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# Development of an O*NET Web-Based Job Analysis and its Implementation in the U. S. Navy: Lessons Learned

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Running Head: WEB-BASED JOB ANALYSIS

# Development of an O*NET Web-Based Job Analysis and its Implementation in the U. S. Navy: Lessons Learned

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Abstract

Job analysis is described as the building block of most human resources (HR) functions. In recent years, many HR functions have been automated or adapted to computer applications; however, the use of computers for job analysis is lagging. The purpose of this paper is to describe a web-based job analysis process that is based on O*NET. The web-based job analysis process is more flexible and less resource intensive than traditional job analysis methods. The paper also will describe the application of the web-based job analysis process in the U.S. Navy and discuss strengths and limitations of this system.

Development and Implementation of an O*NET Web-Based Job Analysis in the U. S. Navy: Lessons Learned

In recent years, the use of the internet for various personnel practices has gained acceptance from practitioners and received more attention in the empirical literature (Crespin & Austin, 2002; Viswesvaran, 2003). For the most part empirical studies and discussion of applications have focused on the use of the internet as a recruitment tool or advertising positions via a company's website or sites that provide access to job postings, such as Monster.com (Chapman & Webster, 2003). The use of the internet is also increasing for screening and selection of employees (Crespin & Austin, 2002; Konradt, 2003; Potosky & Bobko, 2004). Other uses of the internet for personnel practices include training (i.e., computer based training) and organizational surveys (Crespin & Austin, 2002). The use of on-line methodologies for surveys, including job analysis surveys, has increased dramatically in recent years, and most companies choose to use the internet or intranet to collect this type of data (Crespin & Austin, 2002; Sanchez, 1994). Finally, O*NET has been created to provide on-line information about jobs (Crespin & Austin, 2002).

However, in both job analysis surveys and O*NET, the necessary job analysis information (i.e., tasks, knowledges, skills, abilities, and other characteristics or KSAOs) has to be available before it can be used on-line. Most organizations still obtain job analysis data by using face-to-face interviews with panels or individuals (Sanchez, 2000). The use of the internet or a computer to generate such job analysis information has not received as much attention in the research and theory of job analysis and computer application to HR functions. The purpose of this paper is to describe the need for a system to gather job analysis information utilizing a distributed method (the world-wide-web), its development and implementation, and to discuss the strengths and weaknesses of such a system.

*Reasons for Developing a Web-Based System*

Current methodologies of job analysis that rely on face-to-face interviews and observations have been criticized for the time and resource demands they place on organizations and job incumbents (Sanchez, 2000). The current dynamic business environment resulting from increased competition, globalization, rapid changes in technology, and increased use of work-teams, also has created a work environment in which traditional methodologies of job analysis are not sufficient (Sanchez, 1994). Traditional job analysis methodologies are viewed as rigid and slow, both in initial data collection and in updating. Therefore, by using traditional methodologies job analysis information is not easily and quickly adaptable to the rapid changes in the work and organizations (Sanchez, 1994).

In addition to being rigid and slow, traditional methodologies are not designed to cope in a cost-effective way with a global workforce. Typical job analysis methodologies call for face-to-face interviews with a representative sample of job incumbents, usually including top performers, but also representative of various ethnicities, locations, gender, and so forth, to ensure an accurate representation in the information generation phase. With large corporations and a national and global work force, this requirement of face-to-face interviews is too time-consuming and too expensive to be seen as practical.

Traditional job analysis methodologies are viewed either as work-oriented, that is, focusing on collecting information about the tasks performed and behaviors that the worker engages in, or worker-oriented, that is, focusing on worker characteristics such as knowledge skills and abilities (KSAOs) necessary for job performance (Brannick & Levine, 2002). The choice of methodology usually is dictated by the specific use of the job analysis information (e.g., compensation, training development). Using either method results in data that may not be usable for other purposes thus limiting the utility of the job analysis effort. Some practitioners use a combined approach which yields both task and KSAO information. However, this combined approach also increases the time and resources required to perform the job analysis. Many organizations choose a more limited approach due to increased resource demands, resulting in the limited use of job analysis information, and therefore lower utility.

In addition, traditional job analysis methodologies are critical for the HR reform efforts taking place in many large businesses and in the federal government. In order for HR to provide strategic value to the organization and be considered a key player, HR initiatives must be timely, relevant, and efficient. Without the appropriate information from a job analysis, HR cannot provide the solutions necessary. This is particularly difficult in the Federal Government, where there are many jobs in many different sectors. The jobs in the government are changing rapidly not only as a result of technological changes, but also as a result of changes in laws and regulations and federal mandates.

These drawbacks to traditional job analysis, namely, slow collection of information, difficulty to update quickly, difficulty in collecting data from a representative sample, and limited types of data collected and therefore limited use, have revealed the need for a new methodology for collecting job analysis information. This new methodology should be responsive to organizational needs, more efficient, more dynamic and flexible in initial data collection and updates, and that will allow the collection of multiple types of data to allow for multiple uses. Using a computerized, web-based approach seemed to provide a plausible solution.

A review of the literature on computerized job analysis systems revealed that the focus of these systems typically is data collection from a representative sample, once task and KSAO information is available. Some systems allowed for a review of previously created task or KSAO lists (e.g., sending them as attachment for review), while other systems allowed for the job analysis survey to be sent out electronically (Brannick & Levine, 2002). However, a fully developed and integrated system that allowed for the development and generation of task information, review and revision, identification of relevant KSAOs linked to task information, and a survey tool was not available. Moreover, a review of the knowledge elicitation literature suggested the possibility of developing a computer based system to elicit expert knowledge effectively and with similar results as face-to-face interviews (Cooke, 1994; Hoffman, Shadbolt, Burton, & Klein, 1995; Sauer, Schramme, & Ruttinger, 2000).

*O*NET*

The challenge was to develop a system that would allow the elicitation of job related information with minimal intervention and guidance, so that this system could be used in a distributed manner using the world-wide-web to access the system. The first important decision in the development of a web-based job analysis system was to determine what type of job analysis would be used and the structure it would have. The model that was selected as the starting point for the development of the job analysis system was the O*NET content model. The next paragraphs will provide more detail about O*NET and its relevance for developing a web-based job analysis system.

There were several reasons for the selection of O*NET as the starting point. First, O*NET was developed by the Department of Labor which viewed O*NET serving "as a national benchmark that provides a common language for all users of occupational information" (U.S.

Department of Labor, 1993, p. 6). Therefore, O*NET was seen as an appropriate model to be used when multiple jobs are analyzed in a large organization or across multiple organizations. This common language allowed for comparisons across jobs and across organizations. Second, O*NET provides a synthesis of job analysis research, relying upon and reflecting the cumulative knowledge and research on job analysis (Campion, Morgeson, & Mayfield, 1999).

Finally, the O*NET content model was specifically designed to allow for multiple descriptors used for multiple inferences (Mumford & Peterson, 1999). Specifically, the O*NET content model includes six major categories to describe work and the worker. These include (a) worker characteristics, defined as enduring characteristics of the worker and include abilities, occupational values and interest and work style; (b) worker requirements, which are developed through education and experience and include knowledges, skills, and education; (c) experience requirements, defined as structured and unstructured experience that facilitate performance such as training, experience and licensure; (d) occupational requirements, used to describe the actual work being performed and include generalized work activities (GWA), work and organizational context; (e) occupation-specific requirements, which includes more specific information than occupational requirements about the work being performed, including duties and tasks, occupational knowledges, occupational skills, and machines, tools and equipment used on the job; and (f) occupation characteristics providing the broadest view of labor market information (Mumford & Peterson, 1999). One important need identified was finding an efficient way to compile multiple descriptors of job analysis information (such as tasks and KSAOs). O*NET provided the framework to do that.

This description of the O*NET content model also provides an illustration of another important reason why O*NET was selected as the job analysis content model. O*NET was designed to be hierarchical in nature allowing for the use of both broad descriptors that can be used across occupations such as GWAs, skills and abilities, as well as more specific descriptors of a specific position such as tasks, occupational knowledges, occupationally-specific skills, and tools, machines, and equipment.

It is important at this point to consider previous attempts to address this need for a more efficient and cost effective job analysis system that will provide both general and occupationally specific information. Specifically, the Office of Personnel Management (OPM) developed a competency-based system for developing job analysis information (Office of Personnel Management, 2003). According to OPM, over 400 jobs in the Federal system have been analyzed. The competency-based system was designed to provide a common language or framework for job analysis allowing a comparison across occupations and across sectors. However, the OPM methodology requires the development of a list of tasks and competencies for each job for which job analysis is required. The development of this list follows the same steps that are followed in traditional job analysis methodologies (using written documentation to develop tasks and competencies and interviews with SMEs). Further, while OPM has developed a comprehensive list of competencies based on extensive literature reviews, these competencies tend to be job, occupation, or sector specific. This specificity in turn limits the applicability of the information collected.

The development of the computerized based job analysis system is designed to address many of these shortfalls. First, the system needs to allow for the generation of job analysis information across multiple jobs. O*NET includes both broad and specific descriptors, which allow for the generation of job specific information in addition to more general descriptions which can be used across jobs and occupations. In addition, because the job analysis information was going to be used for multiple purposes, both task and KSAO information were needed. Therefore, O*NET seemed the ideal choice. The next section will provide more information about how O*NET was used in developing the web-based job analysis system.

## System Development

### *Task Analysis*

Previous job analysis efforts have used a variety of methods to obtain task information, most commonly using direct elicitation of job information based on interviews with job incumbents and their supervisors. In a job analysis meeting, the interviewer has the responsibility to elicit job-related information such as tasks from the Subject Matter Experts (SMEs). Interviews may be completely unstructured, or may start with a general question of "Tell me what you did on the job yesterday" or "What do you do on your job." These types of questions are so broad that they are viewed as providing very little structure (Hoffman, et al., 1995). Lack of structure increases the importance of the interviewer in directing the meeting and eliciting the necessary information from the SMEs (Brannick & Levine, 2002; Cooke, 1994). Specifically, the interviewer is required to ensure that SMEs provide meaningful, job-relevant information, and to ensure that all aspects of the job get covered. In addition, the information gathered as a result of this unstructured interview tends to be less organized, and therefore more difficult and time consuming to sort out (Cooke, 1994). Finally, multiple interviews with multiple groups of SMEs are needed to ensure coverage of all aspects of the job (Brannick & Levine, 2002), adding to the cost and time demands placed on the organization and SMEs.

In order to collect information in a distributed fashion using a web-based methodology, it is important to find a way to elicit the necessary information without a facilitator. That is, the materials provided to SMEs must provide all the structure that is otherwise provided by a job analyst in a meeting. This type of information elicitation is called free recall (Glass & Holyoak, 1986). Research in both laboratory and real-life settings suggests that cued recall is more effective and allows for more knowledge elicitation (Hudson & Austin, 1970; Koustall, Schacter, Johnson, & Gallucio, 1999; Wood, 1967). Cued recall provides cues that guide information retrieval from memory (Glass & Holyoak, 1986). When job analysis information is elicited in meetings, facilitators provide additional cues by probing SMEs to provide more information and more detailed information about the job, allowing for the development of tasks and KSAOs. In the absence of a facilitator that can ask follow up questions and ensure that all information about the job is recalled, cued recall provides a more effective way to elicit information.

In this context, instead of asking SMEs about their job as a whole, SMEs are asked to recall information about a specific subset or category tasks of the job. In addition to providing structure to the recall process, presenting the SMEs with a specific category within which to recall job behaviors offers an additional benefit. Because information in memory is linked to similar information, the recall of one piece of information is likely to facilitate the recall of information that is similar or is related (Glass & Holyoak, 1986). That is, similar tasks and those that are related functionally will be more likely to be recalled in one time. Providing the cues allows SMEs to not only focus on one aspect of the job at a time, but also facilitates the transfer to a different aspect, preventing interference when a new cue is introduced (a different aspect of the job). Research supports the notion that providing a different cue after recall for the first cue has been completed results in improved recall (Wickens, Born, & Allen, 1963). The cued recall procedure used for the development of this web-based job analysis relies on O*NET to provide the initial structure and the cues.

Mumford and his colleagues have used the GWAs from O*NET to structure the job analysis meeting and provide cues (Clifton, Connelly, Reiter-Palmon, Gilbert, & Mumford, 1991; Connelly, Reiter-Palmon, Clifton & Mumford, 1991; Reiter-Palmon, Uhlman, Clifton, Connelly, & Mumford, 1990; Sager, Mumford, Baughman & Childs, 1999). GWAs have been defined as "an aggregation of similar job activities/behaviors that underlie the accomplishments of major work functions" (Jeanneret, Borman, Kubisiak & Hanson, 1999, p.106). GWAs were designed to be broad and general, as well as cover a wide range of job activities, so they are applicable across occupations. O*NET includes 42 GWAs, which are presented in Table 1. In addition, the O*NET GWAs are based on job analysis research and combine multiple taxonomic efforts (Jeanneret et al., 1999).

Using the O*NET GWAs, SMEs first were asked to select those GWAs that were relevant to their job. Since the GWA list is intended to be applicable for a wide variety of jobs, not all GWAs are appropriate. Once SMEs reached agreement on the GWAs that represent their job, the SMEs then were asked to generate tasks within each GWA they have selected. The GWAs provided a structure to the job analysis interview, allowing SMEs to respond to more specific questions. For example, instead of "tell me everything about your job," the SMEs are being asked "tell me what kinds of things you do that relate to inspecting equipment." By using this cued recall methodology to structure the interview, tasks can be generated much more quickly and efficiently. Mumford and his colleagues found that a one-day panel meeting with ten or fewer SMEs elicited 90% to 95% of the tasks for the job being analyzed. In addition to the savings in time and the number of meetings needed, the cued recall methodology has three additional advantages. First, because the meetings are structured based on GWAs, the resulting information is more organized as tasks are generated within the context of broader GWAs. This reduces the time demands on the job analysts after the meeting. The second advantage, which is important for the purpose of this article, is that the cued recall methodology does not rely as much on the skill and training of the interviewer to elicit all tasks. Because of the structure provided, this methodology can more easily be transferred to a computer application. However, providing probe questions using GWAs does not provide enough structure to the interview. In order to have a successful computer application that can be utilized remotely and with minimal support, a process of generating tasks was needed where additional structure was provided to the SMEs. Third, this process allowed for recall within a specific category of the job, and then provided the additional cue (a new GWA) that facilitated further recall.

Sager et al. (1999) suggest another way to structure the elicitation of tasks based on Prien's (1994) work. Using Sager's approach, common activity words (such as writing, supervising, installing) are identified to create a taxonomy. The taxonomy is then presented to a group of SMEs and they select which activity words fit their job. A second group of SMEs is asked to list all the objects of the activities selected by the first group. This approach has not been used widely, however, Sager et al. (1999) note that this approach has features that may prove useful for on-line generation. Specifically, while the generation of an activity list may be time consuming and difficult for SMEs, using a computer to generate an initial activity list and allowing SMEs to select from it, is much more expedient.

The methodology developed for the web-based job analysis approach was a combination of the GWAs and activity and object words. To allow for individual, distributed work, it was necessary to find a way to design a system that would provide the user with sufficient information to understand the requirements of the task generation process and navigate the system independently without assistance from an expert. The use of GWAs allowed for cued recall and breaking of work into smaller chunks, thus letting the SMEs focus on each GWA sequentially. Within each GWA, a list of possible action words was created to provide a starting point. Previous work has suggested that for each GWA there are specific action words that are more common and best represent the work that is done (Mumford, personal communication, June 20, 2005). For example, for the GWA "Interacting with computers" some common actions include type, program, write, connect, and edit. In addition to actions, common objects could be identified for each GWA. For the example of "Interacting with computers" common objects include program, software, hardware, spreadsheet, and database. Such lists were developed for each GWA and included as part of the task generation process. Not only did these lists provide a cueing mechanism, they also allow for the development of appropriately worded task statements, such that each task includes an action and an object. Therefore, SMEs are able to generate better worded task statements with minimal introduction to the concept of a task statement. An overview of the entire job analysis process is provided in Figure 1.

*Process for Task Generation*

The typical task generation process is described below, however, modifications to the process can occur as a result of specific organizational needs. Before each step, a brief tutorial is provided elaborating the purpose of that specific phase in the whole process, and explaining how the SMEs should use the system. SMEs can return to each tutorial as many times as they wish.

Five to ten SMEs are typically used for each job. The identification of SMEs is similar to that of traditional job analysis methods. SMEs should be above average performers, job incumbents for the job they are analyzing, and have sufficient tenure in the position to be familiar with various aspects of the job (Cranny & Doherty, 1988). If there are differences based on location, shift, or other factors, then SMEs representing these aspects should be included to ensure coverage (Friedman, 1990). Once SMEs are identified (typically by project management and supervisors), their e-mail addresses are entered into the system. A form letter is generated and sent, explaining the purpose of the job analysis effort, and how and why the individual was selected for participation. The letter also directs the SMEs to a URL, and provides a login and password which are needed to gain access to the system. SMEs work independently progressing through the different steps of the task generation process at their own pace.

Once SMEs log into the system, a brief explanation of the purpose of the process and the process itself is given. The first step in the process is a review of existing task data (legacy data) if an existing task list is available. Therefore, previous efforts by the organization are not lost or ignored. Task information may also come from other sources such as job analyses for similar jobs, O*NET, etc. However, if legacy task information is available, then SMEs are asked to review the legacy task list. SMEs are presented with the existing legacy task list and asked to identify those tasks they perform. SMEs are required to review and make a simple yes/no decision (I do this/I do not do this). Any task selected by any of the SMEs is kept for further review at later stages of the process. Once SMEs have reviewed the legacy task list, they move to the next step in the process. If there are no legacy tasks available, then SMEs proceed to the next step immediately.

The SMEs then select GWAs that are applicable to their job. SMEs are instructed to review the full list of GWAs and the definitions of each one before making a selection (see Table 1). They are then instructed to select 6-12 GWAs that represent work they do on their job. These GWAs will then serve as the starting point for task generation. An upper limit on the number of GWAs helps ensure that the task generation process can be completed in one full workday (up to 8 hours), and a lower limit ensures enough coverage by every single SME. GWAs are presented in a random order and each SME is presented with a different randomization of the GWAs. Because the order of presentation may affect which GWAs are selected for inclusion, the random presentation ensures possible selection of different GWAs by different SMEs. In addition, because SMEs work independently, the selection by one person is not influenced by the selection of another, which allows for the selection of different GWAs by different SMEs. The selection of different GWAs by different SMEs also provides an additional way to ensure that all aspects of the job are covered in this task generation process. Once the SME has selected between 6-12 GWAs, he or she can move on to the next step. The system will not allow the person to progress if he or she selected fewer than six or more than 12 GWAs.

The third step involves the use of a taxonomy of actions and objects such as those suggested by Sager et al. SMEs review the list of GWAs that they have selected, and choose one. Once the SME selects a specific GWA, a list of actions and a list of objects appropriate for the GWA become available. The SME is instructed to think about all possible tasks or behaviors that he or she engages in that relate to that specific GWA. The SME then is instructed to review the lists of actions and objects and select those that are appropriate. In addition, the SME is encouraged to add additional actions and objects, as the lists are not meant to be exhaustive. Once the SME is satisfied with the list of actions and objects, he or she can move to the next step, which is pairing the actions and objects.

The fourth step requires SMEs to pair each action with an appropriate object or objects. These two-word statements form the basic structure of a task statement. Each action may be paired with more than one object, and each object may be paired with multiple actions, in separate statements (evaluate work, evaluate subordinates, train subordinates). If at that point the SME identifies missing actions or objects, he or she can go back to the previous step and add the missing objects or actions (either select from the pre-existing list or add new actions and objects). In addition, SMEs may choose to eliminate an action or object that was initially selected but was found to be redundant or not needed. Once the SME determines that all the appropriate pairs have been created, then he or she moves to the final step of creating the full task statements.

These brief two-word statements in most cases are not descriptive enough to provide sufficient detail to fully understand the job. Detailed information is entered by the SME in the form of object and/or statement modifiers. For example, “write financial reports for managerial review,” provides much more detail than simply “write reports.” The object modifier is “financial” and the statement modifier is “for managerial review.” SMEs are required by the system to enter at least one descriptor (either a statement or an object modifier) and not to leave task statements as two-word sentences. In addition, SMEs are told that typically at least 10 tasks are generated for each GWA. This information is provided to encourage SMEs to generate a sufficient number of tasks for each GWA to ensure coverage of the job. SMEs can move between these three steps (action and object selection, action and object pairing, elaboration) as often as they wish.

Once the SME determines he or she has generated all the tasks for the selected GWA, then he or she is asked to select another GWA and repeat this process (action and object selection, pairing and elaboration). However, the SME may return to GWAs and add additional tasks if needed. SMEs can complete this process in one sitting or may take breaks and complete the process over several days. Once tasks are generated for all GWAs selected by the SME, then the SME completes the process by indicating that all tasks for all GWAs were generated. At this point the SME is logged off the system and is not able to return and change anything. A summary of the steps for this process is presented in Table 2. The typical time frame for completion of this process is 4-6 hours, but may take a full eight hour day.

*Task Editing*

The result of the task generation process is the creation of multiple task lists generated by multiple SMEs. These tasks lists are then combined with legacy tasks selected to form a large task list. This task list typically includes 350-1000 tasks, depending on the number of SMEs participating in the task generation and the complexity of the job. At this point, the task list contains duplications (either tasks that are identical or similar) or unnecessary information within individual task statements. Additionally, not all task statements that are generated by the SMEs are written according to the standards. The primary focus of the editing process is similar to editing using the traditional job analysis method, that is, to fine tune task statements by eliminating redundancies, clarifying vague task statements, and eliminating unnecessary information. As in traditional job analysis, the job analyst can also provide some uniformity to the content and structure of the task statements (for example, using only “teach” or “instruct”). The editing is done by a job analyst familiar with the web-based system, and an SME designated to answer any questions that may arise (for example, if the job analyst is in doubt whether two tasks are similar and can be combined or for clarifications). The main purpose of the editing process is to consolidate the information provided by multiple SMEs as well as clarification of that information.

The editing process is another place where it is possible to use the computer to improve efficiency. Action and phrase filters are designed into the system to facilitate the editing process. The analyst simply navigates to the filter screen and either selects verbs from a list of all the actions used in the task list or inputs words or phrases into the filter box. Filtering can be done based on similar actions (counsel, advise, recommend, inform, suggest) or a specific object or phrase in the task (i.e., subordinates, expense reports). Once tasks are filtered, only those containing the selected words are seen, allowing for an easy review of similarities and redundancies.

Similar or redundant tasks are identified and a representative task statement is chosen from the group. If none of the original task statements represent the group of tasks well enough, then a new task statement is written. The original task statements are then removed from the task list; however, they are subsumed under the representative task statement and can be reviewed. This process leaves all tasks generated by the SMEs completely untouched as a historical record of the origin of the edited task. The historical record is kept to allow for review of how tasks were combined to create new tasks and to allow the reversal of this process if necessary. If during the editing process the analyst decides that a task statement was combined with others in error or inappropriately, should be combined with other task statements, or should stand alone, then it can then be removed and returned to the original task list and subsequently be placed more appropriately. This process repeats until all tasks have been combined with other similar tasks or designated as stand alone tasks. In addition, all task statements are reviewed for clarity, typographical and grammatical errors, and corrected if necessary. During the process, if there are any questions or tasks needing clarification, then the analyst can contact the designated SME. Finally, the job analyst reviews the final task list and assigns all the tasks to GWAs. This editing process is the most time consuming phase and can take up to one week, but usually can be completed in 2 days. This time frame is dependent on the complexity of the job, the number of tasks that were generated initially, and the experience of the skill analyst.

*Task List Review and Finalization*

Once the task list has been edited and reduced to a manageable size of clearly written task statements, then it is sent for a review. Supervisors are typically chosen for this role, and anywhere from 3-5 managers are selected. However, any person that is knowledgeable about the job can be used as a reviewer. Each reviewer works independently using a web-based process. The tasks are presented by listing each GWA and then all the tasks assigned to it. In this way, all the tasks that relate to a similar job activity are grouped together, and redundancies and missing tasks are easier to identify. The reviewers are asked to read tasks for clarity and completeness and recommend any changes that are appropriate. They can rewrite or modify a task, assign it to a different GWA, recommend it for deletion if it is not performed, and add new tasks that were not included in the final list. The reviewer also can add comments and explanations for clarification of his or her recommendations. Once all the reviewers have completed their review their comments are forwarded to the analyst for evaluation and final decision. The analyst integrates the recommendations provided from all the reviewers and chooses how to proceed with making any changes. Additionally, the analysts may contact a reviewer for further clarification if needed. At this point the task list is final and complete. The reviewers typically take a few hours to complete this process and the finalization usually takes a few hours as well, but no more than one day. A summary of the task list development process and time frame is presented in Table 3.

*Other Occupationally Specific Information*

In addition to task information, other occupationally-specific information is collected using this process. Specifically, information about tools, machines, resources used, and occupationally-specific knowledges are collected together with the task generation process. Tools are physical objects used on the job that require training in order to be used. Unique knowledge is information that took time or training to acquire. Resources are reference materials used to locate or house information about processes. For example, statistical software is a *tool* used in conjunction with the *unique knowledge* of statistics which may be supplemented by using the statistical software manual as a *resource*. The development of the tool, unique knowledge, and resource list follows the same pattern as developing the task list. After SMEs complete the task generation phase they are asked to review a list of existing tools and machines, a list of knoweldges, and a list of resources. These lists, similar to legacy task information, are available based on previous job analysis for the current position, job analysis performed on a similar occupation, or other documentation available, and are designed to be a starting point in the generation of a comprehensive list tools, knowledges, and resources. SMEs then can add to the list any tools, knowledges, or resources not listed. During the editing phase any duplications and redundancies are eliminated. Further, clarifications and corrections can be made. During the review process the reviewers also review the lists of tools, knowledges and resources and make any recommendations for changes, additions and deletions. These recommendations are then reviewed and if appropriate, adopted. The result is a final list of all tools used on the job, a complete list of all specific knowledges required, and a final list of resources that may be used in the job. In addition to providing additional job information, this information than can be used to further validate and evaluate the comprehensiveness of the task list.

*Skills and Abilities*

The O*NET model also provides a comprehensive list of skills and abilities that are applicable across multiple jobs (Fleishman, Costanza, & Marshall-Mies, 1999; Mumford, Peterson, & Childs, 1999). While a full description of the O*NET skills and abilities is beyond the scope of this manuscript, it is important to note that these general skills and abilities can be used in the job analysis process. To determine which skills and abilities are necessary for job performance, each task is linked to one primary skill and/or ability and one secondary skill and/or ability. A primary skill or ability is one that is critical and necessary for the successful performance of the task. A secondary skill or ability is one that also is necessary for successful performance of the specific task but may not be as important or critical as the primary skill or ability. A task may be linked only to skills or only to abilities (it does not have to be linked to both) or it only may have a primary skill and/or primary ability but not a secondary one. Earlier work on the ability taxonomy suggested that it is best to link tasks and not broader groupings, such as GWAs or the entire job (Fleishman & Mumford, 1988). Further, recent work on competencies has suggested that more accurate descriptions are obtained when task level information is used (Lievens, Sanchez, & DeCorte, 2004). By linking at the task level more accurate judgments about the importance of specific skills and abilities can be made. In addition, by linking tasks to skills and abilities, differences between tasks in the abilities required for successful performance are revealed. Finally, because each task is linked independently, it is possible that a broader range of skills and abilities are selected than when the job as a whole is considered (Fleishman & Mumford, 1988).

The linkage of tasks to skills and abilities is done by trained job analysts. The job analyst is typically the same person who edited the task list, and therefore more familiar with the job. Each task statement is reviewed by the job analyst and a determination made as to which skills and/or abilities the task should be linked to. Previous research using the O*NET taxonomies suggested that analysts provide reliable and valid ratings for skills and abilities (Fleishman, et al., 1999; Mumford, et al., 1999). The linking is conducted on-line using a tool in which all skills and abilities (with their definitions) are available using drop-down menus. The task list is automatically available at the conclusion of the review and finalization stage. The result of this process is a task list for which each task is linked to one or more skills and/or abilities. Depending on the purpose, the list can be examined from a task focus, identifying skills and abilities for each task, or from a skills and abilities perspective, showing which tasks are linked to a specific skill or ability. It is also possible to identify a list of skills and abilities across all tasks. This indicates those skills and abilities that are necessary for job performance for the job as a whole as the skills and abilities are needed for the performance of at least one task. The time frame for linkages is 1 day.

*Surveys*

The final step in the job analysis process is to obtain information from a wide sample of the worker population using surveys. Surveys are conducted on-line using a survey tool. The survey tool includes pre-determined rating scales (e.g., frequency, importance, or criticality) for tasks as well as those appropriate for skills, abilities, tools and knowledges. Additional scales may be added or specific scales may be modified if necessary. The appropriate information (i.e., tasks, tools, skills) is automatically included from the database. Invitations to participate in the survey are automatically generated and sent via e-mail with general information about the purpose of the survey (tailored for each survey) as well as URL and login information. A summary of the web-based job analysis process is provided in Figure 1.

*Updating Information*

One of the criticisms of traditional job analysis methodologies has been the difficulty of updating the information. This system allows for relatively easy and efficient updates. As tasks provide the focus point of this job analysis system (skills and abilities are linked to tasks), one simple way to update the information is to repeat the task review process. This process, as seen in Table 3 takes less than 2 days, and includes the review of the task list by supervisors and/or job incumbents. The feedback from the supervisors and job incumbents can be used to make changes in the task list as outlined in the review and finalization process. During the task review the reviewers also can make changes in the tools, knowledges, and resources lists. Changes in skills and abilities need to occur only for those tasks that have changed. It also is possible to engage in a more thorough revision of the job analysis utilizing the final task list from the original job analysis as legacy data and repeating the entire process. While more time consuming than the previous process, it still is relatively efficient, as the entire process typically takes two weeks.

## Application and Validation

The validity of this approach can be established in several ways, such as the degree to which the system provides for checks and balances, and ensures internal and external validity. The inclusion of job incumbents and managers throughout the job analysis process provides support for the content validity of the information obtained. Further, the process of task generation, editing, and consolidation of the multiple task lists, and review allows for input from both job incumbents and managers at multiple points of the job analysis process. This input helps ensure that the task list is job relevant and comprehensive.

The web-based job analysis process described above was used in several government agencies, most notably the U.S. Navy. The pilot project for application of this process in the Navy was conducted in 2001 and included both enlisted and officers in the area of Information Technology (IT). After implementation, the outcome of the web-based job analysis process was compared to the traditional methodology used by the Navy using Naval and Occupational Standards. Task information about these jobs was already available from previously conducted job analyses using the Naval and Occupational Standards approach, and new information was collected using the web-based approach. Five jobs were identified in the IT workforce (a) Information System Administration, (b) Communications, (c) Installation, Maintenance, and Repairs, (d) Information System Security, and (e) Management and Supervision. A minimum of 8 people were used for the task generation phase for each job, which also included a review of an available task list as legacy tasks. In the review process, at least 3 reviewers for each job were used. The task list from the task generation phase was found to be almost complete, less than 5% of the total number of tasks were added in the review process (Garcia, Gasch, & Wertheim, 2002). This finding, combined with the results of Mumford and his colleagues (Clifton, et al. 1991; Connelly, et al., 1991; Reiter-Palmon, et al., 1990), provides strong evidence for the validity of this approach in generating a task list that is complete and comprehensive.

In addition, this pilot study found that using this web-based job analysis resulted in a more comprehensive description of the work than using the Occupational and Naval standards (Garcia, et al., 2002). The web-based system generated 200 tasks that were not captured by the Naval and Occupational standards and missed only 15 tasks total across the five occupations compared to the Standards. Further, most of the missed tasks represented obsolete technologies, and therefore tasks that were not performed at the time of the job analysis. In addition, tasks developed using the web-based system were judged to be more informative, more specific, and to have greater scope than those generated by the Naval and Occupational Standards. Tasks covered multiple aspects of the job from work planning and prioritizing, system maintenance, troubleshooting, and communication with other personnel.

Finally, surveys of the task list were sent to a representative sample of enlisted personnel and officers, using five different scales, including whether or not the individual performed the task, consequences of misperformance, delay tolerance, time on task, and training adequacy. The surveys were completed by over 700 individuals across the five jobs. Calculation of response rates were not possible because records of the number of invitations sent was not kept. However, a review of the locations revealed that locations were representative of the Navy locations and jobs surveyed (Garcia, et al., 2002). Survey data was then used to identify mission critical tasks, specifically those tasks that are performed by a large number of incumbents, have serious consequences of misperformance, have a low delay tolerance, and involved more time on task.

Information from the job analysis and surveys was used in this pilot project for multiple purposes (Garcia, et al., 2002). First, because the Occupational and Naval Standards are used as the primary source for identification of training needs for the Navy, a comparison between the task list and curriculum can provide an indication of training gaps. In addition, survey data can offer additional information to identify these training gaps because personnel provided information on whether training on each task was available. Second, possible consolidation of training can be determined by identifying similar tasks across jobs. Training currently is conducted for each job separately. However, there is overlap in the tasks performed, and therefore, it is possible to consolidate some training efforts. Third, advancement exams are used in the Navy to determine eligibility for advancement, based on mastery of critical knowledges. However, these exams are based on the school curriculum and Naval and Occupational Standards which were found to be lacking. Using the web-based job analysis advancement exams can be prepared that more accurately reflect job demands. Fourth, because of the link to O*NET skills and abilities, it is possible to identify civilian occupations that have similar requirements. A comparison therefore can be made between the average Navy salary and that of the civilian occupation to determine whether the Navy is competitive.

Since the pilot study, the web-based job analysis has been implemented for over 700 enlisted, officer and civilian jobs in the Navy. While the web-based system has been designed for distributed, individual work on the task generation step, there have been exceptions. In some cases, SMEs were brought together for a one-day session of task generation proctored by a job analyst, with each SME working independently on a web connected computer. In addition, while the web-based system was set up to be self-guided, in some cases, help and support were provided via e-mail or phone to SMEs.

## Evaluation

### *Strengths and Limitations*

Early work provided promising evidence for the validity and utility of the web-based job analysis system. This web-based system is based on O*NET, and therefore based on solid research on job analysis and the elements of work (Campion, et al., 1999). Using principles gained from knowledge elicitation and cognition (Cooke, 1994; Hoffman, et al., 1995; Nisbett & Ross, 1980; Sauer, et al., 2000), a structured cued-recall methodology was developed that allowed for easy computer application and its use with no or limited guidance. In addition, early application of this structured methodology revealed that most tasks were generated by one group of SMEs in one day, and resulted in more accurate and comprehensive task lists than traditional methodologies (Garcia, et al., 2002; Sager, et al., 1999).

In addition, the web-based methodology of job analysis addresses some of the concerns presented by Morgeson and Campion (1997) regarding the social and cognitive sources of inaccuracy in job analysis. Of specific interest here are those factors that affect the generation of job analysis information. By generating information individually and not in a group setting, as is done so often in interviews, some of the social pressures, such as conformity, extremity shifts, impression management, may be eliminated. Similarly, some of the cognitive sources of inaccuracy may be eliminated due to the structured nature of the recall and by forcing more controlled processing, specifically those biases due to information overload and use of heuristics (Morgeson & Campion, 1997).

An additional strength of this process is the flexibility in applying the web-based task generation process. In addition to completing the task generation as described, several possible modifications have emerged during the course of the application of the process in the Navy and in other organizations. The first modification included support for the system via e-mail or phone. This allowed individuals who encountered either hardware or software problems, or had difficulties in understanding and following the process, to ask questions and receive help. A second modification included a group session, in which an introduction and explanation of the process via conference call were given, but then each individual worked alone at their location. A third modification of the web-based application included a group session where all SMEs were brought to the same location. They received the same introduction and explanation, and also were able to ask questions and get help directly and from a live job analyst. SMEs then worked independently each using an internet- connected computer. Finally, it was possible to collect the task information using a combination of these approaches (for example, some data was collected individually from many different locations, while some was collected in group sessions). Each of these approaches has its strengths and weaknesses.

Using the distributed method provides a flexibility that is not available in traditional forms. Job incumbents from any location worldwide may participate, and there is no additional cost associated with bringing in a diverse group for a facilitated session, as is used in traditional job analysis methodologies. Because SMEs can participate in this process without leaving their job for a period of time, supervisors are more likely to nominate the type of SME that is truly needed for this effort – someone who is a high performer and therefore also in demand in the workplace. In addition, the Navy must address some unique concerns relating to data collection from personnel located world wide including in combat zones. The distributed system allows access to those individuals that otherwise would not be able to participate either due to location or the current position they have. Finally, SMEs also can complete the work at their own pace which allows them to complete the work over several days if necessary based on job demands. However, because SMEs still are on the job, finding the time to complete the work associated with the task generation can be difficult. It is not uncommon to have SMEs start the process and not complete it in the time frame designated (usually two weeks). In addition, because the process is voluntary, it is sometimes challenging to get SMEs to participate. Another issue, more prevalent with the fully distributed model, is that the quality of the task statements generated can be quite diverse, with some task statements being poorly written or unclear. One solution for these problems is to identify more SMEs so that the number of SMEs completing the process still is adequate and that quantity would provide what is lacking in quality. In addition, providing help, either through e-mail or phone, increases completion rates as SMEs can get help with any difficulties that may have prevented them from completing the work.

There are several advantages associated with generating tasks in a proctored group setting. While typically more expensive than the distributed method, some of the cost may be mitigated by the fact that individuals from multiple occupations can generate tasks simultaneously, each on a web-connected computer, in one session. Because the work is completed individually, the group does not have to include only individuals from one job, and one facilitator can help a large number of individuals (10-20) – more than would be present at a face-to-face interview. In one case, over 70 individuals from 20 different jobs completed the process in a three day period. Because individuals are required to attend the session, the rate of completion is higher than in a distributed methodology. Individuals tend to spend the day focusing on the job analysis and are not distracted by work requirements. In addition, any difficulties associated with the task generation can be addressed immediately, whether they are software related, hardware related, or related to lack of understanding of the process. Further, the facilitator may be able to catch and correct typical problems associated with task generation such as lack of clarity or detail, resulting in better quality task statements.

Another advantage of the web-based system is the ability to use the information gathered in multiple ways. Information generated from this system currently is being used in the Navy for several applications. First, overlap between jobs within and across job families can be determined using both task and KSAO data. Having both task and KSAO data can lead to better identification of the sources of the overlap and the degree of overlap, than using either one alone (Fleishman & Mumford, 1991; Levines, et al., 2004). The identification of overlap has several implications. First, as stated before, training that occurs separately now can be combined. Second, jobs can be reclassified into job families based on actual similarity of tasks performed and skills needed. Third, as a result of the identification of similarities, personnel may have additional avenues for advancement or lateral movement that were not available before. Finally, information from the web-based job analysis will be used in the 5 Vector Model (5VM) now being developed. The 5VM allows sailors to identify job requirements of those positions they want to advance to and request training that would facilitate their advancement.

Another important advantage emerging from the previous ones is cost effectiveness. One important concern with existing methodologies of job analysis is the cost associated with obtaining and maintaining current job information. Current job analysis techniques take longer and require more personnel hours from incumbents, supervisors and job analysts. The web-based system provides cost savings due to the shortened time frame required to gather information and the lower time commitment from job incumbents and supervisors. Further, cost efficiency is achieved by the ability to collect job analysis information from multiple locations at the same time, without incurring travel costs. Additionally, because the web-based system allows for collection of both task and KSAO information as well as survey data, more information is provided to the organization, which allows multiple uses of the information gathered. Finally, job analysis information is gathered quickly and can be revised quickly ensuring its accuracy and timeliness, allowing organizations to maximize the benefits from the information collected.

The ability to use the internet for this application is a strength but also can be a limitation. In some situations, access to the internet is not available to employees or is not reliable. Under those conditions alternatives must be found. For the generation of tasks, job incumbents may attend a one-day facilitated session instead of a distributed session. Survey data also can be collected using paper and pencil as opposed to the internet. In addition, some individuals may not be as well versed on using the internet or may be afraid to use the computer, making it more difficult to collect the information needed. This may be an issue for jobs where computer use is not required or necessary. While these types of jobs are somewhat less common, they still exist. When a job does not require computer use the importance of help in the form of a facilitated session or phone increases.

Finally, this system, as currently implemented, does not effectively address all types of tasks; specifically, team and social tasks. The tasks are generated from an individual perspective which limits the inclusion of the team context. This can be especially problematic with cross-functional teams in which individuals have unique contributions to a higher level group task. Simply aggregating these individual tasks is not sufficient to identify the focal group task. Additionally, there are technical issues involved with such an endeavor, such as identifying individual team members and their contribution. The issue with soft skills such as communication and leadership is a bit more straightforward. The O*NET taxonomies used by the system do not specifically address them. Skills such as social perceptiveness are part of O*NET but they do not clearly capture affective aspects, for example, consideration. Additionally, other worker-oriented characteristics like attention to detail or ethics may be of importance to certain tasks such as explosive ordnance disposal or handling sensitive information. An effort needs to be made to access some of the characteristics the worker brings to the task, for the task does not exist in a vacuum.

*Future Research*

The work described above provides promising evidence for the validity and utility of a web-based job analysis system that can generate both task and KSAO information in a cost and time effective manner. In addition, the system can provide both broad and general descriptors of the work (GWAs, skills, and abilities) as well more occupationally-specific information (tasks, tools, knowledges, and resources). This system also provides a solution to some of the criticisms of traditional job analysis methodologies with regard to their flexibility, efficiency, cost effectiveness and responsiveness to business needs (Sanchez, 1994, 2000). In addition, this system may address some of the concerns raised by Morgeson and Campion (1997) regarding social and cognitive sources of inaccuracy of job analysis data generation. Of course, this system does not eliminate all sources of bias, particularly those related to other phases of the job analysis such as judgment.

Preliminary results indicate that the web-based system for the generation of tasks provides equal or superior results to traditional job analysis methodologies; however, more information is needed. Specifically, research should address the question of how many SMEs are required to generate the task data such that it would be equivalent to traditional methods, and at what point does the addition of more SMEs become counterproductive. Further, it is possible that the number of SMEs may depend on the administration of the task generation system (distributed vs. facilitated session) and the type of job and job requirements (e.g., are computers used frequently, is written communication an important part of the job, educational requirements, etc.).

In addition, research should address the question of the quality of the data generated using this methodology. Comparisons should be made not only relative to traditional job analysis methodologies, but also within this system, by comparing a distributed model to a proctored group model. For example, what is the rate of completion of the task generation process in a distributed methodology, with or without phone or e-mail support compared with proctored group sessions. Are completion rates higher when support is provided in a distributed session compared to self-guided? Are people asking for help more likely to complete the session, or more likely to start?

Finally, research needs to address the issue of skill and ability linkage. While preliminary results from O*NET support the reliability of job analysts in making these links, data are not available for this system. Additionally, it is not clear if and how job analyst experience may influence the linkage decision and the reliability of the linking of skills and abilities to tasks.

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Table 1

*O*NET Generalized Work Activities (GWAs)*

| Activity Title | Activity Description |
|---|---|
| 1. Getting Information | Observing, receiving, and otherwise obtaining information from all relevant sources. |
| 2. Identifying Objects, Actions and Events | Identifying information received by categorizing or estimating, recognizing differences or similarities, or detecting changes in circumstances or events. |
| 3. Monitoring Processes, Materials or Surroundings | Monitoring and reviewing information from materials, events, or the environment, to detect or assess problems |
| 4. Inspecting Equipment, Structures or Materials | Inspecting equipment, structures, or materials to identify the causes of errors or other problems or defects. |
| 5. Estimating the Quantifiable Characteristics of Products, Events or Information | Estimating sizes, distances, and quantities; or determining time, costs, resources, or materials needed to perform a work activity. |
| 6. Judging the Qualities of Objects, Services or People | Assessing the value, importance, or quality of things or people. |
| 7. Evaluating Information to Determine Compliance With Standards | Using relevant information and individual judgment to determine whether events or processes comply with laws, regulations, or standards. |
| 8. Processing Information | Compiling, coding, categorizing, calculating, tabulating, auditing, or verifying information or data. |
| 9. Analyzing Data or Information | Identifying the underlying principles, reasons, or facts of information by breaking down information or data into separate parts. |
| 10. Making Decisions and Solving Problems | Analyzing information and evaluating results to choose the best solution and solve problems. |
| 11. Thinking Creatively | Developing, designing, or creating new applications, ideas, relationships, systems, or products, including artistic contributions. |
| 12. Updating and Using Relevant Knowledge | Keeping up-to-date technically and applying new knowledge to your job. |
| 13. Developing Objectives and Strategies | Establishing long-range objectives and specifying the strategies and actions to achieve them. |

| Activity Title | Activity Description |
| --- | --- |
| 14. Scheduling Work and Activities | Scheduling events, programs, activities, as well as the work of others. |
| 15. Organizing, Planning and Prioritizing Work | Developing specific goals and plans to prioritize, organize, and accomplish your work. |
| 16. Performing General Physical Activities | Performing physical activities that require considerable use of your arms and legs and moving your whole body, such as climbing, lifting, balancing, walking, stooping and handling of materials. |
| 17. Handling and Moving Objects | Using hands and arms in handling, installing, positioning, and moving materials, and manipulating things. |
| 18. Controlling Machines and Processes | Using either control mechanisms or direct physical activity to operate machines or processes (not including computers or vehicles). |
| 19. Working with Computers | Using computers and computer systems (including hardware and software) to program, write software, set up functions, enter data, or process information. |
| 20. Operating Vehicles, Mechanized Devices or Equipment | Running, maneuvering, navigating, or driving vehicles or mechanized equipment, such as forklifts, passenger vehicles, aircraft, or water craft. |
| 21. Drafting, Laying Out, and Specifying Technical Devices, Parts, or Equipment | Providing documentation, detailed instructions, drawings, or specifications to tell others about how devices, parts, equipment, or structures are to be fabricated, constructed, assembled, modified, maintained, or used |
| 22. Implementing Ideas, Programs, Systems or Products | Carrying out work activities using one's own ideas or directions and instructions from others to install, prepare, deliver, construct, or complete products or systems. |
| 23. Repairing and Maintaining Mechanical Equipment | Servicing, repairing, adjusting, and testing machines, devices, moving parts, and equipment that operate primarily on the basis of mechanical (not electronic) principles. |
| 24. Repairing and Maintaining Electronic Equipment | Servicing, repairing, calibrating, regulating, fine-tuning, or testing machines, devices, and equipment that operate primarily on the basis of electrical or electronic (not mechanical) principles. |

| Activity Title | Activity Description |
|---|---|
| 25. Documenting/Recording Information | Entering, transcribing, recording, storing, or maintaining information in written or electronic/magnetic form. |
| 26. Interpreting the Meaning of Information for Others | Translating or explaining what information means and how it can be used. |
| 27. Communicating with Supervisors, Peers or Subordinates | Providing information to supervisors, co-workers, and subordinates by telephone, in written form, e-mail, or in person. |
| 28. Communicating with Persons Outside the Organizations | Communicating with persons outside the organization, representing the organization to customers, the public, government, and other external sources. This information can be exchanged in person, in writing, or by telephone or email. |
| 29. Establishing and Maintaining Interpersonal Relationships | Developing constructive and cooperative working relationships with others, and maintaining them over time. |
| 30. Assisting and Caring for Others | Providing personal assistance, medical attention, emotional support, or other personal care to others, such as workers, customers, or patients. |
| 31. Selling or Influencing Others | Convincing others to buy merchandise/goods or otherwise change their minds or actions. |
| 32. Resolving Conflicts and Negotiating With Others | Handling complaints, settling disputes, and resolving grievances and conflicts, or otherwise negotiating with others. |
| 33. Performing for or Working Directly With the Public | Performing for people or dealing directly with the public. This includes serving customers in restaurants and stores, and receiving clients or guests. |
| 34. Coordinating the Work and Activities of Others | Getting members of a group to work together to accomplish tasks. |
| 35. Developing and Building Teams | Encouraging and building mutual trust, respect, and cooperation among team members. |
| 36. Training and Teaching Others | Identifying the educational needs of others, developing formal educational or training programs or classes, and teaching or instructing others. |
| 37. Guiding, Directing, and Motivating Subordinates | Providing guidance and direction to subordinates, including setting performance standards and monitoring performance. |
| 38. Coaching and Developing Others | Identifying the developmental needs of others and coaching, mentoring, or otherwise helping others to improve their knowledge or skills. |
| 39. Providing Consultation and Advice to Others | Providing guidance and expert advice to management or other groups on technical, systems, or process-related topics. |

| Activity Title | Activity Description |
| --- | --- |
| 42. Monitoring and Controlling Resources | Monitoring and controlling resources and overseeing the spending of money. |

Table 2

*Steps for Task Generation*

| Steps |
| --- |
| 1. Review of legacy data (if available) |
| 2. Selection of GWAs (6-12) |
| 3. Selection and development of action words and objects |
| 4. Creation of 2 word statements |
| 5. Modification of 2 word statements by adding statement modifiers and object modifiers |

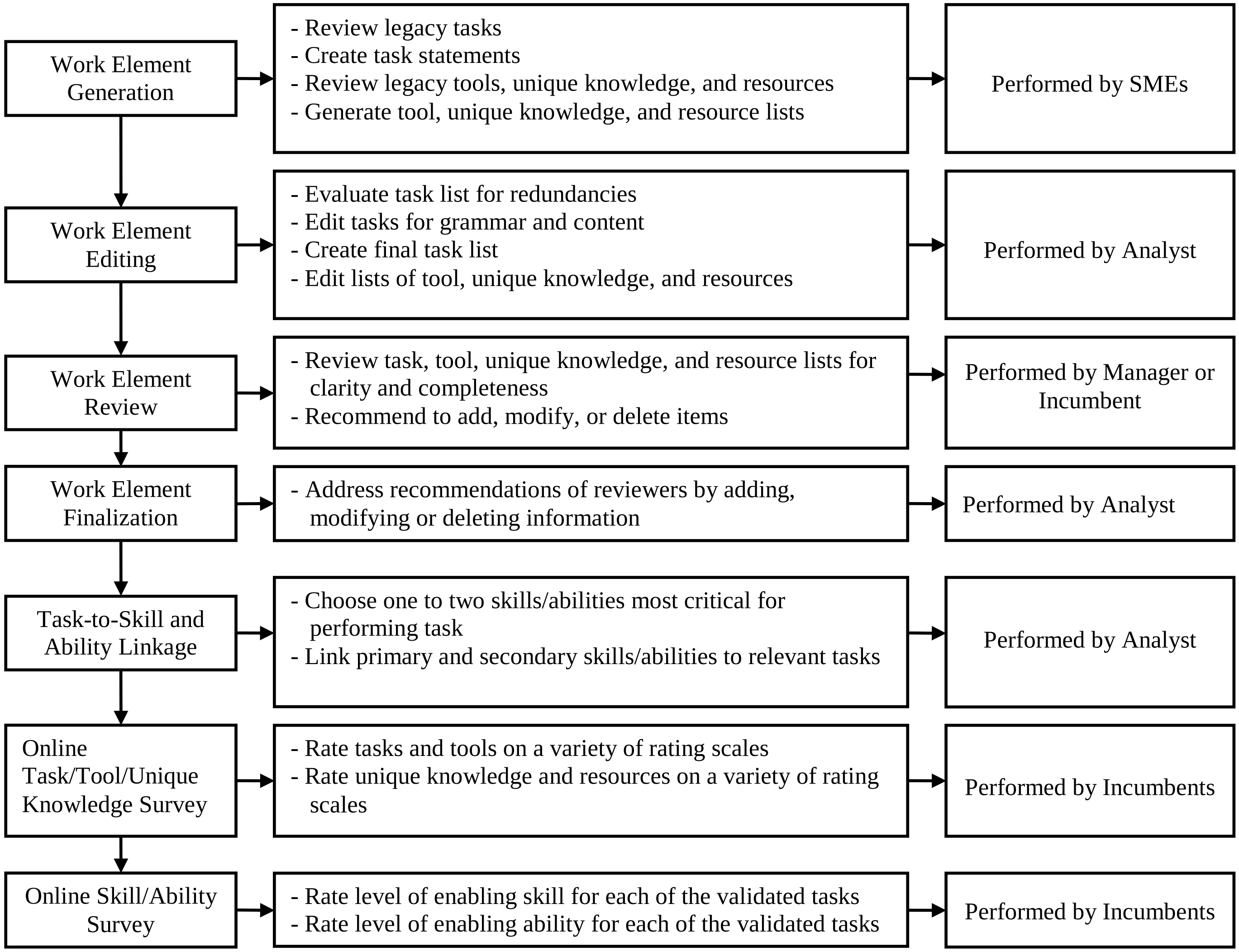
Table 3

*Process and Duration of Completion of Job Task Analysis*

| Process | Duration of Process |
|---|---|
| 1. Task Generation | Time – 1 day |
| 2. Edition | Time – 1 week |
| 3. Review | Time – several hours (2-4) |
| 4. Finalization | Time – 1 day |

List of Figures

*Figure 1*. Graphical depiction of web-based job analysis process.




Adapted from SkillsNET (SkillsNET, 2004)