I chose to go out there and I

		tried to grab my guys that had their fixed schedule first so that it didn't screw up the rotation too much." "…the bottom line is money you know that we want to make things as efficient as possible." "I guess you would have to be able to think analytically. Ok, I have this, then I can have this, then I can have that. You know, you have to be able to sequentially be able to see a pattern."
7. Balance conflicting demands	▪ Shift restrictions ▪ number of workers ▪ overtime ▪ union contract ▪ vacation ▪ certifications ▪ rest period ▪ ensuring employees have 40 hours ▪ Scheduling policies as inputs ▪ corporate rules ▪ military leaves ▪ bereavement policies ▪ various types of schedules ▪ seniority rules ▪ Multitasking ▪ managing and knowing inputs ▪ matching resources to shift coverage ▪ Employee needs and demands ▪ school schedules ▪ restrictive duty ▪ fatigue assessments ▪ various cultures & languages ▪ evaluating benefit to employees ▪ care not to overburden workers ▪ employee preferences	"If you can't multitask being a supervisor, then you are going to struggle." "We look at the previous schedule from the year before and see what worked and what didn't work and if there was anything we wanted to tweak. I look at the amount of officers that I'm given from the Chief and it if there is going to be any spots that I am going to have to lock, which won't be able to bid into. I look at our minimum staffing, what numbers I am going to have to have on the street at any time and then I am going to want to staff at least two about that, so that I can let two officers off at least...Then I get feedback from the sergeants that worked the area and ask them to get feedback from the officers that worked the area and ask them what they think of the schedule, areas that they would like to see changed, or what they like or if they like the schedule just as it is." "...we have male, female, black, white, Hispanic, Albanian, Cuban, Mexican, I mean I don't think there is anyone we don't have and that means you have different levels of you know for a lot of our employees English is a second language and these are all the things that have to be juggled everyday to keep the moral up, to keep people working, and to get the product out. It's a lot and it's a lot of things that we sometimes take for granted."
8. Recognize a problem and need for change	▪ How they realized there was a problem ▪ employee feedback ▪ previous experience ▪ Initiating change ▪ modifying scheduling framework, like how many people are needed in each shift ▪ changing shift times ▪ adding exercise equipment	"And we are out there busy and my team we used to have a two-thirty start time for our second shift and a year ago I changed it, we start at four o'clock in the afternoon because my team is very busy up until four in the morning. Other teams may shut down at 2:30 I move mine to four in the morning so that I have better coverage and more officers...I have three school resource officers that work until four so if something does go on during the day and I need resources I still have school resource officers that I can pull up until four o'clock. But at two-thirty in the morning there are no other resources around here that can help." "You need to be able to look at what people have done before, analyze why it did or didn't work, and come up with a potentially an entirely different way of looking at. The change in the shift relief was a great example of that. We completely rewrote how that formula went together and what it took into consideration."

9. Be flexible	▪ Thinking on feet ▪ Dealing with constant changes to schedule ▪ hourly vs. daily vs. weekly ▪ "on the fly" orders ▪ tardiness and no shows ▪ department needs ▪ production changes ▪ weather ▪ equipment failure ▪ Making adjustments as needed ▪ moving people around	"…when I arrive at work I will check with the guard or my phone to see if anyone called in that will be missing and then I can maybe adjust my schedule right quick that day." "Yes when the storms blow in then I have to tweak the shift a little bit. If someone had to work a 16 the night before and it ran even an hour into their sleep time then I have to adjust and get someone else even if I have to go to a different department to grab a lineman to help fill that shift I will do that." "Some times you fly by the seat of your pants depending upon what the situation brings in. You might come to work thinking it's a normal Monday morning and a storm has hit and all bets are off and you go into emergency mode and we have experienced a lot of that through the years and that's the fun part of the job."
10. Read and comprehend ideas in writing		
11. Express oneself clearly through speaking and writing	▪ "Good communicator" ▪ Modes of communication ▪ email ▪ post on bulletin board ▪ verbal	"I try to be [a good communicator]. Communication to me is like it can be the greatest asset or the largest hindrance in completing the mission there is. You get to the root cause of most conflicts and it has to do with poor communication between the parties involved. Unfortunately when you're dealing with shift workers a lot of the communication from my stand point is via email...so I've had to develop new ways of communicating and I've learned that email is not the best way to communicate with anyone. You know you can write a sentence that seems perfectly straightforward and innocuous and send it and it gets received a totally different way. You have to be careful what you put in an email there is a time and a place for an email and there is a time and a place for verbal communication." "You need to be able to write well so that you can communicate it."
12. Cooperate	▪ Negotiating ▪ Responding to union requests ▪ Maintaining good relations with union contacts	

Table H-4. Content Analysis of Other Characteristics: Key Themes and Quotations from Job Incumbent Interviews

OTHER CHARACTERISTICS		
Other Char.	**Key Themes**	**Quotations from Interviews**
1. Integrity	▪ Fairness ▪ rotating people on shifts ▪ not giving preferential treatment	"I think one of the things that I feel strongly about is and sometimes probably to a fault is I believe in fairness. I try to look at things and try to make sure that it's fair for everyone and that I am not going to look at nurse X and always make sure they get it their schedule just because they want it because they are the one that's going to complain the most or this nurse over here because they never complain. I think it needs to be fair for everyone." "And then also when we rotate shifts every 2 years I look at how many people have worked how many holidays so that I'm not always rotating someone into another schedule where they just lost their Christmas again or their Thanksgiving again…it can make it kind of complicated after the second or third swap but hopefully you know by that time everybody has worked with everybody and everybody has had some time off on the holidays." "I treat everybody equal. I treat everybody equal on overtime. I play no favoritism."
2. Previous involvement with shift work systems	▪ Types of previous jobs ▪ same job and department as people they are now scheduling (e.g., staff nurse/night nurse, dispatcher, sergeant) ▪ Navy service warfare officer ▪ management ▪ What they learned from their experiences ▪ importance of sleep (e.g., firsthand experienced with uninterrupted sleep due to schedule) ▪ role of schedule in job satisfaction and safety ▪ exposure to different aspects of job ▪ how to interact with people ▪ impact of being away from family for long periods of time ▪ empathy ▪ getting familiar with company policies, including scheduling processes	"[When asked if naval experience helped in developing current abilities and personality] Invaluable to me, because as an officer as well as an enlisted guy because I got to see a little bit of both sides of the fence. You spend seven months at sea with a group of guys you get to learn a lot about people that you wouldn't necessarily learn in a cubicle in a company or as a you know tie down at the end of the hall. So I think personally I think it was invaluable. I wouldn't even be sitting here without it. I don't know what I'd be doing but I know I wouldn't be doing this job right now. So to me it was invaluable." "Well I am going to say 99 percent of the time in my job we are going to hire within and we are going to hire someone who has been through this…it's going to take a little bit more than shiftwork.com to get them through this…you have got to know how they feel, how these guys feel after being out in the field and doing the chaotic storms or something safety wise. You almost have to be one of them to do this job." "I think the knowledge that they would need would be that I feel that would be important is that they would need to have worked shift work before. Nights, seconds, days, different days off, and 8-, 10-, 12-hour shifts, I think if they had that background I think they could take a lot of that experience that they had, which would make them better at scheduling. I think that if you came into this and you never been a police officer that has had to work these different shifts the 8, 10, and 12 hours, and had court and overtime and been called in on different occasions I think it would be tough to schedule. I think that is something they would need...Something where as if you experience it I think you can feel the pain of the schedule you are creating. You just can't create it based on calls for service

		time date only or you can't do it based on you know something like 8 hours where you think it will be best for the captain or for overtime. You have to bring in everything."
3. Honesty	▪ Honesty in assigning shifts	"I think I'm honest with people you know I am not trying to put them on a job just because I don't like them. And I would love to put certain people on jobs every single day because I know they do better than others so I try to be honest about rotating everybody even though they might not be as good on the machine as I would like."
4. Discretion		

5. Approachability	▪ Employees feel comfortable with scheduler
	  ▪ employees initiate contact
	  ▪ they are able to say no
	▪ Functioning as resource for employees
		"People feel very open as far as coming in and talking to me at any time."
		"They say I am the go to person."

6. Passion for safety and health	▪ Dissemination of information to employees
	  ▪ newsletter
	  ▪ diet advice
	▪ Adjusting workplace to improve health
	  ▪ treadmill for late night shifts
	  ▪ sunlamp
		"I do subscribe to we have a monthly newsletter that we pay these people to give out a monthly newsletter for shift workers and I post that on the board out there every month and gives them health tips you know how to avoid indigestion you know gastric problems from working nights. How to maximize sleep just different heath tips on working shift and there is also one for supervisors as a email that comes out on a monthly basis that's got all these different articles that you can read for making management aware of the needs of shift workers you know...There was a handbook that I came back from that conference with and I gave it to the guys and it opened some guys up to hey you know I shouldn't eat a huge meal at four o'clock in the morning you know right before I go to bed you know maybe that's why I have heartburn when I wake up the next day or you know. We ended up one of the recommendations was to put the treadmill up in the control room so that if an operator is feeling tired rather then going and slamming two gallons of coffee that's going to interfere with his sleep when he gets off shift you know at two in the morning he can get on treadmill."

7. Patience	▪ Patience as job requirement ▪ Union does not allow for losing patience	"You have to have a lot of patience with people." "…as far as me yelling no. Besides my kids but no you can't lose your cool here. Oh no not with the union."
8. Perseverance	▪ Inner strength ▪ Dedication	"They [people being trained to do scheduling] know the rules, they have the dedication, and they have the desire to get promoted so therefore they have the desire to learn." "…you need to be strong enough to put the patients first and make sure you have enough coverage for your patients."
9. Willing to compromise	▪ Balancing different needs ▪ operational and personnel ▪ Compromising with union	"You have to balance it with you know operational needs versus personnel needs and this is the best compromise we could come up." ("But trying to get in from the union membership that might be losing several hundred thousand dollars over a year in overtime and having to listen to them say listen it's not me I'm going to have to

		listen to my constituents telling me and working out a compromise.")
10. Commands respect	▪ Not being gullible ▪ Firm ▪ Giving and earning respect ▪ Self-confidence	"People have a hard time trying to fool me on things, because I've been around here so long and I know the jobs. And they will try to come up and try to BS me and say, we ok we can't do that because of this is happening and I say NO, you can go over here you can get it done you don't have to wait for this person or that machine to run there's alternatives." "Well I think you could just , you have to be firm…you have to have somewhat of a backbone I mean because you are going told you are always doing something, you either overrun or you didn't make, so you kind of get talked to everyday. So I mean you have to have the ability to have a personality that would match that job number one. Because you are basically directing supervisors/department on what needs to be done, so you can't be a pushover." "…he respects the people that work for him and they respect him back."
11. Well-connected with a community of schedulers	▪ Consulting with schedulers in same industry	"I mean the way we developed this prior to that was we contacted a number of other power plants. I mean we did a lot of talking on the phone in the 2 years we were under the construction before we transitioned to shift work to find out how NPPD the kind of schedules they used how OPPD does their schedules."

12. Sensitivity to different types of people	▪ Lack of sensitivity
	  ▪ prioritizing organizational needs over employee preferences
	▪ Recognition of diversity among employees
	  ▪ ability levels, talents
	  ▪ strengths, weaknesses
	  ▪ gender
	  ▪ preferences
	  ▪ ethnic diversity
	▪ Relating to people
	  ▪ insightful
	  ▪ empathy
	▪ Applying sensitivity in workplace
	  ▪ announce schedule well in advance
	  ▪ allow employees flexibility in determining options
	  ▪ shortened shifts on holidays
	  ▪ allowing people with families to pick vacation time first
	  ▪ filling in rather than calling someone in
		"I do this as a courtesy for the family holidays, Thanksgiving, Christmas, and that kind of thing. I have the night team like this Tuesday night they will work until 11:30, I give them 8 hours of rest and ask them if they could come back in at 8 o'clock the next morning and then I will have both crews on days and then I will let them take off early. It's just a little deal I do for them and I try to always make sure that they get 8 hours off to rest and that includes their travel time and they realize that. But they would rather do that then come in and work that night shift right before the holiday, so it gives them a chance..."
		"So I know and understand what makes one person stressed out and another person can slump it off or bypass it."

APPENDIX I: Job Task Gap Analysis Summary Tables

Job Task Gap Analysis Summary Tables

Table I-1. Gap Analysis Summary Table for Job Tasks

Job Task	Difficulty Rating	Criticality Rating	Overall Importance Rating	Gap Level
Design and implement work schedules for employees, in accordance with staffing requirements and employee workload and availability. (1)	5.78	4.00	9.78	Moderate Gaps
Coordinate with management to establish policies and programs that are sensitive to the particular demands of shift work schedules. (4)	5.67	3.56	9.22	Significant Gaps
Implement schedule changes as necessary due to turnover, absenteeism, employee leave requests, and fluctuating workloads. (3)	5.44	3.44	8.89	Minimal Gaps
Review work production, employee performance, and accident reports in conjunction with shift schedules for potential shift-related trends and take action as necessary. (6)	5.11	3.00	8.11	Significant Gaps
Monitor work hours to ensure that staff members comply with administrative policies and procedures, safety rules, union contracts, and government regulations. (5)	4.11	3.22	7.33	Minimal Gaps
Maintain records of employee's work schedules and timecards and prepare reports as needed. (2)	3.67	2.44	6.11	Moderate Gaps

Note: Number in parentheses indicates original order of job task.

APPENDIX J: KSAO Importance Rating and Ranking Data

KSAO Data Tables

Column Definitions

Attribute – The characteristic analyzed, grouped by KSAOs, and listed in order of SME Importance Rating.
SME Importance Mean (SD) – The overall mean rating of importance provided by SMEs, with standard deviation appearing in parentheses. The mean can range from 1 *(not at all important)* to 5 *(extremely important)*. An asterisk (*) next to the mean indicates that there are significant differences between ratings of importance.
Job Incumbent (JI) Importance Rating – The overall mean rating of importance provided by job incumbents, with standard deviation appearing in parentheses. The mean can range from 1 *(not at all important)* to 5 *(extremely important)*. An asterisk (*) next to the mean indicates that there are significant differences between ratings of importance.
Difference in SME and JI Rankings – This number indicates the difference between SME rankings of importance and job incumbent rankings of importance. KSAOs that are ranked higher by SMEs have positive numbers, whereas KSAOs ranked higher by job incumbents have negative numbers. A zero indicates that SMEs and job incumbents ranked that KSAO the same.
Total Number of Codes in JI Interviews – This number indicates the total number of times the KSAO was coded as appearing in any of the interviews conducted with job incumbents. Higher numbers indicate that the KSAO was discussed more frequently in job incumbent interviews.
Total Number of Interviews Coded with KSAO – This number indicates the number of interviews where the KSAO was coded at least once. This number can range from 0 to 16 (the total number of interviews conducted). Higher numbers indicate that the KSAO appeared more often across interviews.
Percentage of SMEs Indicating Trainable – This number indicates the percentage of SMEs who reported that the KSAO could be taught within a formal training program. Any KSAO with a percentage over 50 percent should be considered for inclusion in a training curriculum.

Table J-1. Knowledge: Importance Ratings, Number of Content Analysis Codes, and Percentage of SMEs Indicating Characteristic Is Trainable

KNOWLEDGE						
Attribute	**SME Importance Mean (SD)**	**JI Importance Mean (SD)**	**Diff. in SME and JI Rankings**	**Total # Codes in JI Interviews**	**Total # JI Interviews w/ Code**	**% of SMEs Indicating Trainable**
The impact work hours have on health, safety, and performance (2)	4.44 (0.73)	4.53 (0.51)	0	16	8	100%
Industry-specific operations and regulations (e.g., OSHA, USDA, HOS) (4)	4.00 (0.87)	4.47 (0.62)	1	16	11	100%
Staffing analysis (7)	4.00 (0.87)	4.18 (0.73)	6	70	15	89%
Various designs used to schedule 24/7 work (e.g., fast/slow, forward/backward rotations) (1)	4.00 (1.32)	4.35 (0.61)	1	5	5	89%
Tools and technologies available for scheduling (6)	3.89 (0.78)	4.24 (0.75)	2	25	10	89%
Company policies and procedures, including interactions with unions and union contracts (5)	3.89 (0.93)	4.53 (0.62)	-4	67	16	78%
The physiology of sleep as related to performance (3)	3.78 (0.97)	4.00 (1.00)	2	24	10	100%

Employee training programs specific to shift work (10)	3.78 (1.09)	3.76 (0.97)	4	4	4	100%
Indicators of an employee's fitness for duty (9)	3.78 (0.83)	3.88 (1.22)	2	8	5	89%
The social implications of shift work (14)	3.67 (0.71)	3.88 (0.86)	0	54	14	89%
Policies and procedures concerning the design of an organization's schedule (8)	3.67 (0.87)*	4.41(0.62)*	-7	66	15	89%
Program evaluation (13)	3.67 (0.87)	4.29 (0.69)	-6	0	0	78%
Basic ergonomics and human factors (12)	3.44 (0.73)	3.71 (0.85)	0	5	2	100%
Human resource systems (11)	3.22 (0.67)	3.53 (1.01)	0	1	1	89%

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering. An asterisk (*) indicates that there are significant differences between SME ratings and JI ratings of importance.

Table J-2. Skills: Importance Ratings, Number of Content Analysis Codes, and Percentage of SMEs Indicating Characteristic Is Trainable

SKILLS						
Attribute	**SME Importance Mean (SD)**	**JI Importance Mean (SD)**	**Diff. in SME and JI Rankings**	**Total # Codes in JI Interviews**	**Total # JI Interviews w/ Code**	**% of SMEs Indicating Trainable**
Recognizing the warning signs of potential fatigue, health, and safety issues (8)	4.56 (1.00)	4.12 (0.86)	7	47	12	78%
Interacting with people (9)	4.00 (0.67)	4.47 (0.62)	1	31	9	89%
Troubleshooting schedule systems (7)	4.00 (0.71)	3.94 (0.90)	7	83	16	100%
Problem solving (4)	4.00 (0.73)	4.47 (0.51)	-2	3	3	89%
Observing (10)	3.89 (0.87)*	4.35 (0.70)*	-1	3	3	78%
Leading people (14)	3.78 (0.50)	4.65 (0.49)	-5	20	14	67%
Communicating with various levels of an organization's hierarchy (1)	3.78 (0.71)	3.94 (1.03)	4	1	1	78%
Using analytical/statistical applications (3)	3.78 (0.97)	3.76 (0.75)	5	41	12	56%
Keeping detailed records (11)	3.78 (0.33)*	4.35 (0.70)*	-5	2	2	78%
Converting complex topics to simple explanations (2)	3.67 (1.09)	3.65 (0.86)	4	17	7	89%
Managing collective agreements (12)	3.56 (0.88)	3.81 (1.17)	1	8	3	78%
Working in teams (13)	3.44 (0.44)*	4.35 (0.86)*	-6	11	7	100%
Using technology (6)	3.33 (0.53)*	4.18 (0.64)*	-6	22	11	67%
Interfacing with multiple systems (5)	3.22 (1.20)*	3.94 (0.56)*	-5	34	13	67%

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering. An asterisk (*) indicates that there are significant differences between SME ratings and JI ratings of importance.

Table J-3. Abilities: Importance Ratings, Number of Content Analysis Codes, and Percentage of SMEs Indicating Characteristic Is Trainable

ABILITIES						
Attribute	**SME Importance Mean (SD)**	**JI Importance Mean (SD)**	**Diff. in SME and JI Rankings**	**Total # Codes in JI Interviews**	**Total # JI Interviews w/ Code**	**% of SMEs Indicating Trainable**
Cooperate (12)	4.33 (0.62)	4.59 (0.67)	1	31	12	56%
Identify and manage risks (2)	4.33 (0.61)	4.24 (0.87)	7	14	8	89%
Be flexible (9)	4.22 (0.61)	4.59 (0.87)	-2	7	7	33%
Recognize a problem and need for change (8)	4.11 (0.53)	4.35 (0.97)	1	0	0	67%
Express oneself clearly through speaking and writing (11)	4.11 (0.75)	4.41 (0.71)	3	3	3	78%
Think critically about problems (6)	4.00 (0.70)	4.35 (0.87)	1	9	7	56%
Self-evaluate to gauge success (3)	3.78 (0.62)	3.82 (0.60)	5	8	5	56%
Ask the right questions and know where to find the appropriate answers (5)	3.67 (0.51)*	4.53 (0.71)*	-5	0	0	67%
Persuade others (4)	3.67 (0.44)	3.88 (0.71)	3	12	10	33%
Read and comprehend ideas in writing (10)	3.67 (0.70)	4.06 (1.05)	-4	5	4	56%
Think independently (1)	3.67 (0.80)	4.35 (0.73)	-1	0	0	44%
Balance conflicting demands (7)	3.44 (0.51)*	4.47 (0.50)*	-8	60	14	89%

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering. An asterisk (*) indicates that there are significant differences between SME ratings and JI ratings of importance.

Table J-4. Other Characteristics: Importance Ratings, Number of Content Analysis Codes, and Percentage of SMEs Indicating Characteristic Is Trainable

OTHER CHARACTERISTICS						
Attribute	**SME Importance Rating**	**JI Importance Rating**	**Diff. in SME and JI Rankings**	**Total # Codes in JI Interviews**	**Total # JI Interviews w/ Code**	**% of SMEs Indicating Trainable**
Integrity (1)	4.67 (0.71)	4.53 (0.62)	1	16	7	33%
Honesty (3)	4.56 (1.01)	4.59 (0.62)	-1	1	1	22%
Discretion (4)	4.33 (0.71)	4.41 (0.62)	1	0	0	33%
Patience (7)	4.11 (0.33)	4.29 (0.69)	3	2	2	33%
Perseverance (8)	4.11 (0.33)	4.24 (0.66)	4	3	2	33%
Passion for safety and health (6)	4.11 (0.60)	4.35 (0.70)	-1	1	1	56%
Approachability (5)	3.89 (0.33)*	4.47 (0.62)*	-4	8	6	33%
Sensitivity to different types of people (12)	3.89 (0.78)	4.12 (0.99)	1	12	7	44%
Commands respect (10)	3.78 (0.97)	3.82 (0.95)	1	6	3	33%
Willing to compromise (9)	3.56 (0.73)*	4.35 (0.70)*	-5	2	2	78%
Well-connected with a community of schedulers (11)	3.44 (1.24)	3.65 (0.86)	0	1	1	100%
Previous involvement with shift work systems (2)	3.33 (1.00)	3.47 (0.62)	0	26	9	67%

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering. An asterisk (*) next to the mean indicates that there are significant differences between SME ratings and JI ratings of importance.

KSAO Importance Ranking Tables & Graphs

Table J-5. Importance Rankings and Rank Differences for Knowledge Characteristics

KNOWLEDGE				
KSAO	**KSAO Label**	**SME Rank**	**JI Rank**	**Rank Difference**
The impact work hours have on health, safety, and performance (2)	K_impact	1	1	0
Industry-specific operations and regulations (e.g., OSHA, USDA, HOS) (4)	K_regulations	2	3	-1
Staffing analysis (7)	K_staffing	2	8	-6
Various designs used to schedule 24/7 work (e.g., fast/slow, forward/backward rotations) (1)	K_designs	4	5	-1
Tools and technologies available for scheduling (6)	K_tools	5	7	-2
Company policies and procedures, including interactions with unions and union contracts (5)	K_policies	6	2	4
The physiology of sleep as related to performance (3)	K_sleep	7	9	-2
Employee training programs specific to shift work (10)	K_training	8	12	-4
Indicators of an employee's fitness for duty (9)	K_fitness	9	11	-2
The social implications of shift work (14)	K_social	10	10	0
Policies and procedures concerning the design of an organization's schedule (8)	K_design	11	4	7
Program evaluation (13)	K_evaluate	12	6	6
Basic ergonomics and human factors (12)	K_ergonomics	13	13	0
Human resource systems (11)	K_resource	14	14	0

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering.

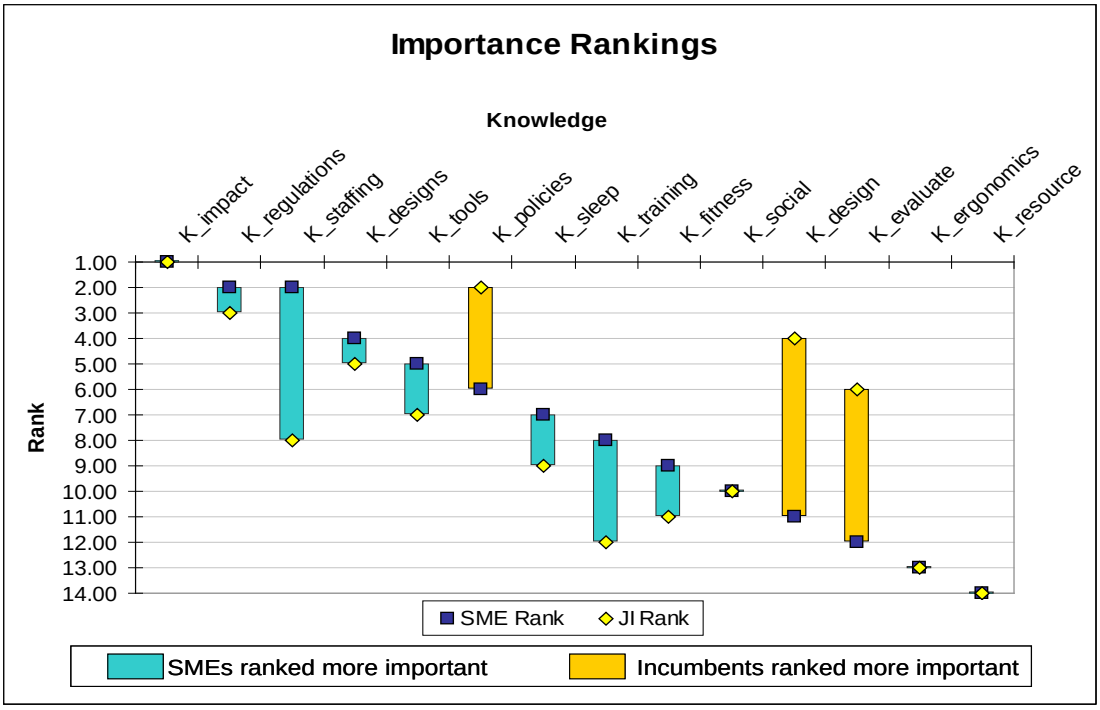

Figure J-1. Graph of Differences in Importance Rankings for Knowledge Characteristics

Table J-6. Importance Rankings and Rank Differences for Skills

SKILLS				
KSAO	**KSAO Label**	**SME Rank**	**JI Rank**	**Rank Difference**
Recognizing the warning signs of potential fatigue, health, and safety issues (8)	S_fatigue	1	8	7
Interacting with people (9)	S_interact	2	3	1
Troubleshooting schedule systems (7)	S_troubleshoot	3	10	7
Problem solving (4)	S_problems	4	2	-2
Observation (10)	S_observe	5	4	-1
Leading people (14)	S_leading	6	1	-5
Communicating with various levels of an organization's hierarchy (1)	S_communicate	7	11	4
Using analytical/statistical applications (3)	S_analytics	8	13	5
Keeping detailed records (11)	S_records	9	4	-5
Converting complex topics to simple explanations (2)	S_explain	10	14	4
Managing collective agreements (12)	S_agreements	11	12	1
Working in teams (13)	S_teams	12	6	-6
Using technology (6)	S_technology	13	7	-6
Interfacing with multiple systems (5)	S_interfacing	14	9	-5

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering.

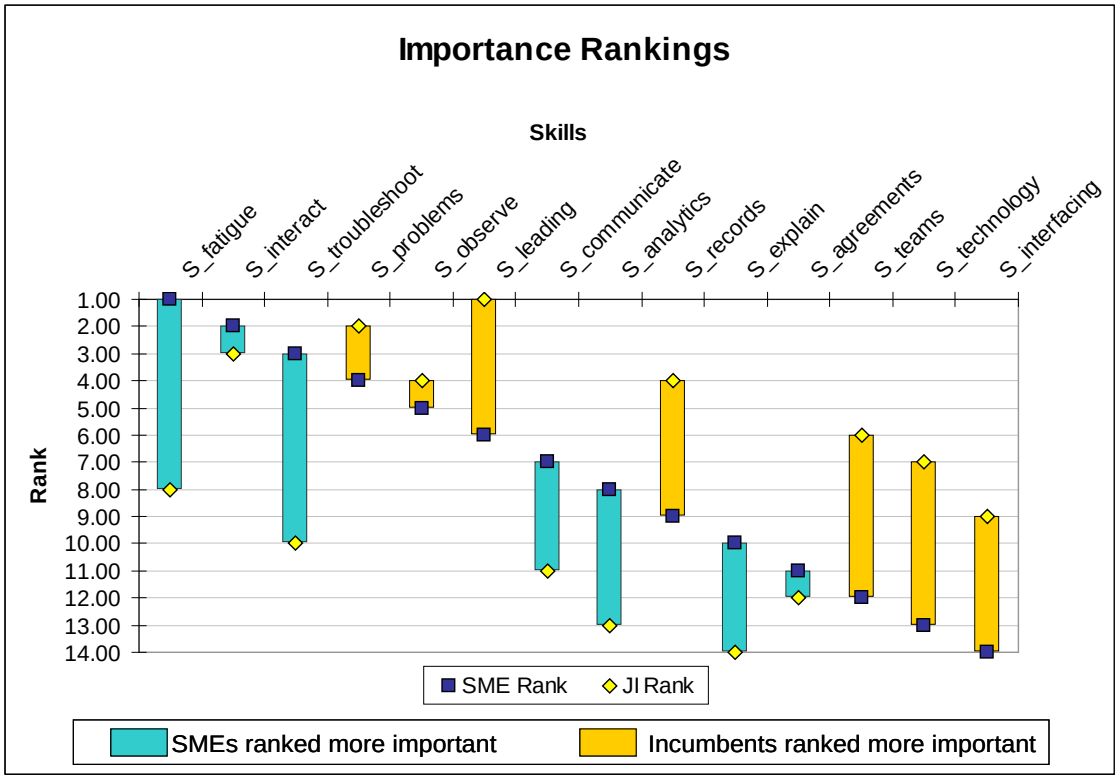

Figure J-2. Graph of Differences in Importance Rankings for Skills

Table J-6. Importance Rankings and Rank Differences for Skills

ABILITIES				
KSAO	**KSAO Label**	**SME Rank**	**JI Rank**	**Rank Difference**
Cooperate (12)	A_cooperate	1	2	1
Identify and manage risks (2)	A_risks	2	9	7
Be flexible (9)	A_flexible	3	1	-2
Recognize a problem and need for change (8)	A_change	4	8	4
Express oneself clearly through speaking and writing (11)	A_express	5	5	0
Think critically about problems (6)	A_critically	6	7	1
Self-evaluate to gauge success (3)	A_evaluate	7	12	5
Ask the right questions and know where to find the appropriate answers (5)	A_ask	8	3	-5
Persuade others (4)	A_persuade	8	11	3
Read and comprehend ideas in writing (10)	A_read	10	10	0
Think independently (1)	A_think	11	6	-5
Balance conflicting demands (7)	A_balance	12	4	-8

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering.

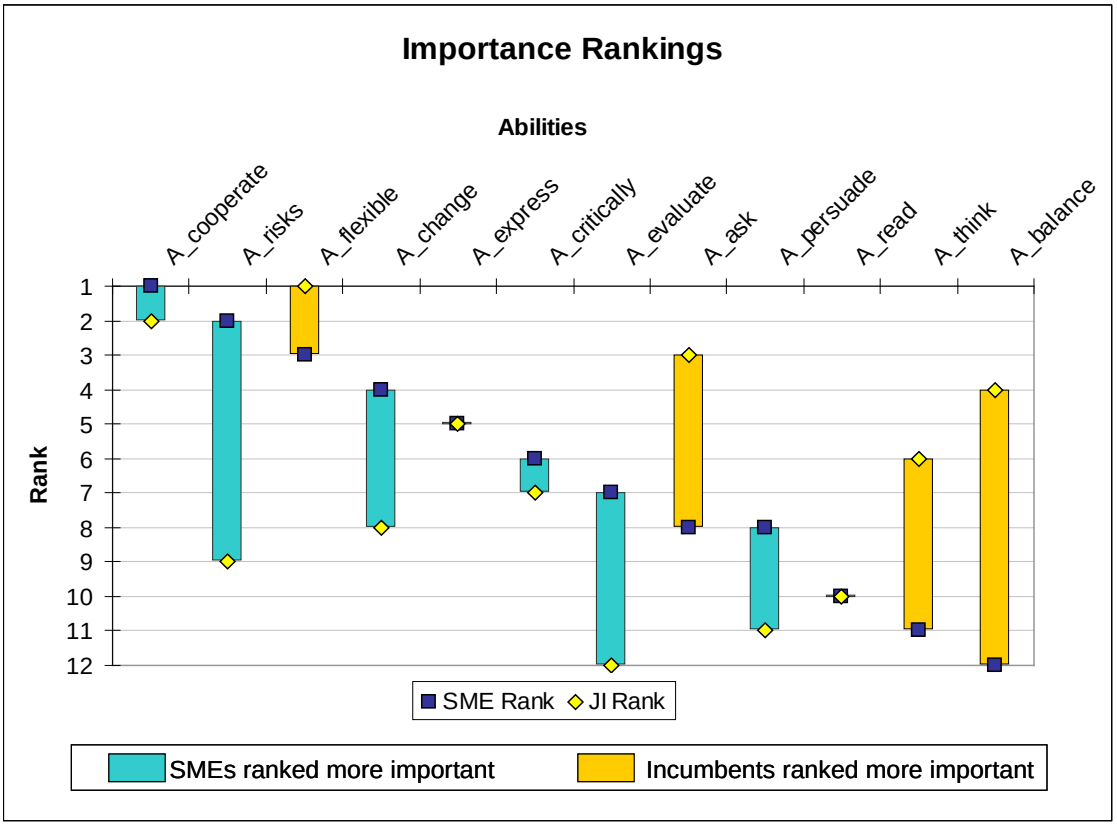

Figure J-3. Graph of Differences in Importance Rankings for Abilities

Table J-7. Importance Rankings and Rank Differences for Skills

OTHER CHARACTERISTICS				
KSAO	**KSAO Label**	**SME Rank**	**JI Rank**	**Rank Difference**
Integrity (1)	O_integrity	1	2	1
Honesty (3)	O_honesty	2	1	-1
Discretion (4)	O_discretion	3	4	1
Patience (7)	O_patience	4	7	3
Perseverance (8)	O_perservere	4	8	4
Passion for safety and health (6)	O_passion	6	5	-1
Approachability (5)	O_approach	7	3	-4
Sensitivity to different types of people (12)	O_sensitive	8	9	1
Commands respect (10)	O_respect	9	10	1
Willingness to compromise (9)	O_compromise	10	5	-5
Well-connected with a community of schedulers (11)	O_connected	11	11	0
Previous involvement with shift work systems (2)	O_previous	12	12	0

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering.

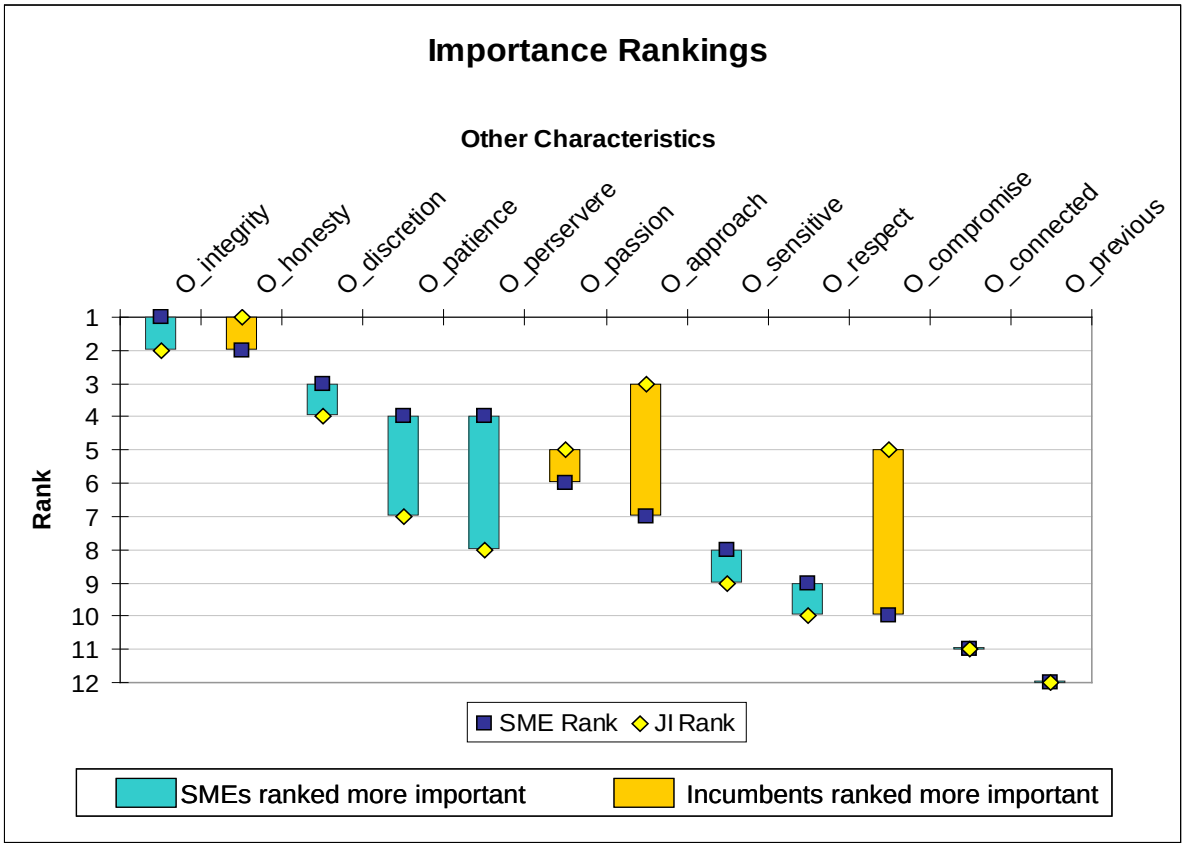

Figure J-4. Graph of Differences in Importance Rankings for Other Characteristics

APPENDIX K: KSAO Gap Analysis Summary Tables

KSAO Gap Analysis Summary Tables

Column Definitions

Gap Assessment – The overall assessment of the gap that exists between the level of KSAO that should be required of future work schedule managers and the level of KSAO that appears to exist currently. The overall assessment options are minimal gaps, moderate gaps, or significant gaps.
Tier – The overall assessment of importance. Each KSAO can fall into one of four tiers: tier 1 is Critically Important and Trainable KSAOs; tier 2 is Important KSAOs with Intergroup Disparities; tier 3 is Moderately Important and Trainable KSAOs; and tier 4 is Important KSAOs but Training Not Applicable. KSAOs in higher tiers are more important than KSAOs in lower tiers. Please see the report for a complete explanation of each tier.
Overall Comments – A summary of qualitative observations from job incumbent interviews and a review of the KSAO data tables. The overall comments informed the final gap assessment.

Table K-1. Gap Analysis Summary Table for Knowledge Characteristics

KNOWLEDGE			
Knowledge	**Gap Assessment**	**Tier**	**Overall Comments**
Various designs used to schedule 24/7 work (e.g., fast/slow, forward/backward rotations) (1)	Significant Gaps	1	Approximately six of the job incumbents interviewed had participated in, or instigated, a schedule redesign while in their current position. Only those that had participated in a schedule redesign indicated some knowledge of different shift schedule design options. In addition, only three of those six indicated that they had personally researched schedule design options and only one had participated in formal training concerning shift schedule designs. It appears that most are not aware of the body of research exploring the positive and negative aspects of various schedule designs unless they were responsible for making considerable changes to their scheduling system.
The impact work hours have on health, safety, and performance (2)	Significant Gaps	1	Both SMEs and job incumbents rated this knowledge as most important for the management of shift work schedules. Clearly, there is agreement that knowledge about the effects of irregular work hours is critical in this job. However, only half of the job incumbents interviewed indicated that they considered health and safety issues when developing or making changes to work schedules. In addition, the two job incumbents who demonstrated the most indepth health and safety knowledge also indicated the desire for more training in this knowledge area. Most concerning is the fact that half of the job incumbents did not explicitly talk about health, safety, or performance concerns with regard to their shift work scheduling duties.
Staffing analysis (7)	Significant Gaps	1	Staffing analysis was rated as very important by both SMEs and job incumbents. However, SMEs ranked this attribute much higher than job incumbents relative to all other knowledge attributes. In addition, staffing analysis was discussed in depth as important to scheduling during the panel discussion held with SMEs in consulting positions. Components of staffing analysis were evident in most

			interviews with job incumbents, and most demonstrated an awareness of the need to balance employee needs with business demands. However, staffing analysis was never discussed as a formalized process. It is likely that those job incumbents working in industries where scheduling is determined by forecasted service volumes are utilizing the outputs of a staffing analysis to create their schedules. More formalized training providing structured information about conducting a staffing analysis should be included in a training program.
The physiology of sleep as related to performance (3)	Significant Gaps	2	Only 3 of the 16 job incumbents interviewed mentioned concerns about sleep and the fatigue levels of their shiftworkers. In addition, only one exhibited indepth knowledge of sleep and performance relationships, as a result of attending a training seminar concerning shiftwork, coincidentally taught by a fatigue management consulting group that employs one of the SMEs we interviewed. Sleep physiology is clearly an area that should be targeted for additional training.
Tools and technologies available for scheduling (6)	Significant Gaps	2	A majority of job incumbents demonstrated indepth knowledge of the tools and technologies used to schedule workers within their organization. However, there was very little awareness of the alternative options that may be available for scheduling. For the most part, the first-line supervisors interviewed appeared to have little control over the technologies utilized by their organization, especially in larger organizations with a centralized scheduling software system and many schedule managers. On the other hand, it was surprising that about half of the job incumbents use simple spreadsheets to schedule their workers. A more in-depth knowledge of the technologies available for shift work scheduling would likely be beneficial to scheduling managers at all levels of an organization.
Program evaluation (13)	Significant Gaps	2	Although job incumbents rated this knowledge higher than SMEs, there was very little direct evidence of knowledge of methods for evaluating a schedule's effectiveness in the interviews we conducted. Additional training in this area would be beneficial to assist schedule managers in recognizing the positive and negative aspects of the scheduling design and system they use, especially in cases where a schedule redesign would be beyond the scope of their job duties and additional, outside assistance would be necessary.
Employee training programs specific to shiftwork (10)	Significant Gaps	3	Although SMEs and job incumbents rated this attribute similarly, SMEs ranked this knowledge considerably higher relative to other knowledge attributes. Furthermore, there is very little evidence of knowledge or use of employee training programs for managing shiftwork based on the job incumbent interviews we conducted. One job incumbent indicated subscribing to a shiftwork newsletter that provides recommendations to shiftworkers for managing their irregular work hours, and another incumbent indicated that the company provided documents to shiftworkers to aid them in managing their work schedules. Shiftwork schedule managers should receive training on managing irregular work schedules so that they can better assist and train their

			shiftwork employees.
Basic ergonomics and human factors (12)	Significant Gaps	3	Only one job incumbent discussed taking ergonomic considerations into account when performing scheduling activities. This person was primarily responsible for scheduling workers on set shifts to specific work tasks and would rotate task assignments every 4 h during a shift. Two of the incumbents interviewed demonstrated some knowledge of fatigue countermeasures related to workplace lighting and physical activity. Knowledge of human factors research with regard to shiftwork was incomplete at best. Although this knowledge was rated relatively low by SMEs and job incumbents, 100% of SMEs indicated that knowledge in this area could be improved through formal training, thus making it a clear area to target when developing training curricula for shiftwork schedule management.
Policies and procedures concerning the design of an organization's schedule (8)	Moderate Gaps	3	Formal and informal policies regarding fitness for duty were discussed indirectly in most of the interviews with managers in safety-critical industries. However, fatigue level was not normally considered as one of the indicators of fitness for duty. In fact, in one organization where employees may be mandated to work an additional 8-h shift if understaffing occurs, only physical indicators (e.g., injuries) are used to assess fitness for duty. Although fitness for duty may not be applicable in all industries that utilize shiftwork, additional training may be useful for those in safety-critical industries.
Human resource systems (11)	Moderate Gaps	3	Although knowledge human resource systems was not captured by the qualitative coding of job incumbent interviews, many interviewees were responsible for monitoring work hours, managing payroll, conducting performance appraisals, hiring new workers, etc. These responsibilities typically fall under the human resource umbrella. In some cases, especially for those with responsibility for a small staff, there was no centralized human resource department. In addition, job incumbents responsible for complicated shift rotation schedules demonstrated knowledge of how the rotation pattern impacts weekly work hours for employees (e.g., some weeks they average 32 h, other weeks 42 h). General knowledge of human resource systems may be required of any worker in a management position. Specific knowledge of how the design of the shift schedule impacts human resource systems is vastly important for this job.
The social implications of shiftwork (14)	Moderate Gaps	3	Job incumbents and SMEs rated knowledge of the social implications of shiftwork relatively low compared with other knowledge areas and ranked the attribute similarly relative to all other knowledge areas. There was also strong evidence that job incumbents consider the social implications of shiftwork when designing and managing their work schedules. However, most of this knowledge appears to stem from incumbents' own experiences working irregular schedules and through communication with staff about their personal preferences and concerns when working other-than-

			day shifts. Additional formal training with regard to the social implications of shiftwork may be beneficial to give schedule managers a more well-rounded understanding of documented psychosocial research on shiftworkers.
Industry-specific operations and regulations (e.g., OSHA, USDA, HOS) (4)	Minimal Gaps	1	Although job incumbents rated this knowledge area higher than SMEs, there were no significant differences in ratings, both groups had an average rating above 4.0 (very important), and both ranked the attribute similarly compared with all other knowledge areas. Most job incumbents talked in depth about complying with industry regulations (where applicable) as something they must consider when making or revising shift schedules. In addition, industry-specific knowledge was often discussed as very important for new work schedule managers to have and/or learn on the job. A majority of the managers interviewed were promoted to their positions after many years of experience as first-line workers in their industry. For instance, one of the transportation organizations that participated indicated that they only take on new first-line supervisors through internal promotions and a well-tailored supervisor-in-training program. It is these first-line supervisors that share scheduling duties. Some industry-specific knowledge can be trained but may be most effectively learned with on-the-job experience.
Company policies and procedures, including interactions with unions and union contracts (5)	Minimal Gaps	2	Knowledge of company policies and procedures was a common theme when talking with job incumbents. All demonstrated indepth knowledge of their organization's policies with regard to such things as overtime, calling people in to work, and the scheduling of people and tasks. In addition, all of the job incumbents from organizations with a unionized workforce clearly indicated the importance of knowing the union contract when making scheduling decisions. Much of this knowledge is organization-specific and is required of all employees at any level of management.
Indicators of an employee's fitness for duty (9)	Minimal Gaps	2	Job incumbents rated this knowledge area significantly higher in importance than SMEs. In addition, there was strong evidence that job incumbents have knowledge of their organization's procedures for designing and managing work schedules. This is a core component of their job responsibilities. However, generalized training concerning this knowledge may not be critical or appropriate due to the vast differences in scheduling policies and procedures even within the same industry. Managers adequately acquire this knowledge through on-the-job training.

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering.

Table K-2. Gap Analysis Summary Table for Skills

SKILLS			
Skill	**Gap Assessment**	**Tier**	**Overall Comments**
Recognizing the warning signs of potential fatigue, health, and safety issues (8)	Significant Gaps	1	Skill in recognizing fatigue, health, and safety risks was rated very highly by SMEs. In addition, there was a considerable difference between SMEs and job incumbents with regard to the overall rank of this skill relative to other skills (SMEs ranked this first, whereas job incumbents ranked this eighth). This attribute is closely related to knowledge of the impact work hours have on health, safety and performance, and knowledge of indicators of fitness for duty. There was minimal evidence from job incumbent interviews that this skill was regularly utilized. In most cases it appears to be a worker's responsibility to monitor his/her own level of alertness, wellness, and ability to perform the job. Training scheduling managers to recognize warning signs of fatigue, health, and safety issues goes hand-in-hand with teaching about the impact work hours have on health, safety, and performance.
Troubleshooting schedule systems (7)	Significant Gaps	2	Troubleshooting in general seemed to be a valuable skill for job incumbents because of the need to make daily changes to work schedules based on the amount of work required for the day and the number of people available to work. Although SMEs and job incumbents rated this skill similarly, SMEs indicated that this was the 3rd most important skill, whereas job incumbents ranked it 10th. Very few incumbents demonstrated direct skill or experience troubleshooting the schedule system during their interview. One incumbent did have vast experience troubleshooting schedule systems; however, that incumbent's job responsibilities included auditing the scheduling system used by the entire organization, which was atypical of most of the people we interviewed. In addition, 100% of SMEs indicated that this was a highly trainable skill.
Using analytical/statistical applications (3)	Significant Gaps	3	There was a lot of variability between job incumbents with regard to use of analytical or statistical applications. Some job incumbents, particularly those responsible for creating the schedule systems that they use, indicated that math, analytical, and/or accounting skills were extremely important in carrying out their jobs. However, two incumbents, when directly asked, stated that math skills were not particularly important to have in their jobs. This skill may be very important for more complicated shift scheduling systems and for schedule managers who are responsible for analyzing scheduling data.
Problem solving (4)	Moderate Gaps	1	Problem solving was rated highly by both SMEs and job incumbents and appeared frequently in job incumbent interviews. Job incumbents demonstrated that problem solving was important in their job both indirectly through dialog concerning their scheduling experiences and directly when asked to list the important skills they use on the job.

Using technology (6)	Moderate Gaps	2	Job incumbents rated using technology as significantly more important than SMEs. In addition, there was significant evidence of the importance of technology skills within each of the incumbent interviews. Several incumbents emphasized the importance of technology skills when asked directly to list the skills important to have in carrying out their scheduling responsibilities. Almost all of the incumbents used computers when scheduling, and many who had been with their organizations for a long time noted that there was a steep learning curve when they switched from scheduling on paper to scheduling with computers. However, it should be expected that scheduling managers have some base level of proficiency with computers. Thus, any technology training should specifically focus on using scheduling software.
Working in teams (13)	Moderate Gaps	2	Approximately half of the job incumbents interviewed demonstrated the need for teamwork skills. Although job incumbents rated this skill significantly higher than SMEs, 100% of SMEs indicated that teamwork skills are highly trainable. Taken together, it is a likely area to target in training. However, this skill likely applies more to management in general than managing schedules in particular.
Converting complex topics to simple explanations (2)	Moderate Gaps	3	Job incumbents and SMEs rated this skill relatively low compared with other skills. SMEs ranked this attribute higher than job incumbents, but it still appeared in the lower half of all skills when ranked by importance. In addition, there was little evidence of this skill set within job incumbent interviews. However, this skill may be more important when considered in combination with other skill and knowledge sets that scheduling managers should have in the future. For instance, converting complex topics to simple explanations may be necessary as a skill when passing on information about the health and safety implications of shiftwork to shiftworkers.
Managing collective agreements (12)	Moderate Gaps	3	Job incumbents in organizations with a unionized workforce demonstrated extensive knowledge of union contracts and skill in negotiating with unions. Only two of the job incumbents interviewed played a role in managing collective agreements and both resided higher up in their organization than most schedule managers. However, when applicable, negotiating with unions and knowing the contract was perceived as extremely important. This skill is also likely to be critical in instances where scheduling managers need to make changes to the design of their shift scheduling system.
Interacting with people (9)	Minimal Gaps	1	Interacting with people was rated significantly higher by job incumbents than SMEs; however, SMEs and job incumbents ranked this attribute similarly relative to all other skills. This skill set was mentioned in almost all of the job incumbent interviews. Although this skill is clearly important for any employee in a supervisory role, it appears to be a critical skill for those responsible for work schedules because of the need to communicate schedule changes to workers, call people in to work, and make decisions about leave and vacation.

Interfacing with multiple systems (5)	Minimal Gaps	2	There was moderate evidence that job incumbents interface with multiple systems as a skill set. Most incumbents discussed this skill in terms of needing to interact with a combination of systems to manage their work schedules. For instance, some incumbents noted that they drew information from production schedules, purchase orders, and equipment availability when scheduling workers to tasks on different shifts. However, SMEs ranked this attribute as least important compared with all other skills. Some of the need to interface with multiple systems may be reduced with the introduction of more streamlined scheduling processes.
Observation (10)	Minimal Gaps	2	Observation skills were rated significantly higher by job incumbents than SMEs, but ranked similarly overall. Two incumbents specifically mentioned observation as an important skill to have in their jobs. Observation may be a critical skill for management in general but is particularly important when considered in light of the need to recognize risks related to shiftwork.
Keeping detailed records (11)	Minimal Gaps	2	There is strong evidence of the need for skill in keeping detailed records in the job incumbent interviews. Incumbents mostly discussed this skill in terms of "keeping track," especially with respect to overtime. Job incumbents rated this skill significantly higher than SMEs, likely because it is a skill expected of managers in general.
Leading people (14)	Minimal Gaps	2	There was strong evidence of leadership in the job incumbent interviews, and these leadership skills were demonstrated in a variety of ways. Leadership may be critical for managers in general, but less important than other attributes when it comes to managing schedules in particular. Leadership skills may be low on the list of training priorities for a program specific to managing work schedules.
Communicating with various levels of an organization's hierarchy (1)	Minimal Gaps	3	The critical element of this skill concerns interacting with different levels of an organization. Job incumbents and SMEs rated this skill similarly, and there was significant evidence in almost all job incumbent interviews that skillfully communicating with upper management and frontline employees was important. In addition, many of the incumbents we interviewed directly stated that communication in general was an important skill to possess in their jobs.

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering.

Table K-3. Gap Analysis Summary Table for Abilities

ABILITIES			
Ability	**Gap Assessment**	**Tier**	**Overall Comments**
Identify and manage risks (2)	Significant Gaps	1	Identifying and managing risks was rated highly by both SMEs and job incumbents; however, SMEs ranked the ability much higher than JIs (ranked second most important as compared with ninth most important, respectively). Risk management was also not particularly evident in job incumbent interviews. This ability is likely related to a general skill in troubleshooting and additional training appears to be needed.
Balance conflicting demands (7)	Significant Gaps	2	The ability to balance conflicting demands was one of the most common KSAO themes to emerge from the qualitative content coding of job incumbent interviews. This documentation suggests that job incumbents regularly need to balance conflicting demands. Although SMEs rated this attribute relatively low and ranked it as least important compared with other abilities, many indicated in interviews that shift scheduling is often a balancing act between employee needs and business needs. This ability may have been undervalued by SMEs, and more training is likely needed to better assist scheduling managers with this balancing act.
Self-evaluate to gauge success (3)	Significant Gaps	3	SMEs and job incumbents rated this attribute similarly, although it was ranked considerably higher by SMEs than job incumbents. Approximately half of the job incumbents discussed self-evaluation in their interview, and it was addressed in terms of the techniques used to self-evaluate. It was also noted that most incumbents did not require approval from a higher level of management before implementing schedule changes; therefore, self-evaluation should be relatively important for most work schedule managers.
Recognize a problem and need for change (8)	Moderate Gaps	1	This ability was rated similarly by SMEs and job incumbents. Approximately one-third of job incumbents interviewed demonstrated a strong ability to recognize a problem and need for change. In these instances incumbents talked at length about the changes they made to the design or procedure for scheduling workers in their unit. However, some of the incumbents interviewed described shift schedules with vast amounts of daily maintenance and frequent instances of having to call people in to work overtime. This suggests that problems in the scheduling system may be unrecognized and additional training is necessary.
Ask the right questions and know where to find the appropriate answers (5)	Moderate Gaps	2	Job incumbents rated and ranked this ability higher in importance than SMEs. There was also evidence of this attribute in approximately half of incumbent interviews; however, most instances related to finding appropriate answers. The ability to ask the right questions may need to be addressed with shiftwork schedule training so that schedule managers are better versed on what questions they

			should be asking with regard to the design of their schedules, their employees' abilities to handle working shifts, and whether change is necessary.
Think critically about problems (6)	Minimal Gaps	1	SMEs and JIs rated and ranked this ability similarly in importance. There was evidence of critical thinking ability in most of the job incumbent interviews. Some incumbents directly reported the need to think critically in terms of being analytical. However, this does appear to be an area where additional training would be beneficial, similar to the ability to recognize problems and manage risks.
Express oneself clearly through speaking and writing (11)	Minimal Gaps	1	SMEs and job incumbents agreed that this ability was very important, and both ranked it the same overall. Most job incumbents indicated that communication in general was an important ability to possess on the job. In addition, communicating schedule changes was a large part of most incumbents' job responsibilities.
Cooperate (12)	Minimal Gaps	1	Cooperation was ranked as highly important by both SMEs and job incumbents. Although there was no explicit mention of cooperation in the qualitative content coding of job incumbent interviews, incumbents did express elements of cooperation when working in teams, communicating with various levels of their organizations hierarchy, and balancing conflicting demands. Cooperation is important, but incumbents do not appear to be lacking in this ability.
Read and comprehend ideas in writing (10)	Minimal Gaps	2	This ability was not well documented in the qualitative analysis of incumbent interviews. However, reading and writing was different to capture in coding because interviewees were unlikely to explicitly state that they comprehend ideas in writing. This attribute does not appear to be particular to scheduling, but generally to management or administrative positions.
Think independently (1)	Minimal Gaps	4	This ability was highly regarded as important by job incumbents and documented as important in four of the incumbent interviews. However, this ability is likely important for managers in general and not particular to shiftwork schedule managers.
Persuade others (4)	Minimal Gaps	4	There was some evidence from incumbent interviews that persuading others is an important component of the scheduling job, mainly with regard to making schedule changes and negotiating with upper-level management and unions. However, only 33% of SMEs regard this as an attribute appropriate to target in formal training.
Be flexible (9)	Minimal Gaps	4	There was significant evidence of the need for flexibility in the majority of job incumbent interviews, and both incumbents and SMEs rated flexibility as highly important. However, only 33% of SMEs regard this as an ability that can be improved with formal training.

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering.

Table K-4. Gap Analysis Summary Table for Other Characteristics

OTHER CHARACTERISTICS			
Other Characteristic	**Gap Assessment**	**Tier**	**Overall Comments**
Passion for safety and health (6)	Significant Gaps	1	Both SMEs and job incumbents rated this characteristic, on average, as very important. However, only one job incumbent demonstrated a passion for safety and health, talking at length about the relationship between shiftwork, health, and performance and countermeasures for managing fatigue related to shiftwork. However, this passion was likely in part due to the incumbent's attending a seminar on shiftwork and fatigue management in the past year. Training may assist in fostering a passion for safety and health.
Well-connected with a community of schedulers (11)	Significant Gaps	3	Only one job incumbent mentioned personally interacting with a community of schedulers. This job incumbent contacted other work schedulers in the industry to understand different scheduling designs. One hundred percent of SMEs indicated that this characteristic can be addressed in a formal training program. In fact, the development of a training credential may foster stronger connections between work schedulers and between schedulers and the greater research and consulting community.
Sensitivity to different types of people (12)	Significant Gap	4	About half of the job incumbents interviewed demonstrated sensitivity to their employees' needs and preferences and an awareness of how that affects work scheduling. However, a few job incumbents discussed policies and procedures that were decidedly insensitive to employees' needs. Although the majority of SMEs indicated that sensitivity is not an easily trainable attribute, training with regard to the social implications of shiftwork may also foster sensitivity to different types of people.
Willing to compromise (9)	Moderate Gaps	2	A willingness to compromise was explicitly mentioned in two incumbent interviews. However, this characteristic may have been undercoded because it overlaps with flexibility and cooperation. In addition, job incumbents rated this characteristic as significantly more important than SMEs. On the other hand, some job incumbents indicated that there are many situations where they must be unwilling to compromise in scheduling for the good of employee health and safety or the organization's bottom line. This characteristic may be perceived as more valuable by some job incumbents than others.
Approachability (5)	Moderate Gaps	4	Approachability was rated significantly higher by job incumbents than SMEs. Approachability was also well documented in the incumbent interviews, with most discussing it in terms of how easy it is for employees to initiate contact and discuss schedule issues or conflicts. However, approachability was not generally regarded as trainable by SMEs.
Previous involvement with shiftwork systems (2)	Minimal Gaps	3	Although this characteristic was rated relatively low by both SMEs and job incumbents compared with other characteristics, it was mentioned in most of the incumbent

			interviews. Job incumbents and SMEs state that working irregular hours can provide unique insight into the job of shift scheduling because schedulers are more keenly aware of the toll shiftwork can take on one's health and social interactions. Some of this shiftwork knowledge is trainable, but many argue that it cannot replace on-the-job experience.
Integrity (1)	Minimal Gaps	4	Integrity was rated and ranked highly by both SMEs and job incumbents. In addition, most job incumbents discussed the value of integrity in terms of making fair and just decisions, following and enforcing the rules, and being dedicated to the work. However, most SMEs did not consider this a characteristic that can be trained.
Honesty (3)	Minimal Gaps	4	Honesty was also rated highly by both groups of participants, but most SMEs indicated that this too is not a trainable characteristic.
Discretion (4)	Minimal Gaps	4	Discretion was rated highly on importance by both SMEs and job incumbents. However, discretion did not appear in the qualitative coding of incumbent interviews, and SMEs indicated that it is unlikely to be a very trainable characteristic. This characteristic is unlikely to be appropriate to target for training.
Patience (7)	Minimal Gaps	4	Two job incumbents mentioned patience as an important characteristic, and both job incumbents and SMEs rated it relatively high on importance. Patience may not be a trainable characteristic, but it does appear to be important for work schedule managers to possess.
Perseverance (8)	Minimal Gaps	4	Perseverance was rated as very important by both job incumbents and SMEs and was briefly mentioned in two incumbent interviews. Perseverance may also be related to incumbents' perceptions of the importance of dedication and the need to be uncompromising in some situations.
Commands respect (10)	Minimal Gaps	4	Three job incumbents specifically mentioned and emphasized commanding respect as an important characteristic to have in their line of work. SMEs indicated this attribute can be important because scheduling managers need to communicate with various levels of their organization.

Note: The number in parentheses listed after each attribute indicates the original KSAO ordering.