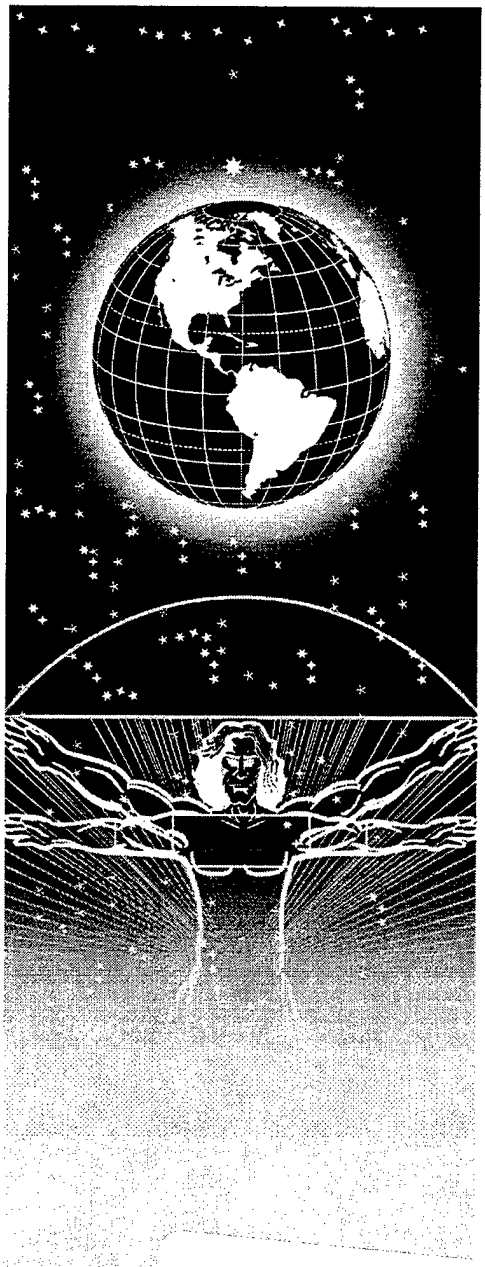
AL/OE-TR-1996-0158 V.4B



UNITED STATES AIR FORCE
ARMSTRONG LABORATORY

Preventing Work-Related Musculoskeletal Illnesses Through Ergonomics: The Air Force PREMIER Program, Volume 4B: Research Report For Level I Ergonomics Methodology Guide For Maintenance/Inspection Work Areas

Richard Barker
Andrew Marcotte
Marilyn Joyce
Van Calvez

The Joyce Institute/Arthur D. Little
1313 Plaza 600 Building
Seattle, Washington 98101

Edward J. Klinenberg, Major, USAF
Cynthia D. Cogburn, Major, USAF
Don E. Goddard, Major, USAF

May 1997

Occupational and Environmental Health Directorate
Occupational Medicine Division
2402 E Drive
Brooks AFB, TX 78235-5114

NOTICES

When Government drawings, specifications, or other data are used for any purpose other than in connection with a definitely Government-related procurement, the United States Government incurs no responsibility or any obligation whatsoever. The fact that the Government may have formulated or in any way supplied the said drawings, specifications, or other data, is not to be regarded by implication, or otherwise in any manner construed, as licensing the holder or any other person or corporation; or as conveying any rights or permission to manufacture, use, or sell any patented invention that may in any way be related thereto.

The mention of trade names or commercial products in this publication is for illustration purposes and does not constitute endorsement or recommendation for use by the United State Air Force.

The Office of Public Affairs has reviewed this report, and it is releasable to the National Technical Information Service, where it will be available to the general public, including foreign nationals.

This report has been reviewed and is approved for publication.

Government agencies and their contractors registered with Defense Technical Information Center (DTIC) should direct requests for copies to: Defense Technical Information Center, 8725 John J. Kingman Rd., STE 0944, Ft. Belvoir, VA 22060-6218.

Non-Government agencies may purchase copies of this report from: National Technical Information Services (NTIS), 5285 Port Royal Road, Springfield, VA 22161-2103.

EDWARD J. KLINENBERG, Maj, USAF, BSC
Chief, Ergonomics Function

TIMOTHY C. IHRY, Lt Col, USAF, BSC
Chief, Occupational Medicine Division

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	May 1997	Final, 1996

4. TITLE AND SUBTITLE
Preventing Work-Related Musculoskeletal Illnesses through Ergonomics: The Air Force PREMIER Program, Volume 4B: Research Report for Level I Ergonomics Methodology Guide for Maintenance/Inspection Work Areas

5. FUNDING NUMBERS

6. AUTHOR(S)
Richard Barker, Andrew Marcotte, Marilyn Joyce, Van Calvez
Edward J. Klinenberg, Maj, Cynthia D. Cogburn, Maj, Don E. Goddard, Maj

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Pacific Environmental Services
560 Herndon Parkway, Suite 200
Herndon, Virginia 20170

The Joyce Institute/Arthur D. Little
1313 Plaza 600 Building
Seattle, Washington 98101

8. PERFORMING ORGANIZATION REPORT NUMBER

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Armstrong Laboratory
Occupational and Environmental Health Directorate
Occupational Medicine Division
2402 E Drive
Brooks Air Force Base, Texas 78235-5114

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
AL/OE-TR-1996-0158 vol.4B

11. SUPPLEMENTARY NOTES

12a. DISTRIBUTION AVAILABILITY STATEMENT
Approved for public release; distribution is unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*

This report describes the results of a pilot test to assess the reliability, sensitivity, validity, and practicality of the Level I Ergonomics Assessment Methodology Guide for Maintenance/Inspection Work Areas. Overall, the pilot test provided evidence to indicate that the developed Level I Methodology assists technicians in arriving at similar solutions as would be selected by an ergonomist for maintenance/inspection tasks. Solutions selected by the technicians agreed with the solutions selected by a consensus of ergonomists 61% of the time. Task duration appeared to play a large role in risk determination discrepancies between the Level I Methodology (both technicians and consensus ergonomists) and the Gold Standard ergonomist. High duration tasks were more likely to be rated high risk by the Level I Methodology, whereas jobs with multiple, moderate duration tasks were more likely to be rated medium risk,

14. SUBJECT TERMS
Ergonomics
Work-Related Musculoskeletal Disorders
Cumulative Trauma Disorders
Maintenance/Inspection workplaces

15. NUMBER OF PAGES
320

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	UL

Standard Form 298 (Rev. 2-89) (EG)
Prescribed by ANSI Std. 239.18
Designed using Perform Pro, WHS/DIOR, Oct 94

TABLE OF CONTENTS

This page intentionally left blank

TABLE OF CONTENTS (Cont'd)

This page intentionally left blank

LIST OF FIGURES

LIST OF TABLES

This page intentionally left blank

1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION TO THE LEVEL I ERGONOMICS ASSESSMENT AND PROBLEM-SOLVING METHODOLOGY RESEARCH REPORT

The U.S. Air Force has sponsored the development of standard ergonomics assessment methodology guides and management tools which will be integrated into the AFOSH Program. These methodologies and tools will be used as a means to minimize or eliminate work-related musculoskeletal disorders (WMDs) associated with routine exposure to ergonomics risk factors at Air Force installations.

This **Research Report** describes how effectively the Level I Ergonomics Assessment and Problem-Solving Methodology for Maintenance and Inspection Work Areas performed in testing, and therefore, how effective it will be as a tool for providing the means for Bioenvironmental Engineering (BEF) to conduct aggressive task-based problem-solving in an Ergonomics Problem Area (EPRA). The methodology which this report describes was initially used for the development and testing of the Administrative Guide. It will subsequently be applied to the development and testing of the Warehouse and Assembly Guides. In order to obtain a clear understanding of the results, an overview of the Methodology design and development process is provided below.

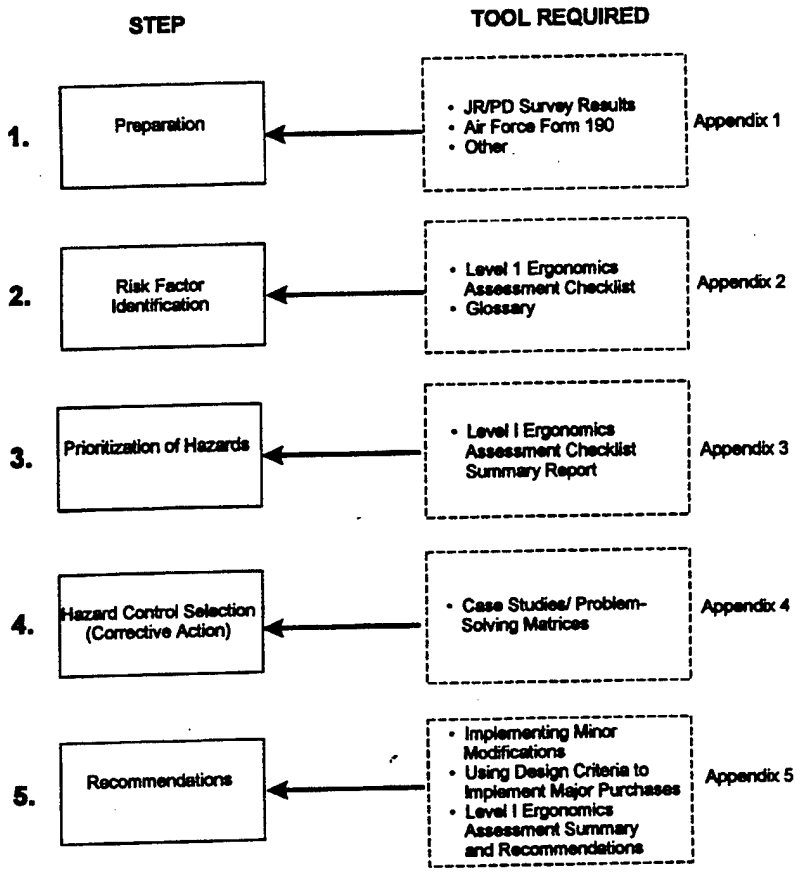
1.2 METHODOLOGY DESIGN

The Methodology, designed for use by a BEF technician with 2-3 years of experience, is applied by following five primary steps:

Step 1. Preparation
Step 2. Risk Factor Identification
Step 3. Prioritization of Hazards
Step 4. Hazard Control
Step 5. Recommendations

The **Level I Ergonomics Assessment** process is shown in Figure 1.1.

Figure 1.1
Level 1 Assessment Process



1.3 DEVELOPMENT AND TESTING PROCESS

The above design is the result of an iterative development and testing process that benefited from the support and cooperation of Air Force personnel at several Air Force Materiel Command (AFMC) locations:

- Armstrong Laboratory/Brooks AFB, Texas
- Wright-Patterson AFB, Ohio
- Eglin AFB, Florida
- Tinker AFB, Oklahoma
- Hill AFB, Utah

The Methodology design incorporates the results of a focused literature review, strategic site visits, criteria established by the Air Force, and input from Air Force technical advisors.

The testing and validation processes were conducted in two primary phases: alpha testing and beta testing. During the alpha phase, ergonomists tested the Methodology. During the beta phase, Air Force personnel tested the Methodology. For each phase, the Methodology was tested for usability, reliability, sensitivity, and validity. Usability testing was performed to ensure that users would be able to apply the Methodology as intended. Reliability testing was performed to determine how consistently that application of the Methodology yielded the same results. Sensitivity testing was performed to determine if the Level I Assessment can determine the difference between actual risk levels in a job. Finally, validity testing was conducted to measure how closely the results from experienced ergonomists matched the results obtained by Air Force personnel. The methods, rationale, and results of the testing and validation are detailed in this report.

1.4 PROJECT RESULTS

The results of the validation process provide evidence of the validity, reliability, sensitivity, and practicality of the Methodology. The results are summarized below:

Validity

- All of the job factor questions were supported by scientific research. The list of job factor questions was inclusive of the Job Factors which would occur in maintenance/inspection tasks.

- The overall theoretical framework of the checklist was a logical structure used in assessment tools which have been validated.

- The general class of corrective actions selected by the end-user agreed with the classes selected by a consensus of ergonomists 61% to 70% of the time. This result suggested that the Level I Ergonomics Assessment assisted end-users in generating solutions that experts would recommend.

- There was a significant relationship between the assessment results of end-users and the Gold Standard ergonomists.

Reliability

- The end users agreed on the selection of Job Factors 67% percent of the time.

Sensitivity

- The Methodology was sensitive enough to significantly distinguish between different levels of exposure and ergonomic risk factors (e.g., high and medium risk).

Practicality and Usability

- The Methodology received favorable usability comments and was well accepted by BEF technicians;

- The Methodology met and improved on the "time for completion" requirements established by the Air Force;

- The Methodology allowed end users to elicit solutions with a high level of reliability; and

- The Methodology was effective on a variety of Air Force Maintenance & Inspection tasks.

The Level I Methodology for Maintenance and Inspection Work Areas can be considered an effective means for identifying and controlling ergonomics hazards in Maintenance & Inspection work areas. In addition, it represents a strong foundation for developing similar approaches to reducing or eliminating the potential for WMDs in Warehouse and Assembly Work Areas.

Overall, the Methodology will enable Air Force personnel to identify appropriate solutions to the ergonomics hazards identified in Maintenance & Inspection jobs. The specific objectives which served as the basis for the Methodology development are compared with the actual performance of the Methodology in Table 1.1.

Table 1.1
Summary of Objectives and Performance

Design Feature	Air Force Criteria/Objective	Actual Methodology Performance
Meets needs of end user	Design the Methodology for use by a BEF technician with 2-3 years of experience.	**Objective met.** • Usability comments obtained during and after beta testing indicate that the Methodology design is appropriate to the expertise of the intended user. • The use of technical "jargon" is avoided. • Clear definitions are provided to eliminate the need for risk factor interpretation. • Step-by-step instructions are provided to the Methodology user through the entire analysis and pattern-matching process.
Ease of data collection analysis	Design the Methodology to enable the user to complete the data collection and analysis on a Maintenance & Inspection job in 1-2 hours. The goal was to minimize time requirements.	**Objective exceeded.** • In trials, the average time required by BEF technicians to complete the analysis process using the Level I Ergonomics Assessment Checklist and Checklist Scoring Summary was approximately 13 minutes. • Data collection is anticipated to require 30 and 60 minutes.
Ease of data collection	The Methodology can be completed through visual observation and employee/supervisor interview.	**Objective met.** • Observing the job/tasks is the primary means for collecting data. • Employees are interviewed informally to obtain comments that may be useful in the hazard identification or improvement processes.
Ease of problem identification	The Methodology should enable the user to identify potentially hazardous tasks within a shop and job.	**Objective met.** • The Level I Ergonomics Assessment Checklist and Checklist Scoring Summary provides an Overall Job Priority score as well as Task Priority Score(s). – The Overall Job Priority Score enables the shop to determine which jobs to fix first. – The Task Score(s) enables a corrective action team to focus on the specific part of the job which contributes most significantly to ergonomics hazard exposure.

Table 1.1
Summary of Objectives and Performance (Cont'd)

Design Feature	Air Force Criteria/Objective	Actual Methodology Performance
Ease of analysis	Enable the user to determine if the content of the job and task(s) meet established ergonomics (risk factor exposure) criteria.	**Objective met.** • Risk factor exposure time is calculated automatically (the user simply circles the appropriate response): both the total task duration as well as the proportion of the task time in which the Job Factor occurs are considered. • The scoring process provides a "high", "medium", or "low" priority score for both the Overall Job and the individual tasks within the job.
Ease of analysis	The Methodology will incorporate lessons learned from the Job Requirements and Physical Demands (JR/PD Survey) developed for use by Public Health (PHF).	**Objective met.** • The User's Methodology describes how to make the best use of information obtained from the Survey. • Information obtained from Part III of the JR/PD Survey provides an initial basis for Job Selection. • The 50 Case Study Problem-Solving Matrices were developed to correspond with the Maintenance & Inspection task types listed in Part III of the survey. • The identical body region categories are used in the survey and in the Level I Ergonomics Assessment Checklist. • The format and style of the documents are consistent.
Ease of control identification	Provide Case Studies that will serve as the basis for the pattern-matching process used to *match* the hazards identified in the tasks with controls that will reduce employee exposure to those hazards.	**Objective exceeded.** • In addition to 50 case studies, a section of the Methodology Guide is devoted to design criteria for implementing the controls that are most appropriate for the job.
Ease of control identification	Design the Methodology to enable the user to identify controls and develop a summary report in 1-2 hours. The goal was to minimize time requirements.	**Objective exceeded.** • The control identification (pattern-matching) process required an average of approximately 10 minutes. • Since the amount of problem-solving required during the beta test was intentionally restricted (to allow statistical comparisons), it is expected that the actual control identification/summary report process will require an average of approximately 25 minutes.

Table 1.1
Summary of Objectives and Performance (Cont'd)

Design Feature	Air Force Criteria/Objective	Actual Methodology Performance
Ease of control identification	Enable the user to choose from a menu of control options (both short-term and long-term) which when implemented, will minimize the risk of musculoskeletal disorders and the hazards identified within the job and tasks.	**Objective exceeded.** • The Methodology Guide (Appendix 4) includes comprehensive Case Study Problem-Solving Matrices which provide a list of controls for 50 of the most common types of maintenance/inspection tasks. • The controls are identified as *modifications/adjustments* (e.g., short-term) and *major changes* (long-term) • Each control is evaluated for its expected impact on health/safety, quality, and productivity.
Ease of follow-up implementation	Determine which type(s) of additional (Level II) analyses may be used if additional data is required.	**Objective met.** • The title page for each Case Study provides direction on the type of Level II analysis that may be completed to provide greater detail on ergonomics risk factor exposure.
Ease of follow-up implementation	The Methodology identifies metrics which will be used to judge the impact of ergonomics improvements on employee health, safety, and performance (e.g., quality, productivity).	**Objective met.** • The title page for each Case Study provides recommendations for the type of performance measures that may be used to justify solutions and/or measure the impact of those improvements. • The design of the Level I Ergonomics Assessment Checklist provides the means for re-evaluating the job after changes have been made. "Before" and "After" Job, Task, and Body Region Priority ratings can be compared to determine the immediate benefits to employee health and safety.

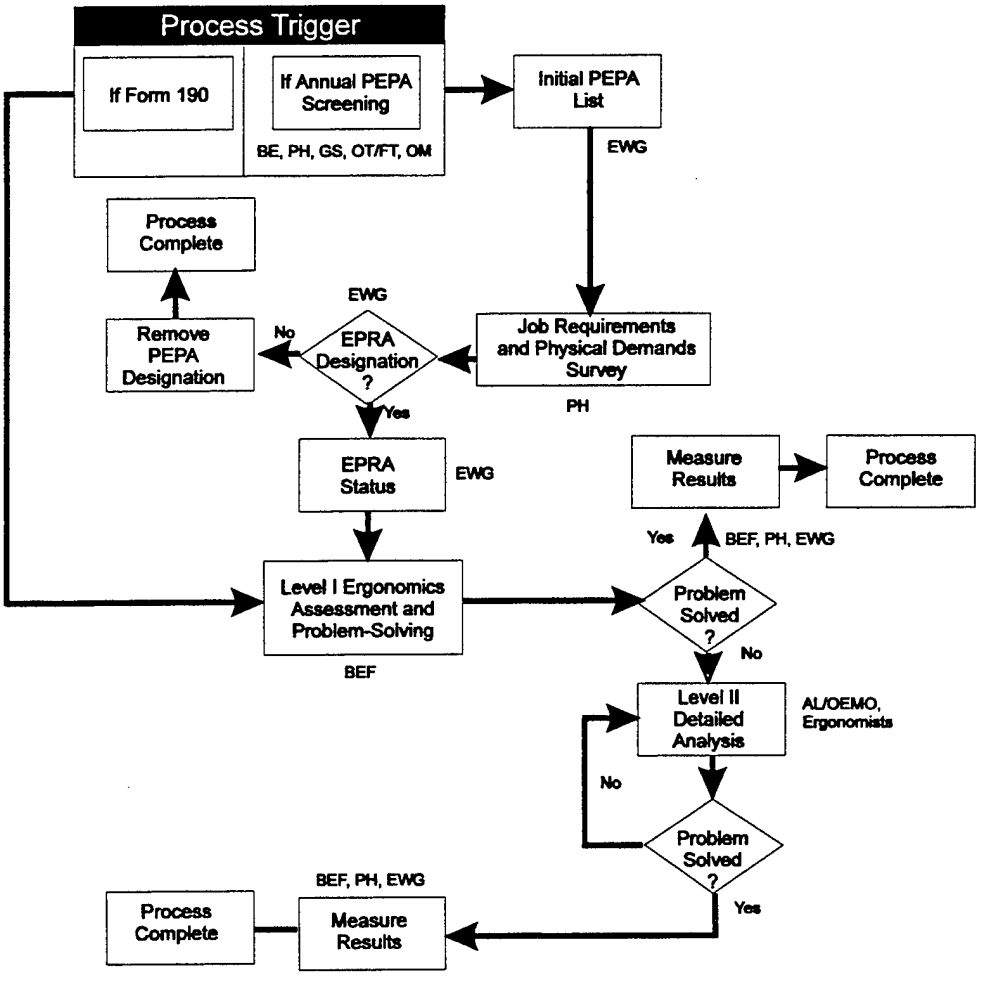
This page intentionally left blank

2.0 DEVELOPMENT PROCESS SUMMARY

2.1 USE OF THE METHODOLOGY IN THE TIERED APPROACH TO PROBLEM-SOLVING

The primary goal of an installation ergonomics program is to prevent work-related musculoskeletal disorders (WMD) among employees routinely exposed to ergonomics risk factors. The basic elements of an installation ergonomics program include: Potential Ergonomics Problem Area (PEPA) designation, Ergonomics Problem Area (EPRA) designation and removal, work area analysis, medical management, and training and education. Both qualitative (PEPA) and quantitative (EPRA) screening techniques are used in sequential fashion to identify employees at risk. The flowchart in Figure 2.1 describes the ergonomics program process.

Figure 2.1
Ergonomics Problem-Solving Process



The Level I Ergonomics Assessment and Problem-Solving Methodology Guide for Maintenance/Inspection Work Areas, which was developed on the basis of the results discussed in this Research Report, provides BEF with a process for conducting a basic ergonomics assessment. Through use of a simple pattern-matching process, the guide identifies realistic controls that will effectively minimize or eliminate employee exposure to ergonomics hazards in jobs in EPRA designated maintenance/inspection areas.

2.2 GENERAL RATIONALE FOR THE METHODOLOGY

The requirements for the Methodology design were specified by Headquarters Air Force Materiel Command, Office of the Command Surgeon (HQ AFMC/SGC) and Armstrong Laboratory. Both organizations desired an **effective** and **efficient** analysis and problem-solving process that could be applied to the full variety of Air Force Maintenance & Inspection work areas. The Methodology was to be designed to reflect the technical capabilities of a Bioenvironmental Engineering (BEF) technician with only 2-3 years of experience. In addition, the process was to place **primary** focus on identifying appropriate controls. Due to the high demands already placed on BEF personnel (e.g., responsibilities for non-ergonomics-related activities) and the potential lack of ergonomics expertise, the Air Force requested that a "pattern-matching" process be created which would:

- minimize the time requirements for assessment and control identification; and
- enable the Air Force to benefit from the expertise of ergonomists who have had years of experience in addressing ergonomic hazards in maintenance/inspection areas.

2.2.1 Objectives. The Methodology is designed to enable the user, primarily through visual observations and employee/supervisor interviews, to:

- identify potentially hazardous tasks within a shop and job;
- determine if the content of the job and task(s) meet established ergonomics (risk factor exposure) criteria;
- determine which type(s) of additional (Level II) analyses may be used if further quantification of ergonomics hazards is required; and
- choose from a menu of control options (both short- and long-term) which, when implemented, minimize the risk of musculoskeletal disorders and the hazards identified within the job and tasks.

The Methodology is designed to enable the user to complete data collection and analysis on a maintenance/inspection job in 1-2 hours, and complete the control identification and summary report in 1-2 hours. The Methodology includes case studies for typical maintenance/inspection tasks. The case studies serve as the basis for the pattern-matching process that will be used to "match" the hazards identified in the tasks with controls that will reduce employee exposure to those hazards. The Methodology identifies metrics which will be used to evaluate the impact of ergonomics improvements on employee health, safety, and performance (e.g., quality, productivity).

2.2.2 Description. Each of the objectives was accomplished by developing a Level I Ergonomics Assessment Checklist, which is an observation-based "checklist", and Case Study Problem-Solving Matrices, which provide a "controls database" for addressing ergonomics hazards. The Level I Ergonomics Assessment Checklist requires no measurement. The technician collects risk factor exposure data by observing the task and talking with the employee. The checklist results can be directly "matched" to the "database" of ergonomics hazards and recommended controls provided in one (or more) of 50 Case Study Problem-Solving Matrices. The matrices are designed to represent the most common Air Force Maintenance/Inspection tasks. A detailed description of the pattern-matching process is found in the Level I Ergonomics Assessment and Problem-Solving Methodology Guide for Maintenance/Inspection Work Areas.

2.3 SCIENTIFIC BASIS FOR THE METHODOLOGY DESIGN

2.3.1 Literature Review.

2.3.1.1 Method. A literature review was conducted to identify existing methodologies that could be used as the basis for the Level I Methodology for *Maintenance/Inspection* Work Areas. Initial results of the review indicated that at the present time, comprehensive ergonomics analysis/problem-solving methodologies, which use pattern-matching as the basis for control identification, do not exist.

As a result, the literature review was targeted to identify *analysis methods* upon which one part of the Methodology, the Level I Ergonomics Assessment Checklist, could be based. Sources for these methods included: peer-reviewed research articles, proposed voluntary or regulatory standards, and proprietary and confidential sources of the analysis methods that were identified and evaluated. Three were drawn from standards, eight were drawn from journals, and the remaining come from proprietary and confidential sources. We have included a list of the proprietary sources that we could use without violating any copyrights or confidentiality agreements.

An evaluation questionnaire was developed. The questionnaire is divided into three sections: Subjective Questions, Objective Questions, and Validation Questions.

2.3.1.2 Evaluation Results. Table 2.1 summarizes the evaluation results. Included in the table are the methods which achieved the highest ratings for each of the objective, subjective, and validation questions. The feature(s) of the method which was most responsible for the high rating is also discussed. These features were considered as a foundation from which an effective Level I Ergonomics Assessment Checklist could be constructed. In some instances, the evaluators have provided comments on desirable features even though none of the methods achieved a high rating.

2.3.1.3 Design Objectives for the Level I Ergonomics Assessment. As a result of the literature review, several additional design objectives were identified as the basis for developing the Level I Ergonomics Assessment. These objectives, as well as those specified by the Air Force, are listed in Table 2.2.

The remainder of this Research Report provides specific information on the practical and scientific basis for the Guide design.

Table 2.1
Literature Review Results

Factor	Methods Which Achieved the Highest Ratings	Desirable Feature(s)
1. Face Validity Checklist seems to measure what it is supposed to measure	• OSHA Draft Checklist, 1995 (U.S. Dept. of Labor, 1995)[1] • ANSI Z365 Checklist, 1995 (Samples #1 and #2) (ANSI, 1992)[2]	• List of risk factors compared to a time exposure scale • All major risk factors considered
2. Overall Understandability When you first look at the tool, you can immediately tell what is going on	• OSHA Draft Checklist, 1995 [1] • ANSI Z365 Checklist [2] (Samples #1 and #2) • PLIBEL, Kemmlert (1994)[3] • Job Evaluation Checklist, 1990 (The Joyce Institute, 1990)[4]	• Matrix/table format • Risk factors listed in a column • Number of response choices limited to reduce variability
3. Ease of Answering Questions Questions are understandable and quick to answer	• OSHA Draft Checklist, 1995 [1]	• Illustrations provided with each question • Concise question descriptions • Exposure cut-off levels clearly defined/quantified
4. Ease of Scoring Scoring is understandable and quick	• ANSI Z-365 (Sample #2) [2]	• Easiest scoring strategies: addition of a column of numbers, count occurrences of check marks, or picking the highest number
5. Checklist Completion Speed Can be filled out quickly	• ANSI Z-365 (Sample #2) [2]	• Minimum number of pages • Minimum number of questions • Simple scoring procedures
6. Ease of Use at the Work site Can be easily completed at the work site	• ANSI Z-365 (Sample #2) [2]	• Single page format • Large size text fonts • Reasonable levels of information on a page
7. Objectivity The questions and scoring are not impacted by different interpretations	• ANSI Z-365 (Sample #1) [2] • OSHA Draft Checklist [1]	• Well-defined questions • Exposure levels clearly defined/quantified • Scoring levels quantified and operationally defined

Table 2.1
Literature Review Results (Cont'd)

Factor	Methods Which Achieved the Highest Ratings	Desirable Feature(s)
8. Minimal Training/Technical Knowledge Required	• OSHA Draft Checklist [1] • ANSI Z-365 (Sample #2) [2]	• No technical jargon (uses "reaching" instead of "shoulder abducted")
9. Relevance of Questions to Typical Work Situations Questions reflect realities in the work environment	• OSHA Draft Checklist [1] • Office/Computer Checklist [5]	• Illustrations of "real" work situations • Questions worded to provide examples of "real world" occurrences of risk factors
10. Flexibility Checklist usable for a variety of different types of tasks	• Uniroyal Industrial Ergonomics Checklist (The Joyce Institute, 1995)[6] • OSHA Draft Checklist [1]	• Questions address risk factors which can occur in a wide variety of tasks • Address visual, environmental issues
11. What are the outputs of the analysis?	• Job Evaluation Checklist [4] • OSHA Draft Checklist [1]	• Ratings provided for multiple body regions and the overall job • Provides direction for problem solving
12. Equipment Required	• ANSI Z-365 (Sample #2) [2] • Uniroyal Industrial Ergonomics Checklist [6]	• No equipment (e.g., calculator or computer) should be required
13. Total Number of Pages (including supporting materials)	• ANSI Z-365 (Samples #1 & 2) [2] • Uniroyal Industrial Ergonomics Checklist [6] • Design checklist, Lifshitz & Armstrong, 1986 [7]	• Minimal number of pages desirable
14. Is there any research to support the tool?	• PLIBEL [3] • RULA, McAtamney & Corlett, 1993 [8] • Upper Extremity Checklist, Keyserling et. al., 1993 [9] • Design checklist [7] • Ergonomics job analysis method, Stetson et. al., 1991 [10]	• Tool supported by research
15. Test/Retest Reliability Same analyst completes more than once/reliability demonstrated	• Ergonomics job analysis method [10]	• Research conducted, favorable result • Clearly defined questions and rating scales • Minimum interpretation required • Resistant to minor changes in worker technique

Table 2.1
Literature Review Results (Cont'd)

Factor	Methods Which Achieved the Highest Ratings	Desirable Feature(s)
16. Inter-Analyst Reliability Multiple analysts complete the checklist/reliability demonstrated	• RULA [8] • PLIBEL [3] • Ergonomics job analysis method [10]	• Research conducted, favorable result • Clearly defined questions and rating scales • Minimum interpretation required • Resistant to minor changes in worker technique
17. Method Sensitivity Discriminates between low and high risk jobs	• RULA [8]	• Research conducted, favorable result • Time exposure scale allows varying levels of exposure • Minimum number of questions
18. Content Validity Uses measures supported in literature	• PLIBEL [3]	• Research conducted, favorable result • Questions/Job Factors are supported in the literature.
19. Concurrent Validity Provides information close in value to that from a more detailed analysis	• PLIBEL [3] • Upper Extremity Checklist [9]	• Research conducted, favorable result • Collects similar information to that obtained by more detailed analysis but collects the information in a more concise manner
20. Predictive Validity Results predict or correlate with injuries, complaints, symptoms	• Design checklist [7] • RULA [8]	• Research conducted, favorable result • Job factor questions supported by research which indicates a relationship between the job factor and discomfort or injuries.
21. Practicality: Ease of Use Measures of overall ease of use and applicability	• Upper Extremity Checklist [9]	• Research conducted, favorable result • Matrix/table format • Illustrations for each question • Well-defined questions • Simple scoring procedures
22. Practicality: Speed of Completion Minimal time required to complete checklist	• Ergonomics job analysis method [10]	• Research conducted, favorable result • Minimum number of questions • Minimum number of pages • Completion time meets or is under specified completion time objectives

Table 2.2
Development Objectives for the Level I Ergonomics Assessment

Air Force Objectives
• Task-based, problem-solving checklist
• Complete by BEF technician without assistance from engineer
• Include visual, musculoskeletal, environmental issues (organizational issues excluded by request of Air Force)
• Checklist completion based on real-time observation as well as employee interview
• Level of musculoskeletal stress rated by body part and overall for the job
• Provides numerical "priority" rating scale
• Analysis of results indicates which aspects of the task and/or workplace may be modified to achieve the most significant improvement
• Indicates the type of detailed analysis (Level II) which is most appropriate when quantification of risk factors is desired
• Enables technician to measure results/impact of workplace improvements
• Applicable to majority of maintenance/inspection jobs
• Consistent with Job Requirements and Physical Demands Survey (administered by PHF)
Additional Objectives Based on Literature Review
• Considers all risk factors supported by the literature
• Avoids the need for taking physical measurements
• Provides examples and illustrations of real world occurrences of risk factors for each question
• Questions designed such that the assessment is resistant to minor changes in worker technique
• Minimizes the use of technical "jargon"
• Provides clear and concise definition for questions and rating scales; minimize the need for interpretation
• Uses a time-exposure scale for making judgments about risk factor; include exposure frequency and task duration
• Defines/quantifies exposure levels
• Minimizes calculations required for scoring
• Provides risk/priority ratings for multiple body regions and overall job
• Provides numerical results and operationally defines scores
• Requires a minimum number of pages
• Uses large text/fonts

3.0 PRACTICAL AND SCIENTIFIC BASIS FOR LEVEL I ERGONOMICS ASSESSMENT CHECKLIST

The Level I Ergonomics Assessment Checklist is comprised of four parts:

- Part I - Work Content
- Part II - Job Factors
  - Shoulder/Neck
  - Hands/Wrists/Arms
  - Back/Torso
  - Legs/Feet
  - Head/Eyes
- Part III - Environmental Factors
- Part IV - Employee Suggestions

3.1 PART I: WORK CONTENT

The list of tasks included in the Task Key List were taken from Part III of the Job Requirements and Physical Demands Survey (administered by PHF). These tasks were extracted from the *Dictionary of Occupational Titles* (U.S. Dept. of Labor, 1991).[11]

Additional tasks were added to improve the breadth of the task list. These additional tasks are presented in Table 3.1.

Table 3.1
Tasks Added to the Work Content Matrix

Task List	
121.	assembly/disassembly internal component
122.	assembly/repair bench work
123.	computer work
124.	hose handling
125.	forming
126.	masking
127.	media blasting (blast cabinet)
128.	media blasting (high pressure gun)
129.	ordnance disposal
130.	prying
131.	visual inspection

Critical tasks are the tasks considered during checklist completion. The cut-off for critical tasks used in the Administrative Guide was one or more hours (See Research Report for Administrative Work Areas). Many Maintenance and Inspection (M/I) tasks, however, are not performed on a daily schedule. For example, a typical M/I job/task might be performed one day a week or three weeks out of the year. Due to the increased variability of job/task performance frequency/duration, it was determined that a percentage scale expressed as the, "total percentage of the work time spent performing the task", would be a more appropriate Task Frequency scale.

The cut-off for critical tasks of 10% of work time was selected to be consistent with the Administrative Guide (1 hr / 8 hr. = 12.5%) but also simple and easy to remember (12.5% was rounded down to 10%). The cut-off for the distinction between moderate and high frequency of 50% of work time was also derived from the Administrative Guide (4 hr. /8 hr. = 50%).

The decision about Critical Tasks suggests that when priorities are established for problem-solving, tasks which occur for less than 10% of work time (total accumulated time performing the task) should not be considered as a primary concern. This is consistent with the hazard-control prioritizing philosophy included in the AFOSH program.

The exception to this rule is for tasks which involve lifting or high forces. These tasks are to be considered critical tasks regardless of the frequency.

3.2 PART II: JOB FACTORS

3.2.1 Format. The checklist design and question/response format was selected to achieve maximum consistency with the JR/PD Survey while still providing a tool which is sensitive enough to quantify risk factors at the job/task level.

Part II is divided into *five* sections by body region. These body regions correspond to the body region structure employed in the survey tool and the individual risk factors are associated with each body region. This structure is similar to that used in the PLIBEL analysis method [3].

The checklist is designed as a table or matrix which lists Job Factors (risk factors) in the left column and frequency/exposure-based responses to the right. This table format is widely used for "Level I" analysis methods (e.g., OSHA Draft Ergonomics Checklist[1]; ANSI Z-365 Draft Checklists [2], Upper Extremity Checklist [9], Ergonomic Job Analysis Method [10]) because it is fast and easy to complete.

To satisfy the objective for providing a task-based problem-solving Methodology, the Level I Assessment Checklist format enables the user to assess exposure to ergonomics risk factors for each of the tasks that make up the larger job. This feature is unique to the Level I Ergonomics Assessment Checklist and provides the basis for assessing the overall job exposure (for within-shop Prioritization purposes), while simultaneously providing individual task exposure information. The task exposure data will enable the technician to prioritize the focus of problem-solving efforts based on the individual task which contributes most significantly to the overall risk factor exposure.

3.2.2 Question Selection. Job Factor questions were based on specific ergonomics risk factors reported to contribute to WMDs. When appropriate, questions from the JR/PD Survey and Administrative Guide were incorporated into *this checklist* to maintain consistency. Additional Job Factor questions were drawn from or based on analysis methods reported in peer review journals, from existing voluntary standards (e.g., OSHA Draft Ergonomics Standard [1], ANSI Z-365 Draft Standard [2], ANSI-HFS 100-1988 VDT Standard [12]), or extrapolated from established risk factors (e.g., stressful postures, excessive force, etc.).

The basis for each of the Job Factor questions is presented in Table 3.2. The table notes if reliability and/or validity has been reported for each question and specifies if the question was substantially altered for inclusion in the Level I Ergonomics Assessment Checklist. *(Note: Minor modifications were made to all questions in order to maximize consistency in verbiage and presentation.)*

Questions were combined whenever possible to improve scoring accuracy. If the co-occurrence of two Job Factors do not produce an additive effect on overall priority scores, then the Job Factors were combined into one question. For instance, since carrying of materials and repetitive arm forces both produce forces in the arm and shoulder, these two Job Factors were combined into one question.

3.2.3 Question/Response Structure and Scientific Basis. The checklist is composed of a series of questions which describe postural deviations, forces, or localized contact stresses for each region of the body. Each question asks if the Job Factor exists in the task being evaluated. If the Job Factor is identified, the checklist asks for a response which estimates the time-based exposure to that risk factor. The checklist design automatically assigns a score which corresponds to the estimated exposure time for that Job Factor.

Table 3.2
Original Source and Treatment of Job Factor Questions

Question Number	Original Source	Adapted from RF/DS	Reliability & Validity Reported	Substantial Alterations from Original
1	RULA [8] p91-99 Chaffin and Andersson (1984) [13] pp 336-341 PLIBEL [3] p1-21 Keyserling et. al. (1993) [9] p811 Kilbom & Persson (1987) [14] p276 Putz-Anderson (1992) [15] p52 Punnett et. al. (1985) [16] p417-425 Sommerich et. al. (1993) [17] p697-717 Hagberg (1984) [18] p269-278	Yes RF/DS #5	Yes	Yes
2	Stetson et. al 1991) [10] p935 Van Cott & Kincade (1972) [19] p72 Putz-Anderson (1992) [15] p62 Snook & Ciriello [20] p1210 Wells et. al. (1983) [21] p814-820 Eastman Kodak (1986) [22] Vol.2, p141	Yes RF/DS #3/#4	Yes	Yes
3	Schoenmarklin, Marras & Leurgans (1994) [23] p1449-1459	Yes RF/DS #4	No	Yes
4	Chaffin & Andersson (1988) [24] p 347 Chaffin (1973) [25] p346-354 Kilbom, Persson & Jonsson (1986) [26] p37-47 RULA [8] p91-99 ANSI Z-365 [2] OSHA draft checklist [1] Kilbom & Persson [14] p275	Yes RF/DS #6/#7	Yes	Yes
5	Putz-Anderson (1992) [27] p23 Keyserling et. al. (1993) [9] p811 Stetson et. al 1991) [10] p927-937 Silverstein et. al. (1987) [28] p343-358 Hammer (1934) p139-140 OSHA draft checklist [1]	Yes RF/DS #8/#9/#18	Yes	Yes
6	Hammer (1934) [29] p139-140 Silverstein et. al. (1987) [27]	Yes RF/DS #11	No	Yes
7	ANSI Z-365[2] Putz-Anderson (1992) [30] p66	Yes RF/DS #20	No	Yes

Table 3.2
Original Source and Treatment of Job Factor Questions (Cont'd)

Question Number	Original Source	Adapted from RF/DS	Reliability & Validity Reported	Substantial Alterations from Original
8	Keyserling et. al. (1993) [9] p810 Van Cott & Kincade (1972) [19] Stetson et. al. (1991) [10] pp 935-936 Putz-Anderson (1992) [15] p62	Yes RF/DS #21	Yes	Yes
9	Schoenmarklin et. al. (1994)[23] Putz-Anderson (1992) [15] p68 Keyserling et. al. (1993)[9] p811	Yes RF/DS #13/#16/#17	Yes	Yes
10	Putz-Anderson (1992) [15] p68-69 Keyserling et. al. (1993) [9] p811 OSHA draft checklist [1]	Yes RF/DS #12	Yes	Yes
11	Keyserling et. al. (1993) [9] p811	No	Yes	Yes
12	McAtamney and Corlett (1993) [8] p93-94 Keyserling (1986) [31] p641-649 OSHA draft checklist [1] Kemmlert (1994) PLIBEL [3]	Yes RF/DS #25	Yes	Yes
13	Marras et. al. (1993) [32] p155-158	Yes RF/DS #25/#26	No	Yes
14	Marras et. al. (1993) [32] p155-158	Yes RF/DS #26	No	Yes
15	OSHA draft checklist [1] RULA [8] p94 Keyserling (1986) [31]	Yes RF/DS #23	Yes	Yes
16	NIOSH Lifting Guide [33] OSHA draft checklist (manual handling portion) [1]	Yes RF/DS #30	Yes	Yes
17	Snook & Ciriello [20] p1197-1213	No	Yes	No
18	NIOSH Vibration Standard [34] p26-48	Yes RF/DS #27	Yes	Yes
19	OSHA draft checklist [1] Kemmlert (1994) PLIBEL [3] p1-21	Yes RF/DS #34	Yes	Yes
20	OSHA draft checklist [1]	No	No	Yes
21	Mattilla et. al. (1993) [35] p405-411 OSHA draft checklist [1]	Yes RF/DS #31	Yes	No
22	OSHA draft checklist [1]	Yes RF/DS #32	No	Yes
23	ANSI Z-365 [2] p11	Yes RF/DS #35/ #38	No	Yes
24	Bergqvist (1995) [36] p201-209	Yes RF/DS #37	No	Yes

A large body of research confirms that the existence of postural deviations, forces, localized contact stress, and high repetition rates (or continuous exposure) in a job can lead to muscular fatigue and WMDs. These factors are called, "primary risk factors." A complete listing of references for each of the primary risk factors is provided in Keyserling [9, 37].

Unfortunately, however, the precise magnitude/duration of exposure to each Job Factor that causes WMDs has not been determined through research. This research report does not attempt to establish a cause-effect relationship. Still, some basic concepts are understood regarding how these risk/job may factors interact and contribute to localized discomfort, pain, etc., which are recognized as pre-cursors to WMDs. Silverstein, et. al. [38,39] found that repetition (i.e., exposure time) and force have a multiplicative effect when they co-occur in a job. Reynolds, et. al. [40] added postural deviation to this equation, suggesting that exposure can be defined as the union of force and postural deviation multiplied by the daily frequency (i.e. amount of exposure). Postures can be thought of as forces exerted internally in the body. Localized contact stress can also be thought of as a force exerted by an external object. All risk factors can be translated into a force experienced internally within some region of the body over a period of time.

Thus, an approach which compares a series of posture and force-related Job Factor questions to an exposure scale, has been suggested in the literature.

For the Level I Ergonomics Assessment Checklist, exposure time is measured by considering the total task duration and as well as proportion of the task time in which the Job Factor occurs. Both task duration and prevalence of the Job Factor within the task are critical to making a correct assessment of the total exposure to that risk factor. For example, a task may be performed all day long (e.g., 7.5 hours per day) but the prevalence of the Job Factor is low (e.g., 5% of the task). Conversely, the prevalence of the Job Factor may be high (e.g., performed continuously, 40 times/minute) but the task duration may be low (e.g., 30 minutes per day). The highest exposure of a Job Factor occurs when both the task duration and the Job Factor prevalence within that task are high. It is critical to be able to discriminate between different levels of task duration and Job Factor prevalence in order to accurately assess and prioritize jobs for corrective action based on overall exposure. Notice, as well, that Job Factor prevalence can be defined in a number of different ways (e.g., as a repetition rate or as a percentage of time) depending on if the activity is continuous or repetitive.

The more common checklists used in industry seek to address the issue of task duration and Job Factor prevalence in a number of different ways. Unfortunately, only a small number of these checklist tools have been formally validated. Furthermore, there is even less research which actually prescribes the most effective way to consider both task duration and Job Factor prevalence.

The sample checklist provided in the OSHA Draft Standard [1] uses a pre-screening approach for which the user first considers task duration then considers the duration of the risk factor within each task. Finally, the user responds to each risk factor question by indicating the total daily duration of the risk factor in all tasks. This approach has a significant drawback in that an extra step is required to estimate risk factor duration. In addition, this approach is more effective for estimating exposure from continuous postures and less effective for repetitive movements.

The ANSI Z-365 Sample Risk Factor Checklist (Sample #1) [2] takes into account both total task duration and Job Factor prevalence (expressed as "repetition rate"). Reynolds, et. al. [40] expresses exposure as daily output (or number of repetitions per day). This works well for repetitive activities but is not as effective for continuous postures.

3.2.4 Scoring.

3.2.4.1 Scaling Function. Three scoring levels were selected as response choices for each Job Factor: "Frequently", "Sometimes", "Occasionally", and "Never". The definitions of each exposure level are defined below:

For each Job Factor, score:

- **Frequently (F):** Job Factor occurs for greater than 50% of the task
- **Sometimes (S):** Job Factor occurs for 10- 50% of the task
- **Occasionally (O):** Job Factor occurs for less than 10% of the task
- **Never (N):** if the Job Factor does not occur **OR** does not apply.

The explicit division between task frequency and Job Factor prevalence is a departure from the Administrative Guide. In the Maintenance and Inspection Guide there is one scale to assess task frequency and a different scale to assess Job Factor prevalence. This change was made to reduce the tendency to confuse task frequency with Job Factor prevalence. This is a particular concern for maintenance and inspection tasks because of the high variability in both task frequency and Job Factor prevalence. In this new approach, decisions of how frequently the task is performed are made distinct from decisions of how prevalent the Job Factor is in the task.

The "Occasionally" category (less than 10% of the task) was added to increase the sensitivity of the tool in capturing high force activities which may take a relatively small proportion of the task time, but which could have a significant impact on the risk of injury. The "Occasionally" category also helps the tool to detect a cumulative effect across Job Factors and across tasks.

Obtaining an estimate of the multiplicative effect between force and exposure time is accomplished through the use of a higher score for Frequently responses, and a lower score for Sometimes and Occasionally responses. The use of a Job Factor prevalence cut-off of greater than 50% of the task time is supported by Silverstein et. al. [39].

Some Job Factor questions were given higher or lower scores than other Job Factor questions (e.g., F=3 S=2 O=1 vs. F=6 S=3 O=1). This scoring strategy enables the Checklist to provide the appropriate "weight" to Job Factors which have a lesser or greater impact on the development of discomfort. The weighting was based on a systematic process on comparing all possible pairs of Job Factor scores for a particular body region. The objective was to assess whether combined scores matched the ergonomists' expectations of the musculoskeletal risk associated with that pair of Job Factors. This process was also conducted for individual Job Factors.

The scoring for Job Factors considers the impact of task frequency and Job Factor prevalence for determining the impact of the Job Factor on musculoskeletal risk. For example, for **Question #16. Lifting forces**, F=7, S=6, O=4, N=0 was used to indicate that even if the amount of time exposed to the Job Factor is low, the musculoskeletal risk can still be significant.

3.2.4.2 Body Region Scoring. For each task, within a single body region, the scores for all Job Factors identified are summed. This summative operation simulates the summative affect across risk factors on a single body region. For instance, consider a person who is applying high forces while working with the arms held away from the body unsupported. In this case, one would expect that a higher priority score would be obtained than if the person were applying high force without reaching.

Task scores represent the column total for all Job Factors in a single body region. These task scores are transferred to the Checklist Scoring Summary (Section 2, Scoring Summary).

3.3 PART III: CHECKLIST/ENVIRONMENTAL FACTORS

3.3.1 Questions. The environmental factors are designed and listed in a format similar to that used for the body regions. The basis for the questions is presented in Table

Table 3.3
Original Source and Treatment of Environmental Factor Questions

Question Number	Original Source	Adapted from RF/DS	Reliability & Validity Reported	Substantial Alterations from Original
25	Canadian Standard [41] p.80	No	No	Yes
26	USAF Technical Report on Indoor Air Quality [44] p.24 Canadian Standard [42] p.69	No	No	Yes
27	Canadian Standard [43] p.63 AFOSH STD 48-19 [45] ch.2	Yes RF/DS #36	No	Yes
28	USAF Technical Report on Indoor Air Quality [44] p.24 Canadian Standard [46] p.72-75	No	No	Yes

3.3.2 Scoring. The Environmental Factors are scored on an agreement scale. A score of 4 is given for "Strongly Agree" responses while a score of 1 is given for "Agree" responses. A score of 0 is given for all other responses.

The environmental rating scale was established to correspond to the priority rating scale used for the body regions. This scale also has three levels: high, medium, and low. The logic for the cut-offs for high, medium, and low are based on a consensus judgment of TJI/ADL ergonomists:

- A medium priority rating corresponds to **one** *Strongly Agree* environmental factor or **four** *Agree* environmental factors.
- A high priority rating corresponds to **two** *Strongly Agree* environmental factors or **eight** *Agree* environmental factors.

Ergonomist consensus considered the likelihood that employee perceived exposure to several Environmental Factors would cause the employee to report a concern. The consensus also felt that environmental factors might also adversely affect job performance.

3.4 PART IV: EMPLOYEE SUGGESTIONS

This section is included to reflect the benefits of employee involvement. While employees may not be qualified to **conduct** the Level I Ergonomics Assessment Checklist, they can provide helpful suggestions and invaluable assistance for prioritizing the focus of any problem-solving efforts. The input requested on the Level I Checklist is more task specific than that which was requested about the potential for improving work in general throughout the shop.

3.5 FINAL SCORING AND RESULTS INTERPRETATION

A tabulation matrix (Scoring Summary section of the Ergonomics Summary Report) is used to calculate the priority ratings for each body region, each task, and for the overall job.

The **Scoring Summary** design resulted from a combination of findings from the literature review as well as the consensus judgment from experienced TJI/ADL ergonomists. In the literature, there is a lack of validated methods for determining a "cut-off" between "ergonomics problem/risk of WMD" and "no ergonomic problem/no risk of WMD." Therefore, the scoring concept and results generated by the Checklist are designed to **prioritize** the need for corrective action based on the highest exposure to ergonomics risk factors. In other words, a "High" rating means **that exposure to risk factors which have been associated with WMDs** is high. It does not mean that the risk for injury is high. *The ergonomics research community continues to work towards providing a dose-response relationship.* When interpreting results, the technician is instructed to focus problem-solving efforts on any job, task, body region which is rated "high" or "medium."

The priority rating scale has three levels: high, medium, and low. The logic for the cut-offs for high, medium, and low are based on the following rationale:

- a medium priority rating corresponds to exposure to **one** *Frequently* Job Factor or **four** *Sometimes* Job Factors; and
- a high priority rating corresponds to exposure to **two** *Frequently* Job Factors or **eight** *Sometimes* Job Factors.

Priority scores are generated for each Body Region, for each Task, and for the Overall Job.

3.5.1 Body Region Score. Body Region Scores for each task are determined by totaling the responses to the Job Factor questions for each task. Body Region scores for the job as a whole are determined by averaging scores across tasks. The averaging process was selected by TJI/ADL ergonomists to reflect the beneficial impact of task variety. Consider the following example jobs.

Job A is comprised of just one task: welding. This task exposes the shoulder/neck to a *high* level of ergonomics risk factors - Body Part Score = 8. Since there is only one task, the Body Region Priority Score is 8, which is a "High" rating.

Job B is comprised of two tasks: welding and computer work. This welding task, which is performed for 5 hours per day, also exposes the shoulder/neck to a "high" level of ergonomics risk factors - Body Part Score = 8. The computer work, which is performed

for 3 hours per day, exposes the shoulder/neck to a "low" level of ergonomics risk factors - Body Part Score = 2. The average Body Region Priority Score is 5, which is a "Medium" rating.

A comparison of the Body Region Priority Score for each task suggests that Job B is easier on the shoulder than Job A. The "Medium" rating on Job B suggests that, since the employee spends part of the day performing a task (computer work), which provides some relief to the shoulder, the overall potential for a shoulder problem is reduced. This is consistent with the ergonomics research literature which indicates that a job designed with task variety should reduce the overall potential for WMD development. Also, since the rating system still indicates that, when welding is performed, the shoulder is at "high" risk, the technician can be directed to identify controls which reduce exposure to ergonomics risk factors that impact the shoulder during welding.

While averaging may not always reflect the precise daily physical experience of the employee, it provides the technician with a standardized method for determining the impact of overall daily exposure and focusing problem-solving efforts in order to achieve the desired impact on employee health and safety. This concept can be referred to as High-Impact, Precision-Strike problem-solving.

3.5.2 Task Score. The individual Task Score is determined by selecting the highest numerical body region score for that task. The highest numerical body region score is converted into a high, medium or low rating. The reason: the feeling of fatigue or pain, which are often precursors to WMD development, is not "averaged" throughout the body by the employee. For example, if exposure to a high level of risk factors causes an employee's shoulder to hurt, the employee does not think, "my shoulder hurts, but the rest of my body is OK, so I must be OK." Rather, the employee reports a shoulder problem because that part of the body hurts. Therefore, if the shoulder is exposed to a high level of ergonomics risk factors, the Task Score reflects that most significant exposure.

3.5.3 Overall Job Priority Score. The Overall Job Priority Score, *high*, *medium*, or *low*, is determined by selecting the highest Body Region Priority Score. The basis for this scoring concept is identical to that which was described in the previous section. Overall Priority Rating is used to determine which jobs need the most immediate attention.

3.5.4 Interpretation and Intended Use of the Results. The Overall Job Priority Rating/Score is used to determine which jobs to address first. Task Ratings/Scores are used to determine which task(s) within the job need to be the focus of problem-solving efforts. And finally, the Body Region Scores for each task are used to target the identification of controls for the body parts that are exposed to the highest level of ergonomics hazards. The objective is *precision-strike focus, high impact* results.

This page intentionally left blank

4.0 BASIS FOR VALIDATING THE METHODOLOGY

4.1 APPROACH

Testing of the Guide was completed in two major steps: alpha testing and beta testing.

The purpose of alpha testing was to provide an iterative basis for methodology development. Experienced ergonomists served as test subjects to enhance the usability and reliability of the Guide prior to subsequent testing. Beta testing examined the performance of the Guide in a controlled environment designed to be as similar as possible to actual use. Beta testing used non-ergonomists (Air Force personnel) to complete the testing. A total of 32 test job scenarios were developed containing video and text information for typical maintenance and inspection tasks which are of concern to Air Force Ergonomics Working Groups. These test job scenarios were used for both alpha and beta testing.

Prior to conducting the alpha testing, two ergonomists familiar with the jobs used in the scenarios completed an independent assessment. The gold standard ergonomists rated the potential for WMD's to each of the 5 body areas for each job scenario. The gold standard ergonomists then provided an overall rating for WMD potential for the job. The ratings were based on a 3 point scale (low, medium or high) in order to correspond directly to methodology ratings. The gold standard ratings were based on professional judgment and experience rather than outputs from any formal assessment protocols. This process was chosen to avoid potential biases which could be present in an assessment protocol. These findings from the two ergonomists served as a Gold Standard to which the methodology performance was compared. The purpose of the Gold Standard was to provide an indicator of concurrent validity and to suggest content changes to the methodology during alpha testing.

The factors which were considered when selecting the Gold Standard ergonomists were:

- experience in industrial ergonomics training, workstation adjustments or modifications, and equipment design;
- first-hand knowledge of Air Force maintenance and inspection jobs; and
- limited involvement in the Maintenance & Inspection Level I Guide development.

The ergonomists selected as Gold Standards were J. Nelson and A. Marcotte. Qualification Summaries are provided in Appendix A. *Note: J. Nelson also served as Gold Standard on the JR/PD Survey and the Administrative Guide development projects.*

4.2 METHOD

4.2.1 Research Design. It was estimated the five subjects would be sufficient for the alpha test to provide a preliminary evaluation of the guide and to provide guidance for required changes. It was also estimated that ten subjects would be sufficient to demonstrate the utility of the Guide. The beta testing was then designed to use 10 BEF technicians as subjects. Each subject (five in alpha test, ten in beta test) evaluated each of the Job Scenarios. Alpha testing used 32 scenarios, which due to the iterative nature of the alpha testing process were not presented in a fully random order. Beta testing used 30 scenarios administered in random order to control order effects. This was, therefore, a repeated measures design, with multiple dependent measures. The dependent measures collected for each scenario were the responses to each of 24 Job Factor questions, the priority scores and ratings for each of the five body regions (shoulder/neck, hand/wrist/arm, back/torso, legs/feet and head/eyes), the overall priority rating for the job, the corrective action selections, and time to complete the evaluation.

4.2.2 Alpha Testing. Alpha testing refers to a series of three iterative trials used in the development process of the Maintenance & Inspection methodology. Each step was designed to provide feedback regarding different aspects of the guide development. Alpha step one involved benchmarking the assessment usability against 4 methods which varied considerably in their approaches (OSHA draft checklist [1], ANSI checklist [2], PLIBEL [3] and RULA [8]). Alpha step two investigated the usability of the case studies for selecting solutions. Alpha step three previewed the beta test, investigating the reliability and validity of the Guide.

4.2.2.1 Subjects. Six ADL/TJI ergonomists participated in alpha steps one and two. Five ADL/TJI ergonomists participated in the third step of alpha testing. These ergonomists are experienced in the use of assessment tools and ergonomics checklists.

4.2.2.2 Procedure and Apparatus.

4.2.2.2.1 Step One--Assessment Benchmarking. Each of the ergonomists was provided with the following materials:

- 5 Job Scenarios and corresponding video tape;
- Level I Ergonomics Assessment Checklist (draft 1) and Scoring Summary (see appendix F);
- OSHA Draft Checklist;
- ANSI Draft Checklist;
- RULA;
- PLIBEL; and
- Usability questionnaires.

The Job Scenarios used in this step were specifically selected to represent a variety of situations and exposures to ergonomics hazards. Tasks included static efforts, forceful efforts, seated work, standing work, upper extremity intensive tasks, and whole body activities. The jobs selected included tasks of a highly repetitive nature and ones with more variety within the task steps. The ergonomists completed each of the 5 assessment methods for as many of the Job Scenarios as possible within a 4-hour time period. At the end of this session, each ergonomist completed an usability questionnaire for each method. After the usability results were tabulated, one ergonomist lead a focus group sessions soliciting feedback for methodology enhancements.

Although the sample group was clearly biased (they were not blind to the methods), the results suggested that the Level 1 methodology and the RULA were considered more useable than the OSHA, ANSI and Plibel methods. These two methods shared the top two spots for nearly every question. The RULA and ANSI were considered the two tools which were most geared towards ergonomists (rather than non-ergonomists). The ANSI method was noted to have a comprehensive definition of risk factors, although the ergonomists felt that it would be difficult for a novice to use. The OSHA method was considered to be the easiest method for a novice to use. The ergonomists felt that the RULA was clear and concise, collecting considerable information with a small amount of paper. The identified strong points of the Level 1 methodology were the clarity of questions, clarity of risk factors (including ease of estimation), usefulness for generating solutions and interpretation of scores. Areas identified for improvement included the treatment of static postures (the ergonomists felt that these were under-reported by the tool) and the length of the checklist.

4.2.2.2.2 Step Two--Solution Selection Usability. Step two occurred in conjunction with step one. Two days after completing step one, the ADL/TJI ergonomists were provided with:

- The same five Job Scenarios and corresponding video tapes;
- Their completed Level I Ergonomics Assessment Checklists (draft 1) and Scoring Summaries (see Appendix F);
- Case Study Manual (draft 1), and;
- User's Instructions (draft 1).

The ergonomists reviewed the video tapes and their responses to the Ergonomics Assessment Checklists. Based on this information, the ergonomists selected solutions from the case study manual. Each ergonomist selected solutions from the case study manual for all jobs on which they had completed an analysis earlier in the week. After this was completed, one ergonomist led a focus group session to determine enhancements to the case study manual. The Alpha test results are provided in Appendix B.

4.2.2.2.3 Step Three--Reliability and Validity. Each of the alpha test subjects was provided with the following materials.

- 32 Job Scenarios and corresponding video tape;
- Level I Ergonomics Assessment Checklist (draft 2)(see Appendix F);
- Checklist Scoring Summary (draft 2);
- Corrective Action List (part of Checklist Scoring Summary);
- Case Study Problem-Solving Matrices (draft 2); and
- User's Instructions (draft 2).

The tasks on which the Job Scenarios were based, were selected to represent a variety of Air Force Maintenance & Inspection tasks and a variety of risk factor exposures. The job scenarios are representative of tasks that would typically be considered for ergonomics intervention, rather than **all** Maintenance & Inspection tasks. As a result, each task would likely have some exposure to ergonomics hazards. The Job Scenarios present a "standardized" result of the data collection process to ensure that each person using the Guide bases their answers on the same information. In actual use, the data collection process is a critical component for obtaining results with the Guide. The potential for variations within this process are not evaluated. It is expected that training and experience will yield consistently accurate data collection.

The Level I Ergonomics Assessment Checklist was used to analyze the job. The Checklist Scoring Summary was used to score the checklist and record results of the pattern-matching process using the 52 Case Study Problem-Solving Matrices. User's instructions were provided to ensure that each ergonomist followed the same procedure for applying the methodology in the Guide. The ergonomists commented on the usability of the Guide components and user's instructions. A third draft of each of the Guide components was developed to reflect those comments (refer to section 5.4.1, Usability). After alpha testing was completed, a consensus score for each Job Factor question from the Level I Assessment Checklist was developed to serve as a testing standard during beta testing. It was determined that there was insufficient information to accurately answer or evaluate the environmental questions. Since these questions do not figure in the scoring and are not reflected in the Case Studies, no analysis was conducted on these questions.

4.2.3 Beta Testing.

4.2.3.1 Subjects. Eleven Air Force personnel were selected to participate in a single-step beta test. These personnel were to be selected to "match" the targeted end-user population: BEF technician with 2-3 years of experience. Eleven personnel were provided and the test was conducted at Hill AFB. The participants and their experience levels are described in Table 4.2. Since beta testing was planned for 10 persons, two people were paired together to complete testing. This was not anticipated to affect

scoring. One person had previously completed the beta testing for the administrative guide, which could provide a small bias in favor of better test performance.

The rationale for selecting ten as the appropriate number of subjects was based on the practicalities of conducting the research. The time frame and the budget for this project permitted only ten subjects' data to be collected and analyzed. The time frame did not permit the alpha test data to be completely analyzed and used as a basis for determining observed effect sizes. The different nature of the subjects in the alpha and the beta tests would have rendered any effect size estimates suspect. Without any reliable estimate of effect size, goal was to run as many subjects as possible. However, given the budget and the time frame available for this project, the number of test subjects appears to have been sufficient to demonstrate an adequate level of reliability, sensitivity, and validity.

The broad range of significant findings suggests that power was indeed adequate to establish statistically significant results. The analyst is unaware of any power calculations appropriate for the kappa statistic. A post-hoc assessment of power for the 60 t-tests comparing beta test job ratings for each scenario to both the gold standard and consensus ratings was performed by calculating the average effect size for the comparisons to the gold and the comparisons the consensus. Based on these two average effect sizes, the power calculation for beta versus consensus t-test was .24 and the power for beta versus gold standard was .74. The lower power for the comparison to consensus ratings is due to the greater degree of agreement between consensus ratings and beta test ratings. This suggests that power was adequate for the test performed.

Table 4.1
Air Force Personnel for Beta Test

Name	Organization	Previous Ergonomics Training	Experience
Terefe Beruk	74 MEDGP/SGPB	yes	2 years
Iara Hofmann A1C	77 MEDGP/SGPB	no	2 years
Jason Shannon SrA	78 AMDS/SGPB	no	2 years
Tracy Baca A1C	75 AMDS/SGPB	yes	2 years
Patricia Richardson	75 AMDS/SGPB	yes	5 years
Benjamin Holley A1C	74 AMDS/SGPB	yes	2 years
Thomas Allen A1C	72 AMDS/SGPB	yes	2 years
Altadawn Bell	76 MDOS/SGPB	yes	2 years
Joseph Emery Ssgt	75 AMDS/SGPB	yes	12 years
David DeSmet	75 AMDS/SGPB	yes	12 years
Mathew Schwally	No further data available		

Note: Some variation in results was expected between personnel with previous knowledge of ergonomics, particularly those who have had previous training in ergonomics analysis. The test pool of 10 subjects was anticipated to provide sufficient power for testing.

4.2.3.2 Procedure and Apparatus. Each of the beta testers was provided with the following materials:

- 30 Job Scenarios and corresponding video tape (plus one sample);
- Level I Ergonomics Assessment Checklist (draft 3) (see Appendix F);
- Checklist Scoring Summary (draft 3) (see Appendix F);
- Corrective Action List (part of Checklist Scoring Summary);
- Case Study Problem-Solving Matrices (draft 3); and
- User's Instructions (draft 3).

The testing was conducted in the following steps: briefing/overview of the methodology, testing, and outbriefing/focus group.

4.2.3.3 Briefing/Overview of the Guide. The ergonomist/facilitator provided a two-hour briefing using a sample job to demonstrate the methodology, use of the materials, and process for completing the assessment and pattern-matching activity. The results from the sample job are not included in the beta test results.

4.2.3.4 Testing. The testing process and materials provided were the same as for the alpha test step three (with the appropriate revisions). Each beta tester followed the User's Instructions to apply the Methodology to each of the Job Scenarios. The testing process was completed in 7 days. Each beta tester was also asked to record the amount of time required to complete both the Level I Ergonomics Assessment Checklist/Checklist Scoring Summary and the pattern-matching/control-identification process for each Job Scenario.

4.2.3.5 Outbriefing/Focus Group. Information on usability was obtained by the Ergonomist who administered the beta test. The ergonomist obtained comments throughout the testing, distributed on usability questionnaire and conducted a focus group/out-briefing with participants to obtain additional comments after the testing was complete. For more details on the process used to obtain usability/practicality comments, refer to Section 4.3.3, Practicality Testing.

4.3 DATA ANALYSIS AND SCIENTIFIC BASIS

The purpose of the data analysis is to show that the design of the Level I Guide meets the project goals. To do this it is necessary to demonstrate that the Guide is reliable, sensitive, valid and practical. These concepts are easily defined. A scale is said to be valid if it measures what it is intended to measure. For example, if one needs to know how much force will be required to provide a given acceleration to an object, then weighing the object provides a valid measure, unless it is necessary to consider other gravitational systems. In that case, weight would not be a valid measure of an object's mass. An ergonomics assessment tool, such as the Level I Checklist, should measure some aspect of human health, comfort or performance in order to be a valid measure.

Reliability, on the other hand, refers to the accuracy and the repeatability of the measurement of a variable. The reliability of an instrument is the foundation for the other concepts. An instrument must be reliable in order to be valid, since one can not be sure that the "valid results" obtained one time will be repeated. In our weight/mass example, asking people to estimate the mass of an object by picking it up would be a valid measure, but would have much less reliability than using an electronic scale. An electronic scale would be very reliable, having excellent repeatability and accuracy. However, if the goal was to evaluate the beauty of an object, rather than its mass, then the scale would not be valid, even though it would be highly reliable.

Sensitivity refers to how well the scaling levels of a tool reflect the levels that exist. Continuing our weight/mass example, if the electronic scale measured (with reliability and validity) the weight of objects in pounds, but you were interested in differences in objects weighing less than ounce, then the scale would not have sufficient sensitivity to identify the differences. In order to have sufficient sensitivity, one would need a scale that reported much finer increments.

Practicality identifies the usefulness and usability of an instrument. Continuing with our weight/mass example, if our electronic scale reported weights with sufficient sensitivity, it might still need to meet constraints such as speed of calibration and portability in order to be a practical scale for its intended application.

Data analysis was accomplished using Microsoft® Excel v7.0 and SAS v6.11.

4.3.1 Reliability Testing. Reliability testing of assessment tools generally takes one of two forms, test/re-test reliability and inter-rater reliability. Test/re-test reliability defines how well the same person will achieve the same results using a tool at different times. Inter-rater reliability defines how well different people will agree on the results.

Several techniques have been used and reported for inter-rater reliability testing with ergonomic assessment tools. The coefficient of variation was used in one study [10] with scores of less than 20 percent for most measures. Multiple regression has also been used [10] with a finding of no statistically significant differences between raters supporting reliability. Kemmlert [3] found weighted averages of Kappa ranging from 0.24 to 0.44 and a percent agreement often above 70 percent. Keyserling, Stetson, Silverstein and Brouwer [9] used inter-rater agreement percentages as a part of their validation. There is little consensus on the best methods for demonstrating inter-observer agreement (Meister, 1985 [47]).

Individual questions were evaluated for reliability by calculating Kappa statistics for the alpha and beta tests (Section 4.2.2 and 4.2.3). The Kappa statistics were chosen because it represents the most accurate method for testing reliability while controlling for the effects of chance. The data meet all of the assumptions for Kappa (Cohen, 1960 [48]; Brennan & Prediger, 1981[49]) which are that :

- the objects categorized are independent;
- the raters operate independently; and
- the categories are independent, mutually exclusive, and exhaustive.

Since it would be expected that a certain amount of agreement would occur by chance, like having 50% correct on a true/false test, the Kappa statistic reports agreement after chance has been removed. A Kappa value can be interpreted as a percent of agreement,

for instance a Kappa of 0.75 indicates an agreement rate of 75% after chance has been removed.

For interpreting the Kappa values the following interpretations were used, consistent with those suggested by Landis and Koch (1977) [50] and as shown in Table 4.2:

Table 4.2
Kappa Value Interpretation

Kappa Values	Interpretation
0.81 to 1.0	Almost Perfect
0.61 to 0.80	Substantial
0.41 to 0.60	Moderate
0.21 to 0.40	Fair
0.0 to 0.20	Slight
< 0.0	Poor

The scores (item level, body region level, and risk rating) from both the alpha and beta test sessions were analyzed independently using the Kappa statistic.

4.3.2 Sensitivity Testing. Measures of tool sensitivity have not generally been reported in the ergonomics assessment tool literature. Sensitivity is demonstrated by how well the tools can distinguish risk factor levels from one job to another. Discriminant analysis was selected as the primary method for the sensitivity analysis. Discriminant analysis is a multivariate technique that uses both grouping data (in this case, the either the Gold Standard or the Consensus judgment of the risk level of each scenario) and the measured variables, and constructs linear combinations of the measured variables to create the best possible categorization to match the known grouping. The discriminant analysis can be conducted many ways; simultaneous and stepwise analyses were conducted for this project. One major advantage for use of discriminant analysis is that, if only the statistically significant discriminant functions are used, then it is more likely to find increased sampling stability than if all of the data was used for the "best" classification (Tatsuoka, 1974 [51]). For this analysis, two variables were constructed for each scenario. The scenario was rated as High, Medium or Low Risk based on the Gold Standard evaluation (the Gold variable) and similarly rated as High, Medium or Low Risk based on the Consensus judgment (the Consensus variable). Each of these categorizations were used as the grouping or classification variable for discriminant analysis. The subject's Overall Job Priority Rating and the five Body Region Priority Scores (Shoulder/Neck, Hands/Wrists/Arms, Back/Torso, Legs/Feet, and Head/Eyes) were used as the predictor variables.

4.3.2.1 Validity. A variety of methods have been used to establish the validity of ergonomic assessment procedures. Predictive validity has been suggested through comparisons with incidence rate [7] and with discomfort ratings [8]. Any predictive validity measures for simple assessment techniques are subject to confounding variables which could greatly reduce power. Concurrent validity has been supported through comparing expert ratings on two different techniques [3] and by comparing novice users of a simple technique with expert users of a more detailed methodology [9]. Content validity has been reported as an item match with scientific literature [3].

4.3.2.1.1 Content Validity. The content validity was based on using referenced criteria to select questions during tool development. Kemmlert [3] reports content validity for the PLIBEL method. Scientific literature was reviewed to provide references for each item in PLIBEL. The primary approach for assessing content validity for the Level I Checklist was to provide support in the literature (particularly validated assessment tools) for all Job Factor questions and scaling approaches.

4.3.2.1.2 Concurrent Validity. The primary method for assessing the concurrent validity of the evaluation was to compare the test evaluations with the Gold Standard. The Gold Standard results were compared to the alpha and beta results using t-tests. The t-test was selected because it is known to be robust to violations of most of the distributional assumptions. With only 5 alpha and 10 beta subjects, it is unlikely that the data will meet the assumptions of the test. However, the test still provides a reliable indication of the differences between the alpha or beta test scores and the Gold Standard. Furthermore, because most assumption violations would cause the test to be liberal, in this particular case that would work against the demonstration of agreement between the test scores and the Gold Standard. The data analyst is unaware of any statistic that would be more accurate in describing this particular situation of comparing a set of "correct" answers with data collected from a number of subjects on each of the 30 Scenarios. The t-test is simple, well known, well understood, and easily communicated.

4.3.2.1.3 Predictive Validity. Predictive validity was not assessed because of much of the discomfort data was lacking or suspect.

4.3.3 Practicality Testing. While the practicality of the methodology is perhaps the most important consideration, it is also the most difficult to quantify in a short-term test. The solid test of practicality is how frequently the tool is applied in examining workstations and the results obtained through the changes. In the shorter-term, several measures were used to examine the practicality of the tool. The usability comments were tabulated, with the assumption that a highly useable tool is more practical than other tools. The descriptive statistics of time requirements were compared to the criteria established, with the assumption that an effective tool that can be completed within the time suggestions has some practicality. The overall agreement regarding solution options was calculated and reported, based on the assumption that a method

which leads to consistent solution recommendations is practical. While none of these measures prove practicality, positive results in all these areas would suggest that technicians will find that the tool is a practical one to use.

4.3.4 Data Reduction. Data were entered into an Excel spreadsheet where checking and coding were conducted. The data were written to an ASCII file and modified using a text word processor for input to SAS. Three SAS datasets were created, one for each of the alpha and beta samples with one logical record per subject, and one for the beta sample with 30 logical records per subject (one record for each Scenario). The single record per subject datasets were used for the reliability analyses, and the multiple record per subject dataset were used for the discriminate analysis. No multiple record per subject dataset was generated for the alpha test because it was judged that there were too few subjects (5) to permit a meaningful discriminate analysis.

4.3.5 Summary of Statistical Selection Rationale. Preliminary data screening was not conducted to evaluate variable distributions. For most parametric statistics, the distributional tests for normality, etc., are more sensitive than are the parametric tests themselves. The parametric tests are quite robust to violations of the distributional assumptions, especially if there are equal number of subjects in each group. Furthermore, the design ensured that the assumptions of the primary statistic for reliability and validity were met. The data meet all of the assumptions for Kappa [48,49], which are that:

- the objects categorized are independent;
- the raters operate independently; and
- the categories are independent, mutually exclusive, and exhaustive.

As discussed above, much of the data collected for this project was recoded to be on a *High, Medium* or *Low* scale. These data therefore are scaled as at least ordinal data, because we know that *High* is larger than *Medium*, and *Medium* is larger than *Low*. However, while the scale itself is only a three level scale, clearly the data represented have more range than that. Furthermore, the original data can lie on a continuum between *High* and *Low*. Therefore, for the purposes of illustrating the observed data, some of the exploratory type of analyses, means and standard errors were calculated, graphed and used in analyses. In many cases, this resulted in values intermediate between *High*, *Medium* and *Low* levels being reported the reader is urged to regard these as approximating the central tendency and variability of the true underlying variable. Importantly, the critical analyses, the Kappa analyses and the discriminant analyses, used these data as representing a categorical scale.

This research project was designed to use the power of a repeated measures design to provide as much value-added information as possible on the Level I Guide. As with any other research project, additional testing with more subjects, on additional Scenarios would yield increased precision, with a commensurate increase in cost and testing time.

The selection of a data analysis strategy is a process that depends on may factors. Minor changes in the research methodology, designed to improve the precision of the study, can necessitate substantial changes in the analysis. The data analyses for this project were finalized after the research methodology was fully developed, following extensive consultation with senior academic research scientists to provide and accurate, concise, and clear portrayal of the results. It is the judgment of the analyst that the value-added approach and results provide an adequate initial basis for evaluating the utility and practicality of the Level I Guide. The raw data is provided in Appendix E.

5.0 RESULTS

5.1 RELIABILITY

The reliability results from the alpha and beta tests are consistent. The average agreements were over 60% (alpha=64%, beta=67%). The mean value of Kappa for individual questions is essentially identical between the test groups (alpha = 0.29, beta = 0.26). The rates compare well with the range of weighted averages of Kappa (0.24 to 0.44) found by Kemmlert [3] and those found in the administrative Guide development (0.22 to 0.23). These results indicate a consistent and statistically significant agreement on individual questions (this agreement is classified in the slight to fair range). The ergonomists and the technicians obtained similar levels of agreement on individual questions as have been found in research studies using other ergonomics assessment tools. Furthermore, the ergonomists and technicians demonstrated agreement on the overall scores for the jobs.

5.1.1 Item Level Agreement. The percent agreement and kappa value were calculated for each job factor question on the alpha and beta tests. Bartko & Carpenter [48] recommend the "generalized" kappa in cases where there are polychotomous data and more than two raters. Since both the alpha and beta test item level data fit this situation, the generalized kappa is reported for item agreement. The percent agreement reported for the alpha and beta tests is based on the formula for determining "percent observed" within the generalized kappa model [48]. The 95% Upper and Lower Confidence Intervals are reported for each question. The response rates for scored responses (scores greater than zero) are also reported.

5.1.1.1 Alpha Test. The general level of agreement between ergonomists using the Level I Checklist is presented in Table 5.1. The agreement rates, not corrected for chance, for the alpha test questions ranged between 35% and 89% for those questions with sufficient response rates of risk factor presence. The utility of questions with lower than a 10% response rate (30 responses) would require careful consideration, particularly if the question also displayed low agreement. **While questions 4, 17, 19, 21, 25, 28 and 29 had low response rates, none of these questions also displayed low agreement.** No questions fit this pattern. Kemmlert [3] found agreement Kappa values in the fair to moderate range for individual questions. A total of 26 of 31 questions had similar agreement rates in this study.

5.1.1.2 Beta Test. Questions with response rates of less than 5% (30 responses) were interpreted cautiously, and considered for removal from the Level I Checklist due to the apparent limited applicability of the question to typical maintenance/inspection jobs. However, the ergonomists decided that the question should remain because these Job Factors although infrequent, are important considerations. To remove the items at this time would potentially limit the applicability of the tool to a wide range of work

situations that may not have been observed during the site visits. Questions with low response rates were numbers 17, 18 and 22. Table 5.2 shows results for the beta tests.

A total of 16 of 26 questions fell in, or above, the range of Kappa values found in the checklist study by Kemmlert [3]. The questions which fell in this range are numbers 1a, 1b, 2, 3, 6, 7, 8, 9, 15, 16a, 16b, 18, 19, 21, 22, and 23. Nearly all questions fall in the descriptions of slight to fair agreement [39]. Although no questions met the goal criteria for Kappa of 0.6 to 0.7, nearly all the questions still have statistically significant agreement.

It appears that some of the disagreement may be the result of difficulties distinguishing between job factors occurring sometimes or frequently. The scoring of question 1a was altered between alpha and beta test administrations such that (for moderate duration tasks) sometimes and frequently responses received the same score. The agreement rose between the alpha and beta test from 41% (Kappa=.17) to 61% (Kappa=.34). Since the results of this Guide are being compared against Kemmlert [3], which uses only a "yes/no" decision for risk factor presence, the potential effects of this difficulty in distinguishing the frequency of occurrence are that this Guide will not perform as well as it might otherwise. The current data coding, which is by scores, not categories, does not allow this comparison without re-entering all raw data from the original data sheets.

What is important to note is the results from the alpha and beta tests are consistent. The mean value of Kappa for each is essentially identical (alpha = 0.29, beta = 0.26). The rates compare well with the range of weighted averages of Kappa (0.24 to 0.44) found by Kemmlert [3]. These results indicate a consistent, and statistically significant, slight to fair agreement.

5.1.2 Overall Score Agreement.

5.1.2.1 Alpha Test. The overall reliability of the Level I Checklist scores and ratings from the alpha test session was measured using a generalized Kappa statistic [52] calculated for the Overall Priority Rating. The agreement rate was 62%, Kappa= 0.18, (95%LCI = 0.00, 95%UCI= 0.36). This indicates a slight agreement (after chance is removed) which is not statistically significant.

5.1.2.2 Beta Test. The same statistics used in the alpha test phase were calculated for the beta test data. The results were similar, although the larger sample size helped to produce statistically significant results. The agreement rate was 55%, Kappa=.18 (95%LCI=.10, 95%UCI=.26).

Statistical significance for agreement in the beta test phases indicates that the agreement obtained was better than would have been expected due to chance. Practical significance suggests that the reliability agreement is slight, with chance corrected agreement rates between 10% and 26%.

Table 5.1
Testing of the Item Agreement Among Ergonomists for Alpha Test

Question	Percent	Kappa	95% LCI	95% UCI	Non-Zero Observations
1a	41%	0.17	0.11	0.23	269
1b	44%	0.21	0.14	0.28	159
2	55%	0.29	0.21	0.37	142
3	72%	0.34	0.18	0.49	67
4	85%	0.36	0.11	0.61	27
5	37%	0.24	0.20	0.28	266
6	45%	0.25	0.19	0.30	271
7	61%	0.29	0.19	0.40	109
8	65%	0.24	0.10	0.38	80
9	44%	0.15	0.08	0.22	157
10	47%	0.12	0.02	0.21	123
11	61%	0.24	0.11	0.37	90
12	51%	0.22	0.13	0.30	137
13	73%	0.45	0.32	0.58	88
14	83%	0.36	0.13	0.59	33
15	35%	0.21	0.17	0.25	241
16	42%	0.15	0.09	0.21	194
17	84%	0.36	0.10	0.61	26
18	62%	0.21	0.08	0.35	82
19	89%	0.36	0.04	0.69	11
20a	68%	0.31	0.17	0.45	78
20b	81%	0.35	0.12	0.57	35
21	85%	0.38	0.12	0.63	26
22	64%	0.44	0.37	0.52	271
23	54%	0.19	0.09	0.29	114
24	57%	0.28	0.18	0.38	119
25	85%	0.34	0.08	0.61	23
26	66%	0.36	0.24	0.47	99
27	57%	0.28	0.19	0.37	125
28	93%	0.46	0.08	0.85	2
29	93%	0.35	-0.09	0.79	4

Table 5.2
Testing of the Item Agreement Among End Users (Beta Testers)

Question	Percent	Kappa	95% LCI	95% UCI	Non-Zero Observations
1a	61%	0.34	0.27	0.40	483
1b	58%	0.26	0.18	0.34	217
2	59%	0.32	0.25	0.38	244
3	74%	0.34	0.22	0.46	138
4	34%	0.11	0.08	0.15	513
5	39%	0.15	0.12	0.18	448
6	79%	0.43	0.31	0.55	130
7	70%	0.39	0.31	0.47	200
8	47%	0.28	0.25	0.31	382
9	63%	0.42	0.37	0.47	276
10	58%	0.13	0.03	0.22	176
11	88%	0.05	-0.24	0.34	37
12	51%	0.14	0.07	0.20	233
13	63%	0.08	-0.04	0.20	142
14	84%	0.17	-0.06	0.39	59
15	50%	0.25	0.20	0.29	486
16a	83%	0.28	0.09	0.47	73
16b	92%	0.26	-0.05	0.58	31
17	95%	0.14	-0.33	0.62	14
18	96%	0.48	0.09	0.87	21
19	62%	0.41	0.36	0.46	471
20	55%	0.19	0.11	0.26	215
21	63%	0.36	0.29	0.42	235
22	96%	0.40	-0.02	0.82	18
23	73%	0.32	0.20	0.44	136
24	53%	0.07	-0.01	0.16	192

5.1.2.3 Alpha - Beta Comparison. The alpha and beta test are not directly comparable because of scoring changes that were implemented at the conclusion of the alpha testing. Alpha test results suggested that the methodology may have been overrating the risk level, particularly in the hands/wrists and shoulder/neck body areas. Subjective feedback also indicated some confusion regarding the proper response to the questions regarding static and repeated gripping. The individual job factor response weightings were altered to produce lower scores, particularly for hands/wrist and shoulder/neck body areas. Several questions were combined to both reduce the risk ratings for these body areas and to reduce potential response confusion. For example, the separate questions on static and repeated gripping which were present in the alpha testing, were combined into one question on the beta testing. Because of these changes,

even if the beta test subjects always identified the same job factors as the alpha test subjects the body area risk ratings and overall priority score would often be different.

5.2 SENSITIVITY

5.2.1 Discriminant Analysis. Four discriminant analyses were conducted for this analysis. The analyses conducted were:

- Stepwise discriminant Analysis – Gold rating of job
- Simultaneous discriminant Analysis – Gold rating of job
- Stepwise discriminant Analysis – Consensus rating of job
- Simultaneous discriminant Analysis – Consensus rating of job

5.2.2 Gold Variable. The stepwise discriminant analysis resulted in one significant discriminant function ($F_{6,588} = 9.56, p < 0.001$), and used the shoulder/neck rating (SNRATE), the hand/wrist/arm rating (HWARATE) and the back/torso rating (BTRATE) scores as predictors. This significant function accounted for almost 18% of the variance in the GOLD rating of the job. The simultaneous discriminant analysis using all 6 variables also resulted in one significant discriminant function ($F_{12,582} = 5.17, p < 0.001$). The significant variables in the simultaneous discriminant analysis were the SNRATE, the HWARATE and the BTRATE scores, as in the stepwise analysis, along with the overall job rating (JOBRATE) variable. The JOBRATE variable was not included in the stepwise analysis, because it was highly correlated with SNRATE, and the correlated variance was important in predicting the Gold Standard classification of the scenarios.

5.2.3 Consensus Variable. The stepwise discriminant analysis resulted in one significant discriminant function ($F_{4,294} = 42.55, p < 0.001$), and used the SNRATE, the JOBRATE, the legs/feet rating (LFRATE) and the BTRATE scores as predictors. This significant function accounted for almost 40% of the variance of the CONSENSUS rating of the job. The simultaneous discriminant analysis using all 6 variables also resulted in one significant discriminant function ($F_{6,292} = 28.52, p < 0.001$). The significant variables in the simultaneous discriminant analysis were the SNRATE, the JOBRATE, the LFRATE and the BTRATE scores, as in the stepwise analysis, and the HWARATE variable. The head/eyes rating (HERATE) variable was not significantly related to the CONSENSUS rating of the job.

5.2.4 Discriminant Analysis Discussion. These four analyses point to two clear conclusions. First, the **Checklist Tool** clearly predicts the CONSENSUS results, accounting for 40% of the variance, while it predicts the GOLD variable results less well, only accounting for 18% of the variance. Second, the major part of this relationship is due to the correlation between the CONSENSUS variable and the JOBRATE and SNRATE variables (which are themselves highly correlated, see Table 5.3).

Table 5.3
Beta Test Correlation Matrix for Job Factor Ratings

Non-significant correlations are enclosed in heavy boxes

Variable correlation *p*	SNRATE	HWARATE	BTRATE	LFRATE	HERATE	JOBRATE	GOLD
SNRATE	1.00 0.0						
HWARATE	.628 .001	1.00 0.0					
BTRATE	.493 .001	.449 .001	1.00 0.0				
LFRATE	.344 .001	.379 .001	.414 .001	1.00 0.0			
HERATE	.090 .121	.100 .084	-.031 .592	.147 .011	1.00 0.0		
JOBRATE	.757 .001	.720 .001	.548 .001	.400 .001	.117 .043	1.00 0.0	
GOLD	.316 .001	.257 .001	.142 .014	.069 .231	-.007 .909	.275 .001	1.00 0.0
CONSENSUS	.549 .001	.464 .001	.426 .001	.350 .001	.091 .116	.545 .001	.048 .403

The conclusion that can be drawn from these analyses is that there is a significant relationship between the evaluations from the Air Force technicians and the expert ergonomists (using both the same Level I Guide or an independent method), and that the Level I Guide can significantly and correctly distinguish between scenarios that were judged by the experts to be of high or medium risk for ergonomic risk factor exposure.

5.3 VALIDITY

5.3.1 Content Validity. There is a strong scientific basis for the inclusion of all the job factor questions present in this analysis. All job factor questions were derived from peer reviewed journals, established technical books, or proposed standards. Each source has been identified as a potential WMD risk factor and/or cause of localized fatigue and discomfort (see Section 6 for a complete listing of references).

The list of job factor questions has been judged to be complete for maintenance and inspection tasks. At least 32 individual analysis methods were evaluated as a part of the literature review process. All risk factor-based questions identified in the 32 methods were considered for inclusion in order to ensure that the list of job factor questions was complete.

The question/response structure (i.e., postural deviations or forces over a period of exposure) is based on a well-established model of how damage accumulates (see Section 1.3.2.3). Several existing analysis methods [36, 10] which use this basic model have been validated.

5.3.2 Concurrent Validity. Table 5.4 illustrates the agreement between the beta test technicians' results and the Gold Standard. Table 5.5 illustrates the agreement between the beta test technicians and the consensus ergonomist. When the beta test scores are significantly different from both the consensus and the gold (in the same direction) it can be assumed that this difference is the result of differences in expert assessments (gold and consensus) and novice assessments. When the beta test is significantly different than the gold but not the consensus it can be assumed that the results illustrate differences in what the Guide and the Gold Standard find within a job. When the beta test scores significantly split the difference between the gold and consensus it can be assumed that these were Job Scenarios on the border of a rating level. Table 5.6 summarizes which Job Scenarios fit each of these 3 possible differences. It is apparent that most of the disagreements were the result of differences between the Guide and Gold Standard approach. This suggests that expert users (alpha test consensus) and novice users (beta test subjects) obtained similar results from the Guide, and that these results differed from the Gold Standard. Table 5.7 demonstrates that the Guide risk ratings do not differ from the Gold Standard in a consistent direction.

While the differences are not in a consistent direction, the differences are consistent. Investigating the specific aspects of the Job Scenarios which created disagreements indicates that the Guide is more likely than the Gold Standard to rate High Duration jobs as high risk. It also appears that for jobs with multiple moderate duration tasks, that the Guide is more likely than the Gold Standard to assign a medium rating. The Guide appears to be more sensitive to task duration than are the Gold Standard scores.

Table 5.4
Comparison Between Beta Test Technicians and Gold Standard, by Scenario, for the Overall Priority Rating Scores

Scenario	Beta - Gold Mean difference	T-value	p=
1	0.9	8.53788	0.00001
2	0	0	1.00000
4	-0.1	-0.94865	0.36516
7	0.8	5.691965	0.00020
9	-1.1	-5.81338	0.00017
12	0	0	1.00000
18	-0.2	-0.94867	0.36515
19	-0.4	-1.42301	0.18517
20	-0.1	-0.94865	0.36516
21	0.4	1.716208	0.11688
23	0.9	3.083582	0.01157
24	-0.2	-1.42299	0.18518
35	-0.7	-4.34732	0.00145
36	-0.9	-4.7564	0.00077
38	-0.6	-2.57431	0.02769
41	0	0	1.00000
43	0.8	5.691965	0.00020
45	0.6	1.863158	0.09204
48	-1	-6.36383	0.00008
60	-0.5	-2.846	0.01737
61	0	0	1.00000
62	-0.1	-0.94865	0.36516
63	0.3	1.333415	0.21197
64	-0.2	-1.42299	0.18518
65	-0.4	-2.32375	0.04250
66	-0.1	-0.94865	0.36516
67	0	0	1.00000
68	0.8	5.691965	0.00020
69	-0.4	-2.32375	0.04250
71	-0.1	-0.52849	0.60869

Table 5.5
Comparison Between Beta Test Technicians and Ergonomist Consensus, by Scenario, for the Overall Priority Rating Scores

Scenario	Difference	T-value	p=
1	-0.1	-0.948653	0.36516
2	0	0	1.00000
4	-0.1	-0.948653	0.36516
7	-0.2	-1.422991	0.18518
9	-0.1	-0.528489	0.60869
12	0	0	1.00000
18	-0.2	-0.948668	0.36515
19	-0.4	-1.423008	0.18517
20	-0.1	-0.948653	0.36516
21	-0.6	-2.574312	0.02769
23	-1.1	-3.768823	0.00367
24	-0.2	-1.422991	0.18518
35	0.3	1.8631384	0.09204
36	0.1	0.5284889	0.60869
38	0.4	1.7162081	0.11688
41	0	0	1.00000
43	-0.2	-1.422991	0.18518
45	-0.4	-1.242105	0.24254
48	0	0	1.00000
60	0.5	2.8459959	0.01737
61	0	0	1.00000
62	-0.1	-0.948653	0.36516
63	0.3	1.3334152	0.21197
64	-0.2	-1.422991	0.18518
65	-0.4	-2.323745	0.04250
66	-0.1	-0.948653	0.36516
67	0	0	1.00000
68	-0.2	-1.422991	0.18518
69	-0.4	-2.323745	0.04250
71	-0.1	-0.528489	0.60869

Table 5.6
Classification of Significant Differences for Overall Priority Rating Scores

Consistent Difference-- Expert/Novice Effect	Gold Difference-- Method Based	Split Difference-- Borderline Job
Scenarios	Scenarios	Scenarios
65, 69	1, 7, 9, 36, 38, 43, 68	21, 23, 60

Table 5.7
Beta Test Job Ratings Compared to Gold Standard Ratings

	Beta Test (n=10)		
	Low	Med	High
Gold Low	4	3	3
Gold Med	14	51	55
Gold High	7	56	117

5.4 PRACTICALITY

The most significant aspect of the entire process is the effectiveness of the Guide in enabling the users to select the appropriate corrective actions. The measure of practicality used in testing focused on whether the Guide could be applied and completed within the time guidelines established by the Air Force.

5.4.1 Usability. Information on usability was obtained from technicians by the ergonomist who administered the beta test. The beta test participants completed an usability questionnaire at the end of the beta test. The ergonomist also obtained comments throughout the testing and conducted a focus group/out-briefing with participants to obtain additional comments after the testing was complete.

The ergonomist encouraged the technicians to ask clarification questions during the testing, as needed, but pointed out that the responses would be limited to information contained within the existing materials. In fact, most of the technicians asked questions whose answers were already contained in the Job Scenario or in the Instructions. For clarification, the ergonomist simply referred the technician to that information. The process for responding to each questions was:

- restated the question;
- directed the technician back to the Instructions and/or Job Scenario; and

- assisted the technician in responding to the original question in light of the new information.

The questions that the technicians asked as they learned and applied the Guide during the testing were recorded. The content of the questions provided information on usability. The questions, responses, and impact on the Guide design are provided in Table 5.8.

Table 5.8
Technician Questions and Experimenter Responses:
Lessons Learned During the Beta Test

Question	Response
Question 1. What do RF/DS, PEPA and EPRA stand for?	**Response:** Provided explanations of abbreviations. **Interpretation:** No interpretation necessary. **Impact on the Final Guide**: none.
Question 2. On scenario #18, what is the difference between folding/fitting and packing/packaging?	**Response:** Recommended use of best judgment **Interpretation:** It can be difficult to distinguish between tasks on the video. **Impact on the Final Guide**: In actual use a technician could ask for clarification from the person doing the job.
Question 3. Should we round fractions up or down?	**Response:** Referred participants to instructions and repeated instructions to round up from 0.5. **Interpretation:** No interpretation necessary. **Impact on the Final Guide**: none.
Question 4. What do we put for environmental questions if there is no information given in the scenario?	**Response:** Instructed participants to answer "neutral." **Interpretation:** This is an artifact of the testing situation. **Impact on the Final Guide**: none, data would be available when actually visiting a shop

The ergonomist conducting the beta test was also responsible for data entry. During data entry, scoring mistakes were noted. When it was noticed that several participants were incorrectly transferring the highest score instead of the average, the ergonomist corrected

the errors and explained the correct method to the participants. Additional mathematical errors were noted and corrected during data entry.

The usability questionnaire consisted of 13 questions with ratings on a five point Likert scale. The questionnaire is contained in Appendix C. One question on the scale was reversed (disagree would be the desired response to "The tool is better suited to an ergonomist than a non-ergonomist"). In order to ease interpretation, the scoring of the reversed question has been adjusted to match the other questions. The average responses for each question fell between 1.8 and 2.3, indicating that participants agreed with each usability statement. Only two of the eleven subjects disagreed with any of the questions. One of these subjects disagreed with 6 statements, while the other subject only disagreed with the statement "The risk criteria are easily estimated without measurement." The similarity of responses for each questions suggests the responses may reflect an overall attitude towards the Guide, rather than specific information about individual questions. With this in mind, it indicates that participants had a generally favorable opinion towards the Guide.

5.4.2 Time Requirements. The time requirements for completing the analysis and for identifying and selecting control measures were calculated based on the beta test sessions. The mean time for completing the Level I Checklist and scoring process was 16.6 minutes with a standard deviation of 10.8 minutes. The mean time for identifying and selecting control measures was 12.0 minutes with a standard deviation of 7.4 minutes. Furthermore there was a clear learning effect, with times decreasing during the testing. On the first day of testing the average total time (checklist + summary) was 59 minutes. By the fourth day performance time improved to a total time of 23 minutes (checklist=13 minutes, summary=10 minutes). These values are well within the criteria established, indicating that this Guide can be used quickly.

5.4.3 Selection of Corrective Actions.

5.4.3.1 Beta Test vs. Consensus Scores: Corrective Action Agreement. The agreement on the selection of corrective actions was examined in two directions. First the percentage of time in which a corrective actions which was selected by a beta test subject was also selected by the consensus ergonomist. Second, the percentage of corrective actions selected by the consensus that were also selected by the beta testers. It was determined that the straightforward agreement rates between the consensus ergonomist and beta testers would results in an inflated agreement based on non-selection of corrective actions (since most actions were not selected for any given scenario agreeing **not** to select a solution was judged to be of minimal importance).

The 143 corrective actions were grouped according to 14 basic types of actions (i.e., workstation modifications, tool modifications, tool selection). The grouping of corrective actions is presented in Appendix D. The percentage of time the beta test subjects selected corrective actions which were the same as the consensus was 61%. This would indicate

that out of 100 corrective actions selected by the beta testers, 61 were actions selected by the consensus ergonomist.

The percentage of time that a corrective action selected by the consensus ergonomist was also selected by the beta test subjects was 70%. This indicates that, on average, whenever the consensus ergonomist identified a solution that 7 out of 10 beta testers would also have identified that solution.

It appears that beta testers were more likely to select solutions regardless of feasibility. The consensus ergonomist appears more selective in identifying solutions. In actual use this effect would be minimized through the involvement of multiple people in a single implementation.

5.5 CONCLUSIONS

The validation process has assessed the reliability, sensitivity, validity, and practicality of the Level I Ergonomics Assessment Guide for Maintenance/Inspection Work Areas in several ways, and while there are some issues that were identified for improvement in subsequent Guide development efforts, the Guide should be considered to have performed adequately. The specific detail summary is provided below.

For inter-rater reliability:

- Agreement rates between end users were similar to that which has been reported in the literature.
- For Overall Job Priority score, the process demonstrated significant reliability, with beta test subjects agreeing 55% of the time. When comparing beta test results to consensus and Gold Standard results, only 2 of 30 jobs suggested differences between expert and novice performance. This supports the notion that the technicians obtain similar priority scores as experts.
- Across all questions in the Level I Checklist, the technicians agreed 67% percent of the time. This means that technicians can identify the same risk factors with minimal training.
- In determining the selection of corrective action categories, the beta test subjects selected the same responses as experienced ergonomists using the Guide over 60% of the time.

For sensitivity:

- There is a significant relationship between the evaluations from the Air Force technicians and the expert ergonomists (both using the same Level I Guide or an independent method).

- The Guide can significantly and correctly distinguish between scenarios that were judged by the experts to be of high or medium risk for ergonomic risk factor exposure.

For content validity:

- All of Job Factor questions are supported by scientific research. The list of Job Factor questions was comprehensive in covering ergonomic risk factors which are expected to occur in a maintenance/inspection environment. The overall theoretical structure of the Guide is a commonly used structure which has been used in other validated methods.

For concurrent validity:

- When comparing beta test results to consensus and Gold Standard results, only 2 or 30 jobs suggested differences between expert and novice performance. This supports the premise that the technicians obtain similar job risk ratings as experts using the Guide. The risk ratings (priority scores) for both technicians and experts using the Guide differed from the gold standard, indicating that the Guide produces risk ratings that may differ at times from the Gold Standard ratings. The task duration appears to play a larger role in determining risk when using the Guide than during Gold Standard assessments. This apparent bias may be desirable to focus attention on the most continually occurring tasks.

For usability/practicality:

- The Guide was easy to use and can be completed in well under the time targets established by the Air Force. Usability comments provided by technicians were favorable.

- Technicians consistently agreed in selecting corrective actions. This means that technicians can be expected to make the same type of recommendations to shop supervisors.

- The solutions selected by the technicians agreed with the solutions selected by a consensus of ergonomists 61% of the time. This result suggested that the Guide assists technicians in generating solutions that experts would recommend. This was one of the primary objectives of the Guide.

Opportunities for Improvement

- The overall level of agreement for specific questions selected for a particular job was lower than the desired criteria. *However, the rates were comparable to agreement rates obtained in published validations for other ergonomics assessment methods.* In addition, regardless of the agreement on individual questions, this study provided evidence to indicate that the Guide assists technicians in arriving at the similar solutions as would be selected by an ergonomist.

- High duration tasks are more likely to be rated high risk, whereas jobs with multiple, moderate duration tasks are more likely to be rated as medium risk jobs.

In summary, the primary strengths of the Guide are:

- it is easy to use;

- it has shown good acceptance by the most likely end user population (BE technicians);

- it meets and improves on the "time for completion" requirements established by the Air Force; and

- it enables Air Force personnel to identify appropriate corrective actions to the ergonomics risk factors identified in Maintenance & Inspection jobs in a way that provides answers that are similar to that which an ergonomist would provide, all in a time-effective manner.

The Level I Ergonomics Assessment and Problem-Solving Guide for Work Areas can be considered an effective means for identifying and controlling ergonomics hazards in work areas. In addition, it represents a strong foundation for developing similar approaches to reducing or eliminating the potential for WMDs in Warehouse and Assembly Work Areas.

This page intentionally left blank

6.0 REFERENCES

1. U. S. Department of Labor, Occupational Safety and Health Administration, (1995) *Draft Ergonomics Protection Standard.* Washington, D. C.

2. American National Standards Institute (ANSI) National Safety Council Draft Standard Z-365, (1992, June 11), (1993, June), (1995, April 17). *Control of Cumulative Trauma Disorders.* Draft Outline.

   Appendix 23-A. (1992. November 2). *Checklist for Evaluation of Ergonomic Stress in Industrial Shops.*

   Appendix 23-B. *Checklist for Evaluation of Ergonomic Stress at Workstations Equipped with Video Display Terminals.*

   Appendix A. (1993, June 4). *Sample Surveillance Tools.*

   Appendix B. *Controlling Workplace Risk Factors.*

3. Kemmlert, K. (1994). A Method Assigned for the Identification of Ergonomic Hazards - PLIBEL. *Scandinavian Journal of Rehabilitation Medicine* (Vol. 26, pp. 1-21).

4. The Joyce Institute. (1995). Job Evaluation Checklist. *Principles and Applications of Ergonomics.*

5. The Joyce Institute. (1990) Office/Computer Checklist. *Practical Office Ergonomics.*

6. The Joyce Institute. (1995). Uniroyal Industrial and Office Ergonomics Checklists. Unpublished.

7. Lifshitz, Y., and Armstrong, T. (1986). A Design Checklist for Control and Prediction of Cumulative Trauma Disorder in Intensive Manual Jobs. In *Proceedings of the Human Factors Society 30th Annual Meeting.* (pp. 945-950).

8. McAtammey, L., and Corlett, E.N. (1993). RULA - A Survey Method for the Investigation of Work Related Upper Limb Disorders. *Applied Ergonomics* (Vol. 24, No. 2, pp. 91-99).

9. Keyserling, W.M., Stetson, D.S., Silverstein, B.A., and Brouwer, M.L. (1993) A Checklist for Evaluation Ergonomic Risk Factors Associated with Upper Extremity Cumulative Trauma Disorders. *Ergonomics* (Vol. 36, No. 7, pp. 807-831).

10. Stetson, D.S., Keyserling, W.M., Silverstein, B.A., and Leonard, J.A. (1991, November). Observational Analysis of the Hand and Wrist: A Pilot Study, *Applied Occupational and Environmental Hygiene* (Vol. 6, No. 11, pp. 937).

11. U.S. Department of Labor. (1991) *Dictionary of Occupational Titles.* Washington, D. C.

12. American National Standards Institute (ANSI)/Human Factors Society Standard 100 (1988). *Human Factors Engineering of Visual Display Terminal Workstation.*

13. Chaffin, D.B., and Andersson, G.B.J. (1984). *Occupational Biomechanics*. New York: John Wiley & Sons.

14. Kilbom, A., and Persson, J. (1988). Work Technique and its Consequences for Musculoskeletal Disorders. *Ergonomics* (Vol. 31, No. 5 p. 276).

15. Putz-Anderson, V. (1992). *Cumulative Trauma Disorders: A Manual for Musculoskeletal Diseases of the Upper Limb.* London, England: Taylor & Francis.

16 Punnett, L., Robins, J.M., Wegnan, D.H. and Keyserling, M., (1985). Soft Tissue Disorders In The Upper Limbs Of Female Garment Workers. *Scandinavian Journal of Work and Environmental Health* (Vol 11. pp. 417-425).

17. Sommerich, C.M., McGlothlin, J. D., Marras., W. S., (1993). Occupational Risk Factors Associated with Soft Tissue Disorders of the Shoulder: A Review of Recent Investigations in the Literature. *Ergonomics* (Vol. 36, No. 6, pp. 697-717).

18. Hagberg, M. (1984). Occupational Musculoskeletal Stress and Disorders of the Neck and Shoulder: A Review of Possible Pathophysiology. *International Archives of Occupational and Environmental Health* (Vol. 53, pp. 269-278).

19. Van Cott, H.P., and Kincade, R.G., (1972). *Human Engineering Guide to Equipment Design.* (p. 72). Washington D.C., U.S. Government Printing Office.

20. Snook, S. H., Ciriello, V.M. (1991). The Design of Manual Handling Tasks: Revised Tables of Maximum Acceptable Weights and Forces. *Ergonomics* (Vol. 34, No. 9, p.1210).

21. Wells, J.A., Zipp, J.F., Schuetter, P.T. and McEleney, J., (1983). Musculoskeletal Disorders Among Letter Carriers. *Journal of Occupational Medicine* (Vol. 25 pp. 814-820).

22. Eastman Kodak (1986) *Ergonomics Design for People at Work Vol 2.* Van Nostrand Reinhold Co. New York.

23. Schoenmarklin, R. W., Marras, W. S. and Leurgans, S. E. (1994) Industrial Wrist Motions and Increase of Hand/Wrist Cumulative Trauma Disorders. *Ergonomics* (Vol. 37, No. 9 pp 1449-1459).

24. Chaffin, D.B., and Andersson, G.B.J. (1984). *Occupational Biomechanics. N*ew York: John Wiley & Sons.

25. Chaffin, D.B. (1973). Localized Muscle Fatigue: Definition and Measurement. *Journal of Occupational Medicine* (Vol. 15, pp. 346-354).

26. Kilbom, A., Persson. J. and Jonsson, B.G., (1986). Disorders of the Cervicobrochial Region Among Female Workers in the Electronics Industry. *International Journal of Industrial Ergonomics* (Vol. 1., pp. 37-47).

27. Putz-Anderson, *op. cit., p.23.*

28. Silverstein. B.A., Fine, L.J., and Armstrong, T.J. (1987). Occupational Factors and Carpal Tunnel Syndrome. *American Journal of Industrial Medicine* (Vol. 11, pp. 343-358).

29. Hammer, A. W. (1934). Tenosynovitis. *International Record of Medicine*. (pp. 139-140). Taubman Medical, 610.5 M5 J86 R4.

30. Putz-Anderson, *op. cit., p.66.*

31. Keyserling, W.M., (1986) A Computer-Aided System to Evaluate Postural Stress in the Workplace. *AIHA Journal* (Vol. 47. pp. 641-649).

32. Marras, W.S., Leurgans S.E., Lavender, S.A., Allread, G.S., Fathallah, F.A., Ferguson, S.A., Rajulu, S.L. (1993) Three Dimensional Dynamic Trunk Motions, Workplace Factors, and Occupational Low Back Disorders. in *The Ergonomics of Manual Work*, Taylor and Francis, Ltd. London.

33. Waters, T., V. Putz-Anderson., A.Garg,. (1994). *Applications Manual for the Revised NIOSH Lifting Equation.* U.S. Department of Health & Human Services, Centers for Disease Control, Cincinnati, Ohio.

34. US Dept of Health and Human Services (1989) *NIOSH Criteria for a Recommended Standard for Occupational Exposure to Hand Arm Vibration* DHHS(NIOSH) publication no. 89-106.

35. Mattila, M., Karwowski, W., and Vilkko, M. (1993, December). Analysis of Working Postures in Hammering Tasks on Building Construction Sites Using the Computerized OWAS Method. *Applied Ergonomics* (Vol. 24, No. 6 pp. 405-411).

36. Bergqvist, U. (1995). Video Display Terminal Work - A Perspective on Long Term Changes. *International Journal of Industrial Ergonomics.* (Vol. 16, pp. 201-209).

37. Keyserling, W.M., Brouwer, M., and Silverstein, B.A. (1993). The Effectiveness of a Joint Labor-Management Program in Controlling Awkward Postures of the Trunk, Neck and Shoulders: Results from a Field Study. *International Journal of Industrial Ergonomics* (Vol. 11, pp. 51-65).

38. Silverstein, B.A., Fine, L.J., and Armstrong, T.J. (1986). Hand Wrist Cumulative Trauma Disorders in Industry. *British Journal of Industrial Medicine* (Vol. 43, pp. 779-782).

39. Silverstein. B.A., Fine, L.J., and Armstrong, T.J. (1987). Occupational Factors and Carpal Tunnel Syndrome. *American Journal of Industrial Medicine* (Vol. 11, pp. 343-358).

40. Reynolds, J.L., Drury, C.G., and Broaderick, R.L. (1994). A Field Methodology for the Control of Musculoskeletal Injuries. *Applied Ergonomics.* (Vol. 25, No. 1, pp. 3-16).

41. Canadian Standards Association (1989). *Office Ergonomics: A National Standard of Canada* (pp. 56). (CAN/CSA-Z412-M89). Canadian Standards Association, Rexdale, Ontario.

42. Canadian Standards, *Ibid., p. 69.*

43. Canadian Standards, *Ibid., p. 63.*

44. USAF Technical Report on Indoor Air Quality.

45. AFOSH STD 48-19. Occupational Exposure to Hazardous Noise.

46. Canadian Standards., *op. cit., pp. 72-75.*

47. Meister, D. (1985). *Behavioral Analysis and Research Methods.* New York: John Wiley and Sons.

48. Cohen, J. (1960). A Coefficient of Agreement for Nominal Scales. *Educational and Psychological Measurement* (Vol. 20, pp. 37 - 46).

49. Brennan, R.L. and Prediger, D.J. (1981). Coefficient Kappa: Some Uses, Misuses and Alternatives. Educational and Psychological Measurement. (Vol. 41 pp. 687-699).

50. Landis, R. and Koch, G. (1977) The Measurement of Observer Agreement for Categorical Data. *Biometrics* (Vol. 33, pp. 159-174).

51. Tatsuoka, M.M., (1974). *Number 3: Classification Procedures: Profile Similarity in Selected Topics in Advanced Statistics: An Elementary Approach.* Champaign, Illinois: Institute for Personality and Ability Testing.

52. Bartko, J. J. and Carpenter, W. T. (1976). On the Methods and Theory of Reliability. *The Journal of Nervous and Mental Disease* (Vol. 163, No. 5, pp. 307-317).

This page intentionally left blank

7.0 BIBLIOGRAPHY

Abu-Ali, M., Purswell, J.L., and Schlegel, R.E. (1994, September). Psychophysically Determined Work-Cycle Parameters for Repetitive Hand Gripping. *International Journal of Industrial Ergonomics.*

Adams, M., Franklin, G., and Barnhart, S. (1994). Outcome of Carpal Tunnel Surgery in Washington State Workers' Compensation. *American Journal of Industrial Medicine* (Vol. 25, pp. 527-536).

AFI 48-101, *Aerospace Medical Operations.*

AFI 91-301, *Air Force Occupational & Environmental.*

AFOSH STD 127-31, *Personal Protective Equipment.*

AFOSH STD 161-17, *Standardized Occupational Health Program.*

AFOSH STD 48-1, *Respiratory Protection Program.*

AFOSH STD 48-17, *Integrated Occupational Health Program.*

AFOSH STD 48-3 (Draft), *Ergonomics Program.*

AFOSH STD 91-204, *Investigating & Reporting US Air Force Mishaps.*

AFOSH STD 48-19, Chapter 2.

Aghazadeh, F., Bisesi, M.S., Rivas, R.D. (1995). Comfort of Personal Protective Equipment. *Applied Ergonomics,*(Vol. 26, No. 3, pp. 195-198).

American National Standards Institute (ANSI) National Safety Council Draft Standard Z-365, (1992, June 11). *Control of Cumulative Trauma Disorders.* Draft Outline. Appendix 23 A & B.

American National Standards Institute (ANSI) Draft Standard Z-365, (June 1993). *Control of Trauma Disorders* (pp. 6-4). Appendix A & B.

American National Standards Institute (ANSI) National Safety Council Draft Standard Z-365, (1995, April 17). *Control of Work Related Cumulative Trauma Disorders.* Working draft.

American National Standards Institute (ANSI)/Human Factors Society Standard 100, (1988). *Human Factors Engineering of Visual Display Terminal Workstations.*

American National Standards Institute (ANSI)/Human Factors Society Standard 100, (1988). *Human Factors Engineering of Visual Display Terminal Workstations (pp. 17-31).*

Application of Survival Analysis to CTD Risk Assessment. (1992). In *Proceedings of the Human Factors Society 36th Annual Meeting.*

Armstrong, T., Werner, R., Waring, W., and Foulke, J. (1986). *Intra-Carpal Canal Pressure in Selected Hand Tasks.* The University of Michigan.

Bartko, J. J. and Carpenter, W. T. (1976). On the Methods and Theory of Reliability. *The Journal of Nervous and Mental Disease* (Vol. 163, No. 5, pp. 307-317).

Bateman, J.E. (1983). Neurologic Painful Conditions Affecting the Shoulder. *Clinical Orthopaedics and Related Research* (Vol. 173, pp. 44-54).

Batra, S., Wang, M.J., and Bishu, R.R. (1994). Glove attributes: Can They Predict Performance? *International Journal of Industrial Ergonomics* (Vol. 14, pp. 201-209).

Bergqvist, M.G., Almby, B., Jansson, E.S. (1994). Hand and Shoulder Ailments Among Laboratory Technicians Using Modern Plunger-Operated Pipettes. *Applied Ergonomics* (Vol. 25, No. 2, pp. 88).

Bergqvist, U. (1995). Video Display Terminal Work - A Perspective on Long Term Changes. *International Journal of Industrial Ergonomics.* (Vol. 16, pp. 201-209).

Bigos, S., Battie, M., Spengler, D., Fisher, L., Fordyce, W., Hansson, T., Nachemson, A., and Wortley, M. (1991). A Prospective Study of Work Perceptions and Psychosocial Factors Affecting the Report of Back Injury. *Spine* (Vol. 16, No. 1, pp. 1-6).

Bishu, R.R., and Klute, G. (1995). The Effects of External Vehicular Activity (EVA) Gloves on Human Performance. *International Journal of Industrial Ergonomics* (Vol. 16, pp. 165-174).

Bjelle, A., Hagberg, M. and Michaelsson, G. (1979). Clinical and Ergonomic Factors in Prolonged Shoulder Pain Among Industrial Workers. *Scandinavian Journal of Work, Environment & Health* (Vol. 5, pp. 205-210).

Bond, G.G., Bodner, K.M., Sobel, W. Shellenberger, R.J. and Flores, G.H. (1988). Validation of Work Histories Obtained from Interviews. *American Journal of Epidemiology* (Vol. 128, No. 2, pp. 343-351).

Borg, G. (1970). Perceived Exertion as an Indicator of Somatic Stress. *Scandinavian Journal of Rehabilitation Medicine* (Vol. 2, pp. 92-98).

Brennan, R.L. and Prediger, D.J. (1981). Coefficient Kappa: Some Uses, Misuses and Alternatives. Educational and Psychological Measurement. (Vol. 41 pp. 687-699).

Burdorf, A. (1992). Exposure Assessment of Risk Factors for Disorders of the Back in Occupational Epidemiology. *Scandinavian Journal of Work, Environment & Health* (Vol. 18, pp. 1-9).

Cakir, A., Hart, D.J., and Stewart, T.F.M. *Visual Display Terminals: A Manual Covering Ergonomics Workplace Design, Health and Safety, Task Organization.* Chichester: John Wiley & Sons.

Canadian Standards Association (1989). *Office Ergonomics: A National Standard of Canada* (pp. 56). (CAN/CSA-Z412-M89). Canadian Standards Association., Rexdale, Ontario.

Carrasco, C., Coleman, N., and Healey, S. (1995). Packaging Products for Customers: An Ergonomics Evaluation of Three Supermarket Checkouts. *Applied Ergonomics* (Vol. 26, No. 2, pp. 101).

Chaffin, D. B., Park, K. S. (1973). A Longitudinal Study of Low-Back Pain as Associated with Occupational Weight Lifting Factors. *American Industrial Hygiene Association Journal*, pp. 513-525.

Chaffin, D.B. (1973). Localized Muscle Fatigue: Definition and Measurement. *Journal of Occupational Medicine* (Vol. 15, pp. 346-354).

Chaffin, D.B., and Andersson, G.B.J. (1984). *Occupational Biomechanics.* New York: John Wiley & Sons.

Cheadle, A., Franklin, G., Wolfhagen, C., Savarino, J., Liu, P., Salley, C., and Weaver, M. (1994, February). Factors Influencing the Duration of Work-Related Disability: A Population-Based Study of Washington State Workers' Compensation. *American Journal of Public Health* (Vol. 84, No. 2).

Cohen, J. (1960). A Coefficient of Agreement for Nominal Scales. *Educational and Psychological Measurement* (Vol. 20, pp. 37 - 46).

Cole, L and Rosa, R. (1994). Construction and Validation of a Musculoskeletal Risk Questionnaire . In *Proceedings of the Human Factors and Ergonomics Society 38th Annual* (pp. 984).

Cole, L. L. (1995, November 20). *Construction and Validation of a Musculoskeletal Risk Questionnaire.* Dissertation.

Colombini, D., Occhipinti, E., Molteni, G., Semeraro, D., and Grieco, A. (1992, September). A Study of Muscle Activity in Workplaces with Keyboard Operations.

Abstract Book from Third International Scientific Conference on Work with Display Units.

Corlett, E.N. (1983). Analysis and Evaluation of Working Postures. In T.O. Kvalseth (Ed.). *Ergonomics of Workstation Design* (pp. 12-15). London: Butterworths.

Dale, W.A. (1982). Thoracic Outlet Compression Syndrome. *Archives of Surgery* (Vol. 117, pp. 1437-1445).

Delisie, A., Gagnon, M. (1995, July). Segmental Dynamic Analysis When Throwing Loads. *International Journal of Industrial Ergonomics* (Vol. 16, No. 1, pp. 9-21).

Dempsey, P.G., and Ayoub, M.M. (1996). The Influence of Gender, Grasp Type, Pinch Width and Wrist Position on Sustained Pinch Strength. *International Journal of Industrial Ergonomics* (Vol. 17, pp. 259-273).

Dickinson, C.E., Campion, K., Foster, A.F., Newman, S.J., O'Rourke, A.M.T., and Thomas, P.G. (1992, June). Questionnaire Development: An Examination of the Nordic Musculoskeletal Questionnaire. *Applied Ergonomics* (Vol. 23, No. 3, pp. 197-201).

Drury, C.G. (1990). Methods for Direct Observation of Performance, in Wilson, J.R., Corlett, and E.N., (eds.). *Evaluation of Human Work (* pp. 35-57). London: Taylor and Francis.

Dunbar, E. (1993). The Role of Psychological Stress and Prior Experience in the Use of Personal Protective Equipment. *Journal of Safety Research* (Vol. 24, No. 3, pp. 181-187).

Eastman Kodak (1986) *Ergonomics Design for People at Work Vol 2.* Van Nostrand Reinhold Co. New York.

Engkvist, I, Hagberg, M., Wigaeus-Hjelm, E., Menckel, E., Ekenvall, L., and PROSA Study Group. (1995) Interview Protocols and Ergonomics Checklist for Analyzing (sic) Overexertion Back Accidents Among Nursing Personnel. *Applied Ergonomics.* (Vol. 26, no 3, pp. 213-220).

Fard, H., and Mital, A. (1993). A Psychophysical Study of High and Very High Frequency Manual Materials Handling - Part I: Lifting and Lowering. *International Journal of Industrial Ergonomics* (Vol. 12, pp. 127-141).

Fard, H., and Mital, A. (1993). A Psychophysical Study of High and Very High Frequency Manual Materials Handling - Part II: Carrying and Turning. *International Journal of Industrial Ergonomics* (Vol. 12, pp. 143-156).

Feldman, R.G., Goldman, R., and Keyserling, W.M. (1983). Peripheral Nerve Entrapment Syndromes and Ergonomic Factors. *American Journal of Industrial Medicine* (Vol. 4, pp. 661-681).

Fleiss, J. L. and Cohen, J., The Equivalence of Weighted Kappa and the Intraclass Correlation Coefficient as Measures of Reliability. *Educational and Psychological Measurement* (Vol. 33, pp. 613 to 619).

Garg, A., and Moore, J.S. (1993). A Job Analysis Method for Predicting Risk of Upper Extremity Disorders at work: Preliminary Results, in R. Nielsen and K. Jorgensen, (eds.). *Advances in Industrial Ergonomics and Safety* (pp. 163-169). Taylor and Francis.

Garg, A., Owen, B. (1994). Prevention of Back Injuries in Health Care Workers. *International Journal of Industrial Ergonomics* (Vol. 14, pp. 315-331).

Goldstein, S.A., Armstrong, T.J., Chaffin, D.B., Matthews, L.S., (1987). Analysis of Cumulative Strain in Tendons and Tendon Sheaths. *Journal of Biomechanics* (Vol. 20 No.1, pp. 1-6).

Graf, M., Guggenbuhl U., Krueger, H., (1995). An Assessment of Seated Activity and Postures at Five Workplaces. *International Journal of Industrial Ergonomics.* (Vol. 15 pp. 81-90).

Grandjean, Etienne, (1988). *Fitting the Task to the Man: A Textbook of Occupational Ergonomics.* Taylor & Francis Ltd., London. pp. 36 - 81.

Grant, K.A., Habes, D.J., and Baron, S.L. (1994). An Ergonomics Evaluation of Cashier Work Activities at Check-Unload Workstations. *Applied Ergonomics* (Vol. 25, No. 5, pp. 310).

Hagberg, M. (1984). Occupational Musculoskeletal Stress and Disorders of the Neck and Shoulder: A Review of Possible Pathophysiology. *International Archives of Occupational and Environmental Health* (Vol. 53, pp. 269-278).

Haigh, R. (1993). The Aging Process: A Challenge for Design. *Applied Ergonomics* (Vol. 24, No. 1, pp. 9).

Hammer, A. W. (1934). Tenosynovitis. *International Record of Medicine.* (pp. 139-140). Taubman Medical, 610.5 M5 J86 R4.

Harber, P., Bloswick, D., Beck, J., Pena, L., Baker, D., and Lee, J. (1993, August). Supermarket Checker Motions and Cumulative Trauma Risk. *Journal of Occupational Medicine* (Vol. 35, No. 8).

Harber, P., Bloswick, D., Beck, J., Pena, L., Baker, D., and Lee, J. (1992, May). The Ergonomic Challenge of Repetitive Motion with Varying Ergonomic Stresses. *Journal of Occupational Medicine* (Vol. 34, No. 5).

Herberts, P., Kadefors, R., Hagfors, C. and Sigholm, G., (1984). Shoulder Pain and Heavy Manual Labor, *Clinical Orthopaedics and Related Research* (pp. 166-178), as cited in Sommerich, C.M., McGlothlin, J. D., Marras., W. S., (1993). Occupational Risk Factors Associated With Soft Tissue Disorders of the Shoulder: A Review of Recent Investigations in the Literature. *Ergonomics* (Vol. 36, No 6, pp. 697-717).

Heus, R., Daanen, H.A.M., and Haventh, G. (1995). Physiological Criteria for Functioning of Hands in the Cold. *Applied Ergonomics* (Vol. 26, No. 1, pp. 5-13).

Holmer, I. (1994). Cold Stress - Part I: Guide for the Practitioner. *International Journal of Industrial Ergonomics* (Vol. 14, pp. 139-149).

Howarth, Peter Alan, and Instance, Owen (1985). The Association Between Visual Discomfort and the Use of Visual Display Units, *Behavior and Information Technology* (Vol. 4, No. 2, pp. 131-149).

The Joyce Institute. (1995). Job Evaluation Checklist. *Principles and Applications of Ergonomics.*

The Joyce Institute. (1990) Office/Computer Checklist. *Practical Office Ergonomics.*

The Joyce Institute. (1995). Uniroyal Industrial and Office Ergonomics Checklists. Unpublished.

Katz, J., Punnett, L., Simmons, B., Fossel, A., Mooney, N., and Keller, R. (1996, Jan.). Workers' Compensation Recipients with Carpal Tunnel Syndrome. The Validity of Self-Reported Health Measures. *American Journal of Public Health* (Vol. 86, No. 1, pp. 52-56)

Kelly, J. P., Rosenberg, L., Kaufman, D. W. and Shapiro, S. (1990). Reliability of Personal Interview Data in a Hospital-Based Case-Control Study. *American Journal of Epidemiology* . (Vol. 31, No. 1, pp. 79-90).

Kemmlert, K. (1994). A Method Assigned for the Identification of Ergonomic Hazards - PLIBEL. *Scandinavian Journal of Rehabilitation Medicine* (Vol. 26, pp. 1-21).

Keyserling, W.M., (1986) A Computer-Aided System to Evaluate Postural Stress in the Workplace. *AIHA Journal* (Vol. 47. pp. 641-649).

Keyserling, W.M., Brouwer, M., and Silverstein, B.A. (1993). The Effectiveness of a Joint Labor-Management Program in Controlling Awkward Postures of the Trunk, Neck and Shoulders: Results from a Field Study. *International Journal of Industrial Ergonomics* (Vol. 11, pp. 51-65).

Keyserling, W.M., Stetson, D.S., Silverstein, B.A., and Brouwer, M.L. (1993) A Checklist for Evaluation Ergonomic Risk Factors Associated with Upper Extremity Cumulative Trauma Disorders. *Ergonomics* (Vol. 36, No. 7, pp. 807-831).

Kihlberg, S. (1995). Biodynamic Response of the Hand-Arm System to Vibration from an Impact Hammer and Grinder. *International Journal of Industrial Ergonomics* (Vol. 16, pp. 1-8).

Kihlberg, S., Kjellberg, A., and Lindbeck, L. (1995). Discomfort from Pneumatic Tool Torque Reaction: Acceptability Limits. *International Journal of Industrial Ergonomics.*

Kilbom, A. (1994). Quantification of Physical Exposure. Institute of Occupational Health, S-17184. *International Journal of Industrial Ergonomics* (Vol. 14, pp. 59-86).

Kilbom, A. (1988). Intervention Programmes for Work-Related Neck and Upper Limb Disorders: Strategies and Evaluation. *Ergonomics* (Vol. 31, No. 5).

Kilbom, A., Persson. J. and Jonsson, B.G., (1986). Disorders of the Cervicobrochial Region Among Female Workers in the Electronics Industry. *International Journal of Industrial Ergonomics* (Vol. 1, pp. 37-47).

Kilbom, A., Persson. J., (1988). Work Technique and its Consequences for Musculoskeletal Disorder. *Ergonomics* (Vol. 31, No. 5, pp. 276). Research Department of the Swedish National Board of Occupational Safety and Health, S-17184, Solna, Sweden.

Kirwan, B. and Ainsworth, L.K. (1992). *A Guide to Task Analysis.* London: Taylor and Francis.

Konz, S. (1994). Standing. *Ergonomics* (Vol. 37, No. 4, pp. 677).

Kumar, S., (1995). Development of Predictive Equations for Lifting Strength. *Applied Ergonomics* (Vol. 26, No. 5, pp. 327 - 341).

Kumar, S., Narayan, Y., and Bacchus, C. (1995, December). Symmetric and Asymmetric Two-Handed Pull-Push Strength of Young Adults. *Human Factors* (Vol. 37, No. 4).

Kuorinka, I., and Koshinen, P. (1979). Occupational Rheumatic Diseases and Upper Limb Strain in Manual Jobs in a Light Mechanical Industry. *Scandinavian Journal of Work, Environment & Health* (Vol. 5, No. 3, pp. 39-47).

Kuorinka, Jonsson, Vinterberg, H., Biering-Soressen, F., Andersson, and Jorgensen, K. (1987, September). Standardized Nordic Questionnaires for the Analysis of Musculoskeletal Symptoms. *Applied Ergonomics.* (pp. 233-237).

Landis, R. and Koch, G. (1977) The Measurement of Observer Agreement for Categorical Data. *Biometrics* (Vol. 33, pp. 159-174).

Lavender, S., Thomas, J., Chang, D., and Andersson, B. (1995, December) Effect of Lifting Belts, Foot Movement, and Lift Asymmetry on Trunk Motions. *Human Factors* (Vol. 37, No. 4).

Lewis, W.G., Narayan, C.V. (October 1993). Design and Sizing of Ergonomic Handles for Hand Tools. *Applied Ergonomics.*

Lifshitz, Y., and Armstrong, T. (1986). A Design Checklist for Control and Prediction of Cumulative Trauma Disorder in Intensive Manual Jobs. In *Proceedings of the Human Factors Society 30th Annual Meeting.* (pp. 945-950).

Loricchio, D., and Lewis, J. (1991) User Assessment of Standard and Reduced-Size Numeric Keypads. *Proceedings of the Human Factors Society 35th Annual Meeting-1991.*

Loslever, P., and Ranaivosoa, A. (1993). Biomechanical and Epidemiological Investigation of Carpal Tunnel Syndrome at Workplaces with High Risk Factors. *Ergonomics* (Vol. 36, No. 5, pp. 537-554).

Maclure, M. and Willet, W. C. Misinterpretation and Misuse of the Kappa Statistic. *American Journal of Epidemiology* (Vol. 126, No. 2, pp. 161-169).

Marley, R. and Kumar, N. (1996). An Improved Musculoskeletal Discomfort Assessment Tool. *International Journal of Industrial Ergonomics.* (Vol. 17, pp. 21-27).

Marras, W.S., Leurgans S.E., Lavender, S.A., Allread, G.S., Fathallah, F.A., Ferguson, S.A., Rajulu, S.L. (1993) Three Dimensional Dynamic Trunk Motions, Workplace Factors, and Occupational Low Back Disorders. *The Ergonomics of Manual Work,* Taylor and Francis, Ltd. London.

Mattila, M., Karwowski, W., and Vilkko, M. (1993, December). Analysis of Working Postures in Hammering Tasks on Building Construction Sites Using the Computerized OWAS Method. *Applied Ergonomics* (Vol. 24, No. 6).

McAtammey, L., and Corlett, E.N. (1993). RULA - A Survey Method for the Investigation of Work Related Upper Limb Disorders. *Applied Ergonomics* (Vol. 24, No. 2, pp. 91-99).

McGehen, F.P., (1977). When Is a Product Portable? *Dimensions/NBS.* Washington, D.C.: National Bureau of Standards (pp. 16-19), as cited in *Ergonomic Design for People at Work* (1986). (Vol 2., pp. 420). Eastman Kodak Company.

Meister, D. (1985). *Behavioral Analysis and Research Methods.* New York: John Wiley and Sons.

Military Standard 1472. Human Engineering Design Criteria for Military Systems, Equipment & Facilities.

Mital, A., and Asfour, S.S. (1983). Maximum Frequencies Acceptable to Males for One-Handed Lifting in the Sagital Plane. *Human Factors* (Vol. 25, No. 5, pp. 563-571).

Mital, A., and Manivasagan, I. (1983). Maximum Acceptable Weight of Lift as a Function of Material Density, Center of Gravity Location, Hand Preference, and Frequency. *Human Factors* (Vol. 25, No. 1, pp. 33-42).

Mital, A., Foononifard, H., and Brown, M.L. (1994, June). Physical Fatigue in High and Very High Frequency Manual Handling - Perceived Exertion and Physiological Indicators. *Human Factors* (Vol. 36, No. 2, pp. 219-231).

Mital, A., Nicholson, A.S., and Ayoub, M.M. (1993). *A Guide to Manual Materials Handling.* London: Taylor & Francis.

Moore, J. (1994, December 1-2). *The Epidemiological Context of Upper Extremity Disorders Associated with Work.* International Conference on Occupational Disorders of the Upper Extremities.

Nachemson, A. and Elfstrom, G. (1970) Intravital Dynamic Pressure Measurements in Lumbar Discs. *Scandinavian Journal of Rehabilitation Medicine - Supplement I.*

Nagamachi, M. (1995, Jan.) Engineering: A New Ergonomic Consumer-Oriented Technology for Product Development. *International Journal of Industrial Ergonomics* (Vol. 15, No. 1, pp. 3-11).

Nelson, J.B., and Mital A. (1995). An Ergonomical Evaluation of the Primary Hand Flexibility and Capability Changes with Increases in Examination/Surgical Glove Thickness. *Ergonomics* (Vol. 38, No. 4, pp. 723-734).

Nichols, H.M. (1967). Anatomic Structures of the Thoracic Outlet. *Clinical Orthopaedics and Related Research* (Vol. 51, pp. 17-25).

NIOSH, Applications Manual for the Revised NIOSH Lifting Equation. (1994) U.S. Department of Health and Human Services.

Ohara, H., Aoyama, H., Itani, T., Nakagiri, S., and Wake, K (1976). Occupational Health Hazards Resulting from Elevated Work Rate Situations. *Journal of Human Ergology* (Vol. 5, pp. 173-182).

Pascarelli, E., and Kella, J. (1993, May). Soft-Tissue Injuries Related to Use of the Computer Keyboard: A Clinical Study of 53 Severely Injured Persons. *Journal of Occupational Medicine* (Vol. 35, Number 5, pp. 522-532).

Punnett, L., Robins, J.M., Wegnan, D.H. and Keyserling, M., (1985). "Soft Tissue Disorders In The Upper Limbs Of Female Garment Workers", *Scandinavian Journal of Work and Environmental Health* (pp. 417-425).

Putz-Anderson, V., (1992). *Cumulative Trauma Disorders: A Manual for Musculoskeletal Diseases of the Upper Limb.* Thoracic Taylor & Francis., London.

Reynolds, J.L., Drury, C.G., and Broaderick, R.L. (1994). A Field Methodology for the Control of Musculoskeletal Injuries. *Applied Ergonomics.* (Vol. 25, No. 1, pp. 3-16).

Ridyard, D.T., Bobick, T.G., and Starkman, B.S. (1990, November). Ergonomics Awareness Training for Workplace Design Engineers. *Applied Ergonomics Technology, and NIOSH, Applied Occupational and Environmental Hygiene* (Vol. 5, No. 11, pp. 771-781).

Ryan, G.A., (1989). Musculoskeletal Symptoms in Supermarket Workers. *Ergonomics* (Vol. 32, No. 4, pp. 359 - 371).

Sauter, S., Swanson, N. (1994, December). *Keyboard Work, Stress and Upper Limb Disorders.* National Institute for Occupational Safety and Health.

Sawin, D., and Scerbo, M. (1995, December). Effects of Instruction Type and Boredom Proneness in Vigilance: Implications for Boredom and Workload. *Human Factors* (Vol. 37, No. 4).

Schulze, J.H. L., Congleton, J.J., Koppa, R.L., Huchingsonm R.D. (1994, August). Effects of Pneumatic Screwdrivers and Workstations on Inexperienced and Experienced Operator Performance. *International Journal of Industrial Ergonomics* (Vol. 16, pp. 175-189).

Schoenmarklin, R. W., Marras, W. S. and Leurgans, S. E. (1994) Industrial Wrist Motions and Increase of Hand/Wrist Cumulative Trauma Disorders. *Ergonomics* (Vol. 37, No. 9 pp 1449-1459).

Silverstein, B.A., Fine, L.J., and Armstrong, T.J. (1986). Hand Wrist Cumulative Trauma Disorders in Industry. *British Journal of Industrial Medicine* (Vol. 43, pp. 779-782).

Silverstein, B.A., Richards, S., Alcser, K., and Schurman, S. (1991). Evaluation of In-Plant Ergonomics Training. *International Journal of Industrial Ergonomics.*

Silverstein. B.A., Fine, L.J., and Armstrong, T.J. (1987). Occupational Factors and Carpal Tunnel Syndrome. *American Journal of Industrial Medicine* (Vol. 11, pp. 343-358).

Smith, M.J., Carayon, P., Sanders, K.J., Lim, S.Y., and LeGrande, D. (1992). Employee Stress and Health Complaints in Jobs With and Without Electronic Performance Monitoring. *Applied Ergonomics* (Vol. 23, No. 1, pp. 17-27).

Snook , S.H., Ciriello, V.M., (1991). The Design of Manual Materials Handling Tasks: Revised Tables of Maximum Acceptable Weights and Forces. *Ergonomics* (Vol. 34, No. 9., pp. 1210).

Snook, S., Vaillancourt, D., Ciriello, V., and Webster, B. (1994, April 15). Psychophysical Studies of Repetitive Wrist Flexion and Extension. *Ergonomics.*

Sommerich, C.M., McGlothlin, J.D., Marras, W.S. (1993). Occupational Risk Factors Associated with Soft Tissue Disorders of the Shoulder: A Review of Recent Investigations in the Literature. *Ergonomics* (Vol. 36, No. 6.)

Sperling, L., Sven, D., Wikstrom, L., Kilbom, A., and Kadefors, R. (1993). A Cube Model for the Classification of Work with Hand Tools and the Formulation of Functional Requirements. *Applied Ergonomics.*

Starr, J. Steven. Effects of Video Display Terminals in a Business Office. (1984) *Human Factors* (Vol 3, No. 356, p.354).

Stetson, D.S., Keyserling, W.M., Silverstein, B.A., and Leonard, J.A., (November 1991). Observational Analysis of the Hand and Wrist: A Pilot Study, *Applied Occupational and Environmental Hygiene.* DOL & State of Washington (Vol. 6, No. 11, pp. 927 - 937).

Tanaka, S., McGlothlin, J. (1993). A Conceptual Quantitative Model for Prevention of Work-Related Carpal Tunnel Syndrome (CTS). National Institute for Occupational Safety and Health. *International Journal of Industrial Ergonomics.*

Tatsuoka, M.M., (1974). *Number 3: Classification Procedures: Profile Similarity in Selected Topics in Advanced Statistics: An Elementary Approach.* Champaign, Illinois: Institute for Personality and Ability Testing.

Thomas, R. G., van Baar, C. E., and Van der Stee, M. J. (1995). Baggage Handling: Posture and the Design of Conveyors. *Applied Ergonomics* (Vol. 26, No. 2, pp. 123-127).

Tyson, R.R., and Kaplan, G.F. (1975). Modern Concepts of Diagnosis and Treatment of the Thoracic Outlet Syndrome. *Orthopaedics Clinics of North America* (Vol. 6, pp. 507-519).

USAF Technical Report on Indoor Air Quality.

US Dept of Health and Human Services (1989) *NIOSH Criteria for a Recommended Standard for Occupational Exposure to Hand Arm Vibration* DHHS (NIOSH) publication no. 89-106.

U. S. Department of Labor, Occupational Safety and Health Administration, (1995) *Draft Ergonomics Protection Standard.* Washington, D. C.

U. S. Department of Labor, Occupational Safety and Health Administration, (1970). *Occupational Safety and Health Act and Implementing Regulations.* Washington, D.C.

U.S. Department of Labor. Division of Occupational Analysis, United States Employment Service, Employment & Training Administration- *Guide to Job Analysis. A "How-to" Publication for Occupational Analysts.* Washington, D. C.

U.S. Department of Labor.(1991) *Dictionary of Occupational Titles.* Washington, D. C.

Ulin, S.S., Armstrong, T.J., Snook, S.H., Monroe-Keyserling, W. (1993). Examination of the Effect of Tool Mass and Work Postures on Perceived Exertion for a Screw Driving Task," *International Journal of Industrial Ergonomics* (Vol. 12, pp. 105-115).

USAF Technical Report on Indoor Air Quality, (p. 24).

Van Cott, H.P., and Kincade, R.G., (1972). *Human Engineering Guide to Equipment Design.* (pp. 72). Washington D.C., U.S. Government Printing Office.

Van Wely, P. (1970). Design and Disease. *Applied Ergonomics* (Vol. 1, No. 5, pp. 262-269).

Washburn, R.A. and Montoye, H.J. (1986). The Assessment of Physical Activity by Questionnaire. *American Journal of Epidemiology* (Vol. 123, No. 4, pp. 563 to 575).

Waters, T., V. Putz-Anderson., A.Garg,. (1994). *Applications Manual for the Revised NIOSH Lifting Equation.* U.S. Department of Health & Human Services, Centers for Disease Control, Cincinnati, Ohio.

Wells, J.A., Zipp, J.F., Schuetter, P.T. and McEleney, J., (1983). Musculoskeletal Disorders Among Letter Carriers. *Journal of Occupational Medicine* (pp. 814-820), as cited in Sommerich, C.M., McGlothlin, J. D., Marras., W. S. , (1993). Occupational Risk Factors Associated with Soft Tissue Disorders of the Shoulder: A Review of Recent Investigations in the Literature, *Ergonomics* (Vol. 36, No. 6, pp. 697-717).

Wells, R. (1994, December 1-2). Biomechanical Models of CTD's/International Conference on Occupational Disorders of the Upper Extremities. Faculty of Applied Health Sciences, University of Waterloo, Ontario, Canada.

Wiker, S.F., Chaffin, D.B., Langolf, G.D. (1989). "Shoulder Posture and Localized Muscle Fatigue and Discomfort," *Ergonomics* (Vol. 32, No. 2).

Wiktorin, C., et al. (1991). Design and Reliability of a Questionnaire for Estimating of Physical Load on Epidemiological Studies. In *Proceedings of International Ergonomics Association* (Vol. 199, pp. 230-232).

Wiktorin, C., Karlqvist, L., et al. (1993). Validity of Self-Reported Exposures to Work Postures and Manual Materials Handling. *Scandinavian Journal of Work, Environment & Health* (Vol. 19, pp. 208-214).

This page intentionally left blank

APPENDIX A

Gold Standard Ergonomists
Qualification Summaries

This page intentionally left blank

Biography

Andrew J. Marcotte, CPE
Ergonomist
The Joyce Institute/A Unit of Arthur D. Little

Mr. Marcotte, MSIE, CPE, is Assistant Director for Ergonomics for The Joyce Institute, a unit of Arthur D. Little, within the Environmental, Health, and Safety Directorate. He specializes in industrial and office consulting and training, and in the development and implementation of strategic ergonomics plans. He has extensive experience with several industries including the automotive, chemical, metal processing, sleep products and office product manufacturing industries.

Office Workplace Consulting: Ergonomics Assessment and Design

- For an international office products company, Mr. Marcotte developed a model ergonomics program plan designed to reflect the manufacturing, safety and engineering management systems already in place. The plan was used to guide the systematic implementation of ergonomics design practices on a "pilot" basis at one of the company's California facilities. After the plan was established, Mr. Marcotte trained individuals (top management, engineers, supervisors, employee work teams) who would be responsible for implementing all aspects of the program. (Avery Dennison, 1994-1995)

- For a major U.S. bedding manufacturer, Mr. Marcotte developed and assisted in implementing a cost-effective abatement plan that addressed ergonomics hazards for which the company had been cited and prepared the company for responding to OSHA. Mr. Marcotte used analyses that identified ergonomics hazards as well as production and handling process inefficiencies, and worked with the company management team to evaluate appropriate handling technology and identified changes to the production scheduling system. As a result, the company obtained a 60 percent reduction in the OSHA fine; reduced the number of times each unit is handled from 7 to 3; decrease shipping-related injuries from 9 to 1 and increased plant-wide production capacity by 50 percent at current employment levels in a one year period. (Adam Wuest/Serta, 1991-1992)

Industrial Workplace Consulting: Ergonomics Assessment and Design

- For an aluminum smelting and manufacturing company, Mr. Marcotte conducted advanced ergonomics training for engineers and supervisors in smelting, rolling, ingot, packaging and maintenance areas. Trained the internal ergonomist in advanced ergonomics problem solving and solution design techniques and certified the ergonomist to conduct in-house ergonomics training. (ALCOA, 1990-1993)

- For an iron foundry, he trained members of a joint management-union ergonomics committee to recognize the probable causes of injuries and to devise prevention strategies based on ergonomics principles. (Chrysler, 1988)

- For a metal fabricator, Mr. Marcotte trained engineers and health/safety professionals in task analysis methodology to assist in the identification of ergonomic stressors. (Chrysler, 1988)

- For a paper products facility, Mr. Marcotte analyzed and recommended modifications to hand-packing operations including: pre-orienting packages to correspond to the shipper's fill pattern; providing guide rails to locate packages closer to the operator; and designing adjustable height for shipper conveyor to allow for size variances. (Proctor & Gamble, 1989)

- He analyzed and recommended modifications to a materials handling operation for a moist chemical product. Provision of a platform and modifications to the material container provided better access and reduced bending and overhead reaching. (BASF, 1990)

- For an automobile and auto parts manufacturer, he modified tool handling operations in the molding environment by adding roller tops to tooling transfer carts. This reduced operator fatigue by reducing push/pull forces required to move the tooling during production. Low back stress was reduced and productivity increased by 33%. (GM Central Foundry, 1986)

- For a utility/service industry, he identified equipment and tool design elements and work procedures that were contributing to back injuries for utilities service technicians. Recommendations included equipment modifications as well as safe work practices and handling procedures for ladders used during pole work. (CENTEL, 1990-1991)

- For a medical instrument manufacturer, he analyzed and recommended modifications designed to prevent injuries on a production line dedicated to wand assembly for bar-code data collection systems. Recommendations targeted simple workplace modifications to improve the present system as well as product redesign elements to improve manufacturability and assembly of future products. (Welch Allyn, 1990-1992)

- Mr. Marcotte analyzed sewing workstations for a major garment manufacturer, and recommended design modifications to provide adjustable workstations based on job analysis. This resulted in a reduction of stresses, pain and discomfort of the operators, thereby minimizing the potential for cumulative trauma disorders in the neck, shoulders and back. (ILGW, 1988-1989)

- Mr. Marcotte trained engineers at a truck manufacturing plant to minimize back injuries and improve throughput by redesigning work area layout and procedures. (GM-Moraine Assembly, 1988-1989)

- At a meat processing plant, he evaluated and recommended design and layout modifications for a pork processing line, to reduce reaches and grip forces and to increase productivity. As a result, ergonomics is now being adopted into the overall facilities and equipment design process. (Hygrade, 1988-1990)

Ergonomics Program Design, Management and Auditing

- For a bedding association, Mr. Marcotte developed a strategy manual designed to provide ergonomics guidelines that will assist bedding manufacturers in developing ergonomics programs that will reduce work-related industries and lower costs. The guidelines also are designed to place the industry in a strengthened position to ensure that, if a federal ergonomics standard proposed by the Occupational Health and Safety Administration (OSHA) is adopted, the new guidelines will be reasonable and focused on the industry's actual conditions. (ISPA, 1994-1995)

- Mr. Marcotte developed guidelines for ergonomics in the Chemical and Allied Industries through the Chemical Manufacturer's Association. (1992)

Education/Professional Activities

Mr. Marcotte, a certified professional ergonomist, earned his Master of Science in Industrial and Operations Engineering, specializing in Ergonomics/Occupational Health & Safety Engineering, from the University of Michigan at Ann Arbor. He holds a Bachelor of Science in Industrial and Systems Engineering from the General Motors Institute at Flint, Michigan.

He previously served on the ANSI - Z-365 Subcommittee and is a member of the Human Factors and Ergonomics Society, the American Society of Safety Engineers and the Institute of Industrial Engineers.

Research/Publications

Marcotte, A. J., Barker, R. T. *Level I Ergonomics Assessment Methodology for Maintenance and Inspection Work Areas*, United States Air Force Materiel Command/Armstrong Laboratories, December 1996.

Marcotte, A. J., Barker, R. T. *Level I Ergonomics Assessment Methodology for Administrative Work Areas*, United States Air Force Materiel Command/Armstrong Laboratories, October 1996.

Marcotte, A. J., Barker, R. T. *Job Requirements/Physical Demands Survey Methodology*, United States Air Force Space Command/Armstrong Laboratories, September 1996.

"Ergonomics Applied to Product & Process Design Achieves Immediate, Measurable Cost Savings," HFES, San Diego, CA, October, 1995.

Marcotte, A. J., Weinkamp, P., Jackson, P., and Bretz, T., "Moving Mattresses Safely: A Case Study in Manual Materials Handling," International Ergonomics Association, Warsaw, Poland, June 1993.

Marcotte, Andrew and Adams, Edie, "A Manager's Guide to Ergonomics in the Chemical and Allied Industries," Chemical Manufacturers Association (CMA), 1992.

Marcotte, A. J., "Implementing a Successful Ergonomics Program Using In-House Expertise: Results Through Training, "Proceedings of the IEA Annual Meeting, Paris, France, July, 1991.

Marcotte, A. J. and Martino, John, "Injury Prevention In An Incentive-based Production Environment: A Case Study," Proceedings of the IFIESR Annual Meeting, Lake Tahoe, Nevada, June 1991.

Cook, Robert E. and Marcotte, A. J., "Ergonomic Improvement in Games Manufacturing: A Case Study," Proceedings of the HFS 34th Annual Meeting, Orlando, Florida, October 1990.

Presentations

Marcotte, A.J., "Making a Business Case for Ergonomics," Organization Resources Councelors, Inc., San Francisco, CA, September, 1995.

Marcotte, A.J., "Ergonomics: Value-Added Safety," Fisher Scientific Conference, Two Rivers, WI, March, 1995.

Marcotte, A.J., "Ergonomics Workstation Analysis for the Bedding Industry," International Sleeps Products Association, Albuquerque, NM, March, 1995.

Marcotte, A.J., "How to Develop a Practical Written Ergonomics Plan," Manufacturers' Education Council, Columbus, OH, February, 1995.

Marcotte, A. J., "Ergonomics Measurable Results in the Chemical Industry: Case Studies." Presentation identifying key applications and results of ergonomics improvements in chemical process operations. National Safety Congress, Chicago, IL. October 1993.

Marcotte, A. J., "Public Utilities and Ergonomics: Problems and Solutions." Case study presentation identifying potential scope of problems and results of improvements in public utilities work. National Safety Congress, Chicago, IL. October 1993.

Biography

Jeffrey B. Nelson, CPE
Ergonomist
The Joyce Institute/A Unit of Arthur D. Little

Mr. Nelson, MSIE, is a consultant for The Joyce Institute/A Unit of Arthur D. Little specializing in industrial and office consulting and training and in the design of consumer products for industrial and home environments. He has extensive experience in office product manufacturing, automobile assembly, semiconductor and clean room environments, and the chemical and consumer product industries.

Industrial Workplace Consulting: Ergonomics Assessment and Design

- For a modular housing fabricator in Mexico, Mr. Nelson designed a "super jig" for use in the construction of modular housing, and evaluated and critiqued the prototype of the machine.

- For a major hospital, he evaluated the stresses caused during plasma vial inspection. His recommendations included the redesign of a new "reject" holding cart, the adjustment of a lighting screen, the relocation of task lighting, the implementation of a worker rotation procedure, and the balancing of line speeds.

- For a corrugated box manufacturer, Mr. Nelson identified the stressors placed on workers involved in a box assembly procedure. He recommended process improvements and equipment modifications, including the relocation of controls, scheduled employee rotation, and the purchase of manual lifting devices. He also recommended the purchase of automated folding equipment, and created a design for a stationary folding apparatus.

- For a consumer products manufacturer, he evaluated a rotational molding operation, and recommended process revisions as well as design modifications for the working platform, the material delivery system, several tools and molds.

- For a sewage disposal facility, Mr. Nelson identified the musculoskeletal stressors placed on workers involved in the transfer of motor oil between containers. He recommended the purchase of a manual siphon pump to eliminate static loading on the shoulder, which was occurring during the performance of several tasks.

- For a snack foods manufacturer, Mr. Nelson identified the sources of musculoskeletal stressors placed on workers involved in the hand packing and box construction processes. Additionally, he was asked to identify those benefits which would be gained with the implementation of further ergonomics based improvements. Mr. Nelson recommended the installation of a mechanized box maker and label applicator, the addition of a height-adjustable table between two conveyor lines, and the height and weight constraints for the mylar packaging rolls. He also recommended modifications to the job rotation, and indicated the potential risk with changes in line speed.

- For the U.S. Air Force-Materiel and Space Command, Mr. Nelson served as the "Gold Standard Ergonomist" during the task evaluation and recommendations phases. During his lengthy visits to USAF bases in Massachusetts and Florida, he identified and ranked those tasks which contained large amounts of musculoskeletal stressors. Additionally, for each identified task, he devised engineering-based solutions to alleviate those stressors.

- For the U.S. Postal Service, Mr. Nelson evaluated the mechanized bulk mail sorting/delivery operation. He recommended lighting adjustments for all tasks, provision of anti-fatigue matting, adjustment of keypad features for workers at standing workstations, creation of a company-wide job/worker rotation policy, workstation redesign to facilitate movement and enable the use of both hands, substitution of manual keypad entry with a bar-code reading system, and the purchase of headsets and adjustable chairs for control room monitors. He also recommended the incorporation of advanced ergonomics analysis techniques into future design.

Office Workplace Consulting: Ergonomics Assessment and Design

- For a regional hospital, Mr. Nelson recommended improvements to the Critical Care, Histology and Transcription Departments. His recommendations resulted in the redesign of work areas for enhanced visibility, alleviation of psychosocial stresses and increased desk space. He also recommended the automation of certain activities to reduce stresses to the upper limbs and remove external trauma; and recommended the development of policy covering workload distribution, workstation layout and materials placement.

- For a hospital, Mr. Nelson redesigned a medical records storage facility. His recommendations included the installation of new equipment and the redesign of out-patient records facility.

- For a large technology firm, Mr. Nelson developed a manual that instructs computer input device users in how to improve their workstation layout, body orientation and work habits by incorporating ergonomics principles. For the manual, he created a customized checklist to reinforce these principles on an ongoing basis through the use of exercises and strategies to increase comfort.

- For a railway management office where there had been workplace injuries, he identified stressors and recommended improvements including the equipment purchase, institution of formal evaluation procedures, redesign of work areas and suggested design for future space planning efforts, training in office ergonomics.

- Mr. Nelson evaluated physical and psychosocial issues involved with an aerospace-industry office worker who had been diagnosed Fibromyalgia. His recommendations included workstation redesign and enhancements, education about Fibromyalgia, broadening of the worker's job to include greater responsibility and variety of tasks, and training in office ergonomics.

Product Design Criteria Development for End-User

- For a multinational computer design firm, Mr. Nelson developed design and operational criteria to be used in the development of a computer input device. The criteria will allow for movement/control in all planes and force feedback without causing potential injury.

Training Design and Implementation

- For the U.S. Postal Service, Mr. Nelson developed and implemented customized ergonomics course material, addressing those ergonomics stressors for tasks involving sitting, standing and materials handling.

- Mr. Nelson has trained employees in ways to identify, alleviate and prevent workplace ergonomics hazards at numerous industrial and office firms, including a chemical manufacturer, an electrical component/semiconductor manufacturer, an electronic test equipment manufacturer, a hospital equipment manufacturer, newspaper printing and publishing companies, manufacturers of office, vinyl and paper products, an international petrochemical company, a major pharmaceuticals firm, a pulp and paper processor, a seafood processor, a manufacturer of silicon wafers, a truck manufacturer and a wood and steel cabinet construction firm.

Education/Professional Activities

Mr. Nelson, a Certified Professional Ergonomist, received a Master of Science in Industrial Engineering, specializing in Industrial Ergonomics, from the University of Cincinnati in Ohio. He holds a Bachelor of Science in Kinesiology, specializing in Biomechanics, Neurology and Physiology from the University of California at Los Angeles.

He is a member of the Human Factors and Ergonomics Society and the American Society of Safety Engineers.

Publications

Nelson, Jeffrey B. and Anil Mital, "An Ergonomical Evaluation of the Primary Hand Flexibility and Capability Changes with Increases in Examination/Surgical Glove Thickness," *Ergonomics*, Vol. 38, No. 4, April 1995.

Presentations

Nelson, J. B. and Joyce, M. "Measuring the Results of Ergonomics Training," ErgoCon, San Jose CA, May 1995.

Nelson, J. B., and Joyce, M. "Computer Related Injuries: Ergonomics and OSHA Guidelines," Society of Architectural Administrators, Los Angeles CA, May 1994.

Nelson, J. B. and Joyce, M. "Ergonomics," Western Safety Congress, Anaheim CA, May 1994.

APPENDIX B

Alpha Test Results Suggested the Following Changes to Enhance Usability.

This page intentionally left blank

Table B
Alpha Test Results Suggested the Following Changes to Enhance Usability

Concern	Modification
Low task duration category under-rated infrequent lifting tasks and contributed to overall uncertainty in selecting categories	Eliminated low duration category. All lifting treated as at least moderate duration. Weighting factors for lifting related job factors increased.
Methodology appeared to over-rate the shoulder/neck and hands/wrists body regions	The weighting for some job factors within these body areas were reduced. Job factor questions within these body areas were combined or eliminated to reduce total number of possible points for a body area.
In some cases, raters forgot to carry subtotal across to the second page when hands/wrists/arms body region job factor questions extended across two pages.	The reduced number of questions allowed hand/wrist/arm to fit on one page, eliminating this potential problem.
Alpha test subjects were concerned that the two separate and force questions (one for static and one for repeated) lowered agreement on the alpha test and would create greater amounts of disagreement among novice users.	The two questions were combined into a single question.
Alpha test subjects were concerned that the wording of the job factor questions for the legs/knees/feet were somewhat ambiguous, causing experienced ergonomists to disagree on correct responses to the same identified hazards.	The wording of the job factor questions for legs/knees/feet were modified to improve clarity.
Alpha test subjects were concerned with the clarity of wording on a number of individual questions.	Minor modifications to the wording, examples and criteria (>10 degrees) were incorporated to improve clarity.

This page intentionally left blank

APPENDIX C

Usability Questionnaire

This page intentionally left blank

Appendix C

Usability Questionnaire

Questions	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagre
The wording of the questions is clear	1	2	3	4	5
The wording of the response choices is clear	1	2	3	4	5
The risk criteria are well defined within each question	1	2	3	4	5
The risk criteria are easily estimated without measurement	1	2	3	4	5
I am reasonably certain that most of my responses are correct	1	2	3	4	5
The tool has sufficient breadth of risk identifiers	1	2	3	4	5
The tool is useful for generating solutions	1	2	3	4	5
The tool is better suited to an ergonomist that a non-ergonomist	1	2	3	4	5
The tool is well suited for field use	1	2	3	4	5
The tool is useful for ranking jobs	1	2	3	4	5
The scores can be generated quickly and easily	1	2	3	4	5
The activities performed in maintenance/inspection are covered in the tool	1	2	3	4	5
The scores can be clearly interpreted	1	2	3	4	5

This page intentionally left blank

APPENDIX D

Grouping of Corrective Actions to Determine Corrective Action Agreement Between Beta Testers and Concensus Ergonomists

This page intentionally left blank

Grouping of Corrective Actions to Determine Corrective Action Agreement Between Beta Testers and Concensus Ergonomists

Groupings	Corrective Action Numbers
1. Design	16, 37, 99, 101, 102, 128, 129, 140
2. Manual Material Handling	4, 26, 36, 46, 58, 61, 69, 71, 78, 83, 106, 107, 119, 126, 127, 130, 131, 139, 142
3. Workstation	9, 24, 31, 32, 38, 41, 57, 63, 64, 79, 80, 81, 82, 90, 112, 114, 115, 117, 118, 123, 124, 132, 136
4a. Tool Modification	3, 21, 33, 34, 54, 68, 72, 74, 88, 91, 92, 94, 103, 121, 133, 137
4b. Different Tool	10, 29, 43, 55, 59, 62, 66, 70, 75, 76, 77, 89, 98
5. Work Practices	1, 2, 5, 8, 11, 12, 13, 20, 25, 42, 97, 138, 141
6. Visual	14, 18, 22, 27, 30, 60, 84, 100, 108, 109
7. Temperature	7, 15, 23, 93, 104, 105, 110
8. Cart/Floor	17, 19, 35, 47, 48, 67
9. Office	39, 40, 44, 45, 49, 53, 56, 65, 73, 85, 111, 122
10. Tool Support	116
11. Other	113
12. Armstrong Labs	6
13. Chair	28, 87, 120
14. Foot	50, 51, 52, 86, 95, 96, 134, 135, 143

This page intentionally left blank

APPENDIX E

Raw Data: Alpha and Beta Test

This page intentionally left blank

Appendix E

ALPHA TEST SUMMARY

Appendix E

This page intentionally left blank

Appendix E

Alpha Test Summary

Ergonomist	Scenario														SN Rating	HWA Rating
Gold	1														3	2
Gold	2														3	3
Gold	4														3	2
Gold	7														2	2
Gold	9														2	3
Gold	12														2	2
Gold	18														2	2
Gold	19														2	2
Gold	20														3	2
Gold	21														2	3
Gold	23														1	1
Gold	24														2	3
Gold	35														3	2
Gold	36														3	2
Gold	37														2	1
Gold	38														3	2
Gold	41														3	3
Gold	43														2	2
Gold	45														1	1
Gold	48														2	3
Gold	60														3	3
Gold	61														2	3
Gold	62														3	3
Gold	63														1	2
Gold	64														3	3
Gold	65														2	1
Gold	66														2	2
Gold	67														2	3
Gold	68														2	2
Gold	69														3	3
Gold	70														2	2
Gold	71														2	1
Linda	1	40	25	4	0	0	0	0	0	13	18.5	7	2.5	2.5	3	3
Linda	2	46	24	3	0	0	0	0	0	15	30	13	6	4	3	3
Linda	4	45	30	1	0	0	0	0	0	14	15	7	5.5	5	3	3
Linda	7	50	65	2	0	0	0	0	0	8.5	15	2	8	4	3	3
Linda	9	56	65	15	0	0	1	0	1	11	9	5.7	2.3	3	3	3
Linda	12	60	60	10	4	0	0	0	0	9.5	8.5	6.5	2	4	3	3
Linda	18	70	60	17	0	0	0	0	0	8.3	6	6	3.7	0	3	2

Alpha Test Summary

Programmer	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Linda	19	60	90	9	0	0	0	0	0	9.3	6.3	8.7	4.3	2	3	2
Linda	20	65	45	7	0	0	0	0	0	13	20	19	0	3	3	3
Linda	21	45	50	14	0	0	0	0	0	8	12	8	3	3	3	3
Linda	23	60	30	5	0	0	0	0	0	3.5	1	1	2	0	1	1
Linda	24	81	45	8	0	0	0	0	0	6.5	21	4.5	4.5	5	2	3
Linda	35	60	70	11	1	0	0	0	1	8.5	7	8.5	6	2.5	3	2
Linda	36															
Linda	37	40	45	12	0	0	0	0	0	2	4	8	3	3	1	2
Linda	38	45	65	6	1	1	4	1	0	9.3	8.3	9.6	2.5	0	3	3
Linda	41															
Linda	43	45	45	13	0	0	1	0	0	6.5	7.5	4	2.5	0	2	2
Linda	45	45	55	16	0	0	0	0	0	8	5	5	5	0	3	2
Linda	48	65	55	18	4	0	0	0	0	5.7	8	5.7	2	0	2	3
Linda	60	70	90	22	1	1	1	1	0	12	8.2	5	2.6	0	3	3
Linda	61	45	55	20	0	0	0	0	0	18	18	11	4	0	3	3
Linda	62	45	50	21	0	0	0	0	0	16	21	8	3	2	3	3
Linda	63	55	55	19	0	0	0	0	0	3	3.5	3.5	1.5	0	1	2
Linda	64	60	65		0	0	0	0	0	9.5	2	6.5	1.5	0	3	1
Linda	65	65	70	23	0	0	0	0	0	5.3	5	6	2.3	3.3	2	2
Linda	66	75	80	24	4	0	0	0	0	4.75	6.25	5	2.5	1.2	2	2
Linda	67	45	55	27	4	0	1	0	0	10	9	7	3	4	3	3
Linda	68	45	45	25	0	0	0	0	0	15	12	8	6	2	3	3
Linda	69	55	55	28	4	0	0	0	0	7	4.5	5	2.5	1	2	2
Linda	70	50	50	26	4	0	1	0	0	11	3	2.5	5	0	3	1
Linda	71	65	75	29	0	0	0	0	0	4	5.7	2.3	2.3	2	2	2
Mward	1	50	60	18	1	0	0	4	0	12	12	12	8	3	3	3
Mward	2	60	60	1	0	0	0	0	0	11	32	8	8	2	3	3
Mward	4	75	60	2	0	0	0	0	0	13	12	8	3	2	3	3
Mward	7	75	90	3	0	0	0	0	0	12	7	15	10	8	3	2
Mward	9	90	60	10	0	0	0	0	4	7	5	8	7	0	3	2
Mward	12	60	60	9	1	0	0	0	1	10	13	10	3	4	3	3
Mward	18	90	60	11	1	0	0	0	0	6	7	10	5	1	2	2
Mward	19	90	60	12	4	0	0	0	0							
Mward	20	45	45	6	0	0	0	0	0	13	17	9	0	0	3	3
Mward	21	45	45	15	0	0	0	0	0	8	13	9	5	3	3	3
Mward	23	75	75	7	1	0	1	0	1	10	9	11	6	0	3	3
Mward	24	75	75	4	4	0	1	4	0	13	19	10	10	4	3	3
Mward	35	60	60	14	4	0	0	1	0	13	15	10	8	4	3	3
Mward	36	75	45	31	0	0	1	1	1	8	10	9	3	2	3	3

Ergonomist	Scenario	[illegible]	Sum Time	Order	29	30	31	32	33	SN Score	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating
Mward	37	35	35	17	0	0	0	0	0	5	4	4	2	2	2	2
Mward	38	75	75	8	1	0	1	4	0	11	16	14	4	0	3	3
Mward	41															
Mward	43	75	60	5	1	0	4	0	1	5	12	3	3	0	2	3
Mward	45	60	45	13	1	0	0	1	1	10	13	8	6	0	3	3
Mward	49	75	45	16	1	0	0	1	1	6	7	7	4	2	2	2
Mward	60	90	50	19	0	0	0	4	4	11	10	6	4	2	3	3
Mward	61	15	25	20	0	0	0	4	4	22	20	18	7	0	3	3
Mward	62	30	25	21	1	0	0	4	4	25	25	16	11	2	3	3
Mward	63	45	55	22	0	0	0	0	1	6	3	5	1	0	2	1
Mward	64	40	40	23	0	0	0	0	0	10	11	13	4	0	3	3
Mward	65	60	60	24	1	0	1	0	1	7	5	5	6	4	2	2
Mward	66	70	75	27	4	4	5	5	2	4	4	5	5	2	2	2
Mward	67	45	30	25	4	0	4	0	1	15	17	13	8	4	3	3
Mward	68	45	25	26	4	0	0	0	0	17	11	5	7	3	3	3
Mward	69	40	35	28	4	0	0	0	0	6	6	14	6	2	2	2
Mward	70	60	50	29	4	0	1	0	0	9	11	9	8	2	3	3
Mward	71	70	40	30	0	0	0	0	0	5	5	6	4	2	2	2
Paul	1	40	45	8	0	0	0	4	0	5	10	5	3	3	2	3
Paul	2	60	55	1	0	0	0	4	0	10	38	7	6	4	3	3
Paul	4	45	60	2	0	0	0	0	0	6	8	5	3	3	2	3
Paul	7	30	49	3	0	0	0	0	0	6	6	4	3	1	2	2
Paul	9	49	50	10	0	0	1	0	4	4	9	4	2	1	2	3
Paul	12	76	60	9	1	0	0	4	0	7	16	9	3	5	2	3
Paul	18	55	50	14	0	0	0	0	0	5					2	2
Paul	19	65	61	6	1	0	0	0	0	8	7	11	7	2	3	2
Paul	20	30	30	4	1	0	0	0	0	13	12	11	0	4	3	3
Paul	21	25	10	24	0	0	0	0	0	4	6	8	0	3	2	2
Paul	23	59	38	5	4	0	1	0	1	4	0	8	2	1	2	1
Paul	24	45	45	7	0	0	0	4	0	6	14	7	7	2	2	3
Paul	35	33	24	17	1	0	0	1	0	6	5	6	6	0	2	2
Paul	36	40	25	20	0	0	1	1	1	6	9	4	2	2	2	3
Paul	37	40	15	15	0	0	0	0	0	1	5	8	3	0	1	2
Paul	38	49	55	11	0	1	0	4	0	8	7	7	3	0	3	2
Paul	41	28	23	18	0	0	0	0	0	8	16	3	4	0	3	3
Paul	43	45	45	12	0	0	1	1	0	4	9	2	2	1	2	3
Paul	45	35	25	13	0	0	0	4	1	7	7	9	3	1	2	2
Paul	48	49	32	16	1	0	0	0	0	2	8	3	2	0	1	3
Paul	60	75	60	19	0	0	0	1	4	7	6	2	2	0	2	2

Alpha Test Summary

Ergonomist	Scenario	Rating	Sum Time	Score	Q9	Q0	Q1	Q2	Q3	SN Score	HWA Score	BT Score	LE Score	HE Score	SN Rating	HWA Rating
Paul	61	20	15	31	0	0	0	0	4	12	26	11	6	0	3	3
Paul	62	35	20	21	1	0	1	1	1	10	8	2	3	3	3	3
Paul	63	25	25	22	0	0	0	0	0	3	4	1	2	2	1	2
Paul	64	25	20	23	0	0	0	0	0	6	4	5	1	0	2	2
Paul	65	44	42	25						5	6	4	2	4	2	2
Paul	66	55	40	26	0	0	0	4	1	7	9	6	3	4	2	3
Paul	67	51	23	27	4	0	1	1	1	9	12	2	6	3	3	3
Paul	68	40	20	28	0	0	0	0	0	16	13	5	6	4	3	3
Paul	69	48	35	?	0	0	0	0	0	5	9	7	2	0	2	3
Paul	70	35	25	30	4	0	1	1	1	9	10	5	5	2	3	3
Paul	71	35	30	29	0	0	0	0	0	4	7	4	2	2	2	2
Rick	1	7	12	12	0	0	0	1	1	8	19	5	3	0	3	3
Rick	2	8	11	13	0	0	0	0	0	18	28	5	8	3	3	3
Rick	4	9	13	14	0	0	0	0	0	11	7	4	3	1	3	2
Rick	7	30	43	1	0	0	1	0	0	11	11	7	4	0	3	3
Rick	9	20	49	2	0	0	0	0	0	4	7	7	2	0	2	2
Rick	12	18	28	3	0	0	0	0	0	7	6	7	2	2	2	2
Rick	18	18	22	15	0	0	0	0	0	7	6	4	4	0	2	2
Rick	19	12	16	16	0	0	0	0	0	3	1	7	4	0	1	1
Rick	20	22	15	4	1	0	0	0	0	13	18	13	0	3	3	3
Rick	21	14	17	5	0	0	0	0	0	11	13	8	0	0	3	3
Rick	23	8	14	18	0	0	0	0	0	7	4	12	6	0	2	2
Rick	24	13	23	6	4	0	4	4	0	5	16	4	5	0	2	3
Rick	35	19	15	7	1	0	0	0	1	9	9	4	7	0	3	3
Rick	36	14	9	24	0	0	0	0	0	8	6	0	2	0	3	2
Rick	37	10	13	8	0	0	0	0	0	11	6	9	3	0	3	2
Rick	38	18	11	9	0	1	1	1	0	3	6	5	2	0	1	2
Rick	41	10	12	32	0	0	0	0	0	17	16	4	3	0	3	3
Rick	43	14	9	10	0	0	0	0	0	7	17	2	3	0	2	3
Rick	45	6	8	11	0	0	0	0	0	8	1	8	5	0	3	1
Rick	48	14	16	17	0	0	0	0	0	5	6	4	3	0	2	2
Rick	60	17	43	19	0	0	0	0	0	7	6	2	3	0	2	2
Rick	61	10	7	20	0	0	0	0	0	12	13	5	9	0	3	3
Rick	62	6	17	21	0	0	0	0	0	13	8	0	3	0	3	3
Rick	63	10	15	22	0	0	0	0	0	5	7	5	2	1	2	2
Rick	64	20	13	23	0	0	0	0	0	10	6	9	2	0	3	2
Rick	65	19	12	25	0	0	0	0	0							
Rick	66	24	5	26	0	0	0	0	0	2	1	1	2	0	1	1
Rick	67	16	6	27	1	0	4	0	1	7	6	4	2	1	2	2

Alpha Test Summary

Ergonomist	Scenario	Click Time	Sum Time	Order	29	30	31	32	33	SN Score	HWA Score	ET Score	LF Score	HE Score	SN Rating	HWA Rating
Rick	68	5	4	28	0	0	0	0	0	13	3	3	3	0	3	1
Rick	69	9	7	29	1	0	0	0	0	6	4	6	2	0	2	2
Rick	70	10	11	30	4	0	1	0	0	13	5	1	2	0	3	2
Rick	71	43	7	31	4	0	0	0	0	7	3	3	2	0	2	1
Van	1	15	15		0	0	0	0	0	8.5	14.5	5.5	2.5	2.5	3	3
Van	2	15	25		0	0	0	0	0	10	23	5	6	5	3	3
Van	4	25	45		0	0	0	0	0	14.5	9.5	9	8.5	5	3	3
Van	7	23	15		0	0	0	0	0	12.5	8.5	7.5	7.5	3	3	3
Van	9	15	25		0	0	0	0	0	7.3	4.3	4.3	2	1	2	2
Van	12	18	30		0	0	0	0	0	8	7.5	5	2	4	3	2
Van	18	14	24		0	0	0	0	0	5.25	5	2.3	3.25	2	2	2
Van	19	20	25		0	0	0	0	0	7	13	12.5	4.5	2.5	2	3
Van	20	15	15		0	0	0	0	0	11	10	4	0	3	3	3
Van	21	11	8		0	0	0	0	0	5	8	8	0	6	2	3
Van	23				0	0	0	0	0	3	0	7	2.5	0	1	1
Van	24	18	20		0	0	0	0	0	4	15.5	6.5	7.5	5	2	3
Van	35	50	36		0	0	0	0	0	10	8.5	14	8	4	3	3
Van	36	20	20		0	0	0	0	0	6.33	5.67	3.67	2	2.67	2	2
Van	37	10	8		0	0	0	0	0	7	5	9	0	0	2	2
Van	38	30	35		0	0	4	4	1	6.3	7.6	9.6	2	0	2	2
Van	41	12	15		0	0	0	0	0	13.5	22.5	7	1.5	0	3	3
Van	43	19	16		0	0	0	1	1	2	6.5	3.5	2.5	0	1	2
Van	45	16	12		0	0	0	0	0	8	1	8	2	0	3	1
Van	48	13	15		0	0	0	0	0	8.5	11.5	4.5	2	0	3	3
Van	60	20	30		0	0	0	0	0	6.8	4.2	4	2	2	2	2
Van	61	10	11		0	0	0	0	0	21	12	7	2	2	3	3
Van	62	10	10		0	0	0	0	0	13	18	5	3	0	3	3
Van	63	10	18		0	0	0	0	0	4	4	6	2	1	2	2
Van	64	12	14		0	0	0	0	0	11.5	5	7.5	2	0	3	2
Van	65	20	38		0	0	0	0	0	7	5.3	3	2.3	4	2	2
Van	66	43	75		0	0	0	0	0	6	8	6	2.67	3	2	3
Van	67	18	35		0	0	0	0	0	8.5	14	6.5	3	3	3	3
Van	68	10	16		0	0	0	0	0	16	8	7	8	5	3	3
Van	69	15	20		0	0	0	0	0	9	7	6	3	4	3	2
Van	70	10	11		0	0	0	0	0	11	7	3.5	6	0	3	2
Van	71	15	35		0	0	0	0	0	4.5	3	3.5	2	1.5	2	1

Alpha Test Summary

Ergonomist	Scenario	S1 Rating	LF Rating	ME Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15
Gold	1	2	1	1	2		1	1												
Gold	2	2	1	1	3						1				1					
Gold	4	2	1	1	3	1		1		1										
Gold	7	2	2	1	2							1			1					
Gold	9	2	1	1	3		1					1								
Gold	12	2	2	1	2			1				1						1		
Gold	18	2	1	1	2															
Gold	19	3	2	1	3							1			1					
Gold	20	2	1	1	3			1				1					1			
Gold	21	2	1	1	2															
Gold	23	1	1	1	1															
Gold	24	2	2	1	3										1					
Gold	35	3	3	1	3															
Gold	36	2	2	2	3		1													
Gold	37	2	2	1	2	1		1				1								
Gold	38	3	2	1	3															
Gold	41	2	1	1	3															
Gold	43	1	1	1	2															
Gold	45	2	1	1	2		1													
Gold	48	1	1	1	3		1													
Gold	60	1	2	1	3															
Gold	61	1	2	1	3						1									
Gold	62	2	1	1	3															
Gold	63	3	2	1	2											1				
Gold	64	3	1	1	3															
Gold	65	1	2	2	2	1		1				1			1					
Gold	66	2	1	1	2		1	1							1					
Gold	67	2	3	1	3			1												
Gold	68	2	2	1	2															
Gold	69	3	2	1	3															
Gold	70	2	2	1	2															
Gold	71	2	2	1	2															
Linda	1	2	1	1	3															
Linda	2	3	2	2	3															
Linda	4	2	2	2	3															
Linda	7	1	3	2	3							1			1					
Linda	9	2	1	1	3															
Linda	12	2	1	2	3															
Linda	18	2	2	1	3							1								

Alpha Test Summary

Ergonomist	Scenario	B Rating	LF Rating	HE Rating	Glob Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15
Linda	19	3	2	1	3							1								
Linda	20	3	1	1	3			1												
Linda	21	3	1	1	3	1														
Linda	23	1	1	1	2															
Linda	24	2	2	2	3										1					
Linda	35	2	2	1	3										1					
Linda	36																			
Linda	37	3	1	1																
Linda	38	3	1	1	3											1		1		
Linda	41																			
Linda	43	2	1	1	2															
Linda	45	2	2	1	3															
Linda	48	2	1	1	3															
Linda	60	2	1	1	3															
Linda	61	3	2	1	3															
Linda	62	3	1	1	3															
Linda	63	2	1	1	1															
Linda	64	2	1	1	3															
Linda	65	2	1	1	2															
Linda	66	2	1	1	2							1			1					
Linda	67	2	1	2	3										1					
Linda	68	3	2	1	3							1								
Linda	69	2	1	1	2							1			1					
Linda	70	1	2	1	3															
Linda	71	1	1	1	2							1			1					
Mward	1	3	3	1	3															
Mward	2	3	3	1	3															
Mward	4	3	1	1	3															
Mward	7	3	3	2	3															
Mward	9	3	2	1	3															
Mward	12	3	1	2	3															
Mward	18	3	2	1	3							1					1			
Mward	19																			
Mward	20	3	1	1	3															
Mward	21	3	2	1	3	1									1					
Mward	23	3	2	1	3											1				
Mward	24	3	3	2	3															
Mward	35	3	2	2	3															
Mward	36	3	1	2	1										1					

Alpha Test Summary

Ergonomist	Scenario	BT Rating	LP Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15
Mward	37	2	1	1	2							1								
Mward	38	3	2	1	3										1	1		1		
Mward	41																			
Mward	43	1	1	1	3															
Mward	45	3	2	1	3														1	
Mward	49	2	2	1	2															
Mward	60	2	2	1	3										1					
Mward	61	3	2	1	3															
Mward	62	3	3	1	3															
Mward	63	2	1	1	1											1	1			
Mward	64	3	2	1	1													1		
Mward	65	2	2	2	1	1														
Mward	66	2	2	1	1	1						1								
Mward	67	3	3	2	3															
Mward	68	2	2	1	3										1					
Mward	69	3	2	1	2										1		1			
Mward	70	3	3	1	2					1										
Mward	71	2	2	1	1	1									1					
Paul	1	2	1	1	3															
Paul	2	2	2	1	3															
Paul	4	2	2	1	3															
Paul	7	2	1	1	2															
Paul	9	2	1	1	3															
Paul	12	3	1	1	3															
Paul	18	2	1	1	2															
Paul	19	3	2	1	3															
Paul	20	3	1	2	3															
Paul	21	3	1	1	3															
Paul	23	3	1	1	3															
Paul	24	2	2	1	3															
Paul	35	2	2	1	2										1					
Paul	36	2	2	2	3															
Paul	37	3	1	1	3	1														
Paul	38	2	1	1	3											1				
Paul	41	1	2	1	3															
Paul	43	1	1	1	3															
Paul	45	3	1	1	3															
Paul	48	1	1	1	3										1					
Paul	60	1	1	1	3															

Alpha Test Summary

Ergonomist	Scenario	BT Rating	UF Rating	HE Rating	Total Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15
Paul	61	3	2	1	3															
Paul	62	1	1	1	3															
Paul	63	1	1	1	2															
Paul	64	2	1	1	2															
Paul	65	2	1	2																
Paul	66	2	1	2	3	1						1			1					
Paul	67	1	2	1	3															
Paul	68	2	2	2	3										1					
Paul	69	2	2	1	3															
Paul	70	2	2	1	3										1					
Paul	71	2	1	1	3										1					
Rick	1	2	1	1	3															
Rick	2	2	3	1	3															
Rick	4	2	1	1	3										1					
Rick	7	2	1	1	3															
Rick	9	2	1	1	2															
Rick	12	2	1	1	2															
Rick	18	2	2	1	2							1			1					
Rick	19	2	2	1	2							1								
Rick	20	3	1	1	3															
Rick	21	3	1	1	3										1					
Rick	23	3	2	1	3															
Rick	24	2	2	1	3															
Rick	35	2	2	1	3										1					
Rick	36	1	1	1	3															
Rick	37	3	1	1	3	1														
Rick	38	2	1	1	2															
Rick	41	2	1	1	3															
Rick	43	1	1	1	3															
Rick	45	3	2	1	3															
Rick	48	2	1	1	2															
Rick	60	1	1	1	2															
Rick	61	2	3	1	3							1								
Rick	62	1	1	1	3															
Rick	63	2	1	1	2															
Rick	64	3	1	1	3															
Rick	65																			
Rick	66	1	1	1	1															
Rick	67	2	1	1	2															

Ergonomist	Scenario	BT Rating	LF Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15
Rick	68	1	1	1	3															
Rick	69	2	1	1	2															
Rick	70	1	1	1	3															
Rick	71	1	1	1	2										1	1				
Van	1	2	1	1	3															
Van	2	2	2	2	3															
Van	4	3	3	2	3	1														
Van	7	2	2	1	3															
Van	9	2	1	1	2															
Van	12	2	1	2	3															
Van	18	1	1	1	2															
Van	19	3	2	1	3							1								
Van	20	2	1	1	3															
Van	21	3	1	2	3										1					
Van	23	2	1	1	2											1				
Van	24	2	2	2	3										1					
Van	35	3	3	2	3										1					
Van	36	1	1	1	2															
Van	37	3	1	1	3	1														
Van	38	3	1	1	3															
Van	41	2	1	1	3															
Van	43	1	1	1	2															
Van	45	3	1	1	3															
Van	48	2	1	1	3															
Van	60	2	1	1	2															
Van	61	2	1	1	3							1								
Van	62	2	1	1	3															
Van	63	2	1	1	2															
Van	64	2	1	1	3															
Van	65	1	1	2	2															
Van	66	2	1	1	3										1					
Van	67	2	1	1	3															
Van	68	2	3	2	3															
Van	69	2	1	2	3															
Van	70	1	2	1	3															
Van	71	1	1	1	1											1				

Alpha Test Summary

Ergonomist	Scenario	CA16	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36
Gold	1													1					1			
Gold	2								1					1					1			
Gold	4													1								
Gold	7													1					1			
Gold	9													1					1			
Gold	12													1					1			
Gold	18																					
Gold	19															1						
Gold	20													1								
Gold	21																					
Gold	23																					
Gold	24								1													
Gold	35																					
Gold	36													1					1			
Gold	37			1												1						
Gold	38			1																		
Gold	41										1			1								
Gold	43			1																		
Gold	45																					
Gold	48								1													
Gold	60								1													
Gold	61													1								
Gold	62													1					1			
Gold	63		1																			
Gold	64																					
Gold	65													1			1					
Gold	66													1		1						
Gold	67								1													
Gold	68																					
Gold	69																					
Gold	70																					
Gold	71			1																		
Linda	1								1								1		1			
Linda	2													1			1		1			
Linda	4			1										1			1		1			
Linda	7			1										1			1		1			
Linda	9			1										1								
Linda	12																1					
Linda	18			1										1								

Ergonomist	Scenario	CA16	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36
Linda	19		1	1													1					
Linda	20			1			1							1								
Linda	21																					
Linda	23		1																			
Linda	24			1										1			1		1			
Linda	35													1			1		1			
Linda	36																					
Linda	37																					
Linda	38		1	1		1				1				1								
Linda	41																					
Linda	43			1																		
Linda	45																					
Linda	48			1																		
Linda	60			1					1					1								
Linda	61																					
Linda	62			1										1								
Linda	63		1	1																		
Linda	64		1	1																		
Linda	65		1			1								1			1		1			
Linda	66		1	1										1								
Linda	67																1					
Linda	68																		1			
Linda	69		1											1					1			
Linda	70			1		1																
Linda	71			1										1					1			
Mward	1																		1			
Mward	2													1					1			
Mward	4			1										1					1			
Mward	7			1																		
Mward	9			1										1								
Mward	12													1			1					
Mward	18		1	1						1				1					1	1		
Mward	19																					
Mward	20			1			1							1								
Mward	21																					
Mward	23		1	1						1				1								
Mward	24			1										1			1		1			
Mward	35		1											1					1			
Mward	36		1						1					1					1			

Alpha Test Summary

Ergonomics	Scientific	CA16	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36
Mward	37			1										1					1			
Mward	38		1	1		1				1				1								
Mward	41																					
Mward	43																					
Mward	45								1													
Mward	49			1	1				1													
Mward	60			1					1					1					1			
Mward	61																					
Mward	62			1										1								
Mward	63									1				1								
Mward	64		1	1	1					1												
Mward	65			1										1			1		1			
Mward	66													1			1					
Mward	67			1													1					
Mward	68			1										1					1			
Mward	69		1	1						1				1					1			
Mward	70		1	1	1				1	1				1								
Mward	71	1	1	1										1		1						
Paul	1																					
Paul	2																					
Paul	4																					
Paul	7																					
Paul	9													1			1					
Paul	12																					
Paul	18			1										1								
Paul	19																					
Paul	20																					
Paul	21																					
Paul	23																					
Paul	24																					
Paul	35			1																		
Paul	36			1																		
Paul	37																					
Paul	38			1		1								1								
Paul	41			1																		
Paul	43			1	1												1					
Paul	45																1					
Paul	48			1																		
Paul	60			1										1								

Alpha Test Summary

Ergonomist	Scenario	CA16	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36
Paul	61																					
Paul	62			1										1								
Paul	63																					
Paul	64			1	1																	
Paul	65																					
Paul	66													1			1					
Paul	67																1					
Paul	68													1								
Paul	69		1	1																		
Paul	70			1	1												1					
Paul	71													1								
Rick	1																					
Rick	2																1					
Rick	4			1										1			1					
Rick	7																					
Rick	9																					
Rick	12																1					
Rick	18													1			1					
Rick	19			1										1								
Rick	20			1			1							1								
Rick	21																1					
Rick	23																					
Rick	24							1														
Rick	35																					
Rick	36																					
Rick	37																					
Rick	38			1																		
Rick	41																					
Rick	43																					
Rick	45																					
Rick	48													1								
Rick	60																					
Rick	61																					
Rick	62																					
Rick	63																1					
Rick	64																					
Rick	65																					
Rick	66																					
Rick	67																					

Alpha Test Summary

Ergonomist	Scenario	CA10	CA11	CA12	CA13	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36
Rick	68																					
Rick	69																					
Rick	70																					
Rick	71																					
Van	1													1			1		1			
Van	2													1			1		1			
Van	4													1			1					
Van	7																1					
Van	9													1					1			
Van	12													1			1		1			
Van	18													1			1					
Van	19			1										1			1					
Van	20			1			1							1			1					
Van	21																1					
Van	23																					
Van	24					1								1			1		1			
Van	35		1											1			1		1			
Van	36																1					
Van	37																1					
Van	38			1				1						1								
Van	41			1	1						1		1									
Van	43																					
Van	45																					
Van	48																					
Van	60													1								
Van	61																					
Van	62			1										1								
Van	63		1							1							1					
Van	64			1	1																	
Van	65					1			1					1			1		1			
Van	66			1										1			1		1			
Van	67																1					
Van	68																					
Van	69													1			1		1			
Van	70			1	1																	
Van	71													1					1			

Ergonomist	Scenario	CA37	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57
Gold	1			1		1	1													1	1	
Gold	2			1																1		
Gold	4			1								1		1								
Gold	7																					
Gold	9														1							
Gold	12					1																
Gold	18																					
Gold	19								1			1			1							
Gold	20																			1		
Gold	21																					
Gold	23																					
Gold	24																			1		
Gold	35																					
Gold	36			1																1		
Gold	37											1		1	1						1	1
Gold	38																					
Gold	41			1																1		
Gold	43																					
Gold	45											1			1							
Gold	48																			1		
Gold	60																					
Gold	61			1																1		
Gold	62			1																1		
Gold	63																			1		
Gold	64																					
Gold	65			1								1			1					1		
Gold	66											1			1					1		
Gold	67																			1		
Gold	68																					
Gold	69																					
Gold	70																				1	
Gold	71																				1	
Linda	1			1																1		
Linda	2			1								1			1					1		
Linda	4													1								
Linda	7																					
Linda	9																			1		
Linda	12																			1		
Linda	18																				1	

Alpha Test Summary

Ergonomist	Scenario	CA37	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57
Linda	19												1									
Linda	20																			1		
Linda	21																					
Linda	23																					
Linda	24					1														1		
Linda	35	1																		1	1	
Linda	36																					
Linda	37																					
Linda	38						1													1		
Linda	41																					
Linda	43					1																
Linda	45					1															1	
Linda	48																			1		
Linda	60																			1		
Linda	61																					
Linda	62						1													1		
Linda	63					1																
Linda	64																					
Linda	65	1																		1		
Linda	66			1																1		
Linda	67																					
Linda	68																			1		
Linda	69	1																		1		
Linda	70																					
Linda	71																			1		
Mward	1	1		1																1	1	
Mward	2											1			1					1		
Mward	4	1		1																		
Mward	7	1		1			1													1	1	
Mward	9														1					1		
Mward	12																			1	1	
Mward	18																			1	1	
Mward	19																					
Mward	20																			1		
Mward	21																			1	1	
Mward	23														1							1
Mward	24					1						1								1		
Mward	35			1																1	1	
Mward	36	1																		1		

Alpha Test Summary

Ergonomist	Scenario	CA37	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57
Mward	37																			1	1	
Mward	38						1								1					1	1	
Mward	41																					
Mward	43									1										1	1	
Mward	45					1				1										1	1	
Mward	49					1	1													1	1	
Mward	60			1			1								1					1		
Mward	61			1																		
Mward	62						1													1		
Mward	63					1										1				1		
Mward	64											1										
Mward	65		1											1						1		
Mward	66																			1		
Mward	67	1		1			1													1		
Mward	68						1													1		
Mward	69						1													1		
Mward	70		1				1													1		
Mward	71														1	1				1	1	
Paul	1																					
Paul	2																					
Paul	4																					
Paul	7																			1		
Paul	9																					
Paul	12																					
Paul	18	1																				
Paul	19																					
Paul	20																					
Paul	21																					
Paul	23																					
Paul	24																					
Paul	35																			1		
Paul	36			1																1		
Paul	37																					
Paul	38														1							
Paul	41			1																		
Paul	43																					
Paul	45					1				1										1		
Paul	48																			1		
Paul	60																			1		

Alpha Test Summary

Ergonomist	Scenario	CA37	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57
Paul	61																			1		
Paul	62																					
Paul	63			1		1														1		
Paul	64																					
Paul	65																					
Paul	66																			1		
Paul	67	1																		1		
Paul	68																			1		
Paul	69																			1		
Paul	70																					
Paul	71				1															1	1	
Rick	1																			1		
Rick	2											1								1		
Rick	4																					
Rick	7																					
Rick	9																			1		
Rick	12																			1		
Rick	18																				1	
Rick	19								1													
Rick	20			1																		
Rick	21																			1		
Rick	23																					
Rick	24																			1		
Rick	35																			1		
Rick	36																			1		
Rick	37				1																1	
Rick	38																			1		
Rick	41			1																1		
Rick	43																					
Rick	45																					
Rick	48																					
Rick	60	1																		1		
Rick	61																			1		
Rick	62	1																		1		
Rick	63			1																		
Rick	64																					
Rick	65																			1		
Rick	66																					
Rick	67						1															

Alpha Test Summary

Economist	Scenario	CA37	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57
Rick	68																					
Rick	69																					
Rick	70																					
Rick	71																					
Van	1	1																		1		
Van	2																			1		
Van	4	1		1			1							1						1		
Van	7	1					1															
Van	9																			1		
Van	12			1																1		
Van	18																					
Van	19																	1				
Van	20			1																1		
Van	21																					
Van	23																					
Van	24	1																		1	1	
Van	35	1																		1		
Van	36																					
Van	37																				1	
Van	38						1								1							
Van	41			1																1		
Van	43																					
Van	45																					
Van	48																			1		
Van	60																			1		
Van	61																			1		
Van	62						1													1		
Van	63																				1	
Van	64																					
Van	65											1			1					1		
Van	66																			1		
Van	67	1					1															
Van	68			1																		
Van	69						1													1		
Van	70						1													1		
Van	71																				1	

Alpha Test Summary

Ergonomist	Scenario	CA58	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78
Gold	1								1						1							
Gold	2																					
Gold	4											1								1		
Gold	7																					
Gold	9								1													
Gold	12								1						1					1		
Gold	18																					
Gold	19																					
Gold	20																	1				
Gold	21																					
Gold	23																					
Gold	24																					
Gold	35																					
Gold	36													1	1							
Gold	37																					
Gold	38				1																	
Gold	41								1													
Gold	43				1		1															
Gold	45						1															
Gold	48																					
Gold	60								1													
Gold	61							1	1					1								
Gold	62								1					1								
Gold	63													1								
Gold	64																					
Gold	65	1													1			1				
Gold	66								1					1					1			
Gold	67																					
Gold	68									1										1		
Gold	69																					
Gold	70																					
Gold	71				1					1		1										
Linda	1														1							
Linda	2							1														
Linda	4						1															
Linda	7																					
Linda	9																					
Linda	12													1	1							
Linda	18				1			1														

Ergonomist	Scenario	CA58	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78
Linda	19						1					1							1			
Linda	20															1						
Linda	21															1						
Linda	23																					
Linda	24																					
Linda	35						1															
Linda	36																					
Linda	37																					
Linda	38																					
Linda	41																					
Linda	43														1							
Linda	45																					
Linda	48																					
Linda	60						1															
Linda	61							1														
Linda	62																					
Linda	63														1				1			
Linda	64																					
Linda	65				1																	
Linda	66													1					1			
Linda	67																					
Linda	68																					
Linda	69																		1			
Linda	70													1								
Linda	71						1									1						
Mward	1													1								
Mward	2							1							1							
Mward	4																					
Mward	7													1								
Mward	9																					
Mward	12													1								
Mward	18				1		1	1						1	1							
Mward	19																					
Mward	20																					
Mward	21															1						
Mward	23				1		1	1											1			
Mward	24						1	1						1	1							
Mward	35						1	1						1								
Mward	36													1								

Alpha Test Summary

Ergonomist	Subject	CA58	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78
Mward	37											1		1								
Mward	38				1						1								1			
Mward	41																					
Mward	43																					
Mward	45											1		1	1							
Mward	49													1	1						1	
Mward	60													1								
Mward	61				1									1	1					1		
Mward	62																					
Mward	63							1						1	1							
Mward	64													1								
Mward	65		1											1	1			1				
Mward	66						1							1								
Mward	67						1	1														
Mward	68													1					1			
Mward	69													1								
Mward	70						1							1					1			
Mward	71						1							1	1	1						
Paul	1																					
Paul	2																					
Paul	4																					
Paul	7																					
Paul	9							1						1								
Paul	12																					
Paul	18				1		1	1														
Paul	19																					
Paul	20																					
Paul	21													1								
Paul	23																					
Paul	24																					
Paul	35																					
Paul	36													1								
Paul	37																					
Paul	38				1		1		1		1								1			
Paul	41																					
Paul	43														1							
Paul	45														1							
Paul	48														1							
Paul	60							1														

Alpha Test Summary

Ergonomist	Schedule	CA58	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78
Paul	61							1	1													
Paul	62																					
Paul	63													1	1				1			
Paul	64																		1			
Paul	65																					
Paul	66													1	1							
Paul	67																					
Paul	68																					
Paul	69																		1			
Paul	70													1					1			
Paul	71						1								1							
Rick	1													1								
Rick	2							1						1	1							
Rick	4																					
Rick	7																					
Rick	9																					
Rick	12													1								
Rick	18							1														
Rick	19																					
Rick	20																					
Rick	21													1								
Rick	23		1																			
Rick	24							1														
Rick	35																					
Rick	36													1								
Rick	37																					
Rick	38								1													
Rick	41													1								
Rick	43													1								
Rick	45																					
Rick	48														1							
Rick	60							1														
Rick	61							1	1					1								
Rick	62																					
Rick	63													1					1			
Rick	64																					
Rick	65																	1				
Rick	66																					
Rick	67																					

Alpha Test Summary

Employee	Score ID	CAT1	CAT2	CAT3	CAT4	CAT5	CAT6	CAT7	CAT8	CAT9	CAT10	CAT11	CAT12	CAT13	CAT14	CAT15	CAT16	CAT17	CAT18	CAT19	CAT20	CAT21
Rick	68													1								
Rick	69																					
Rick	70													1					1			
Rick	71													1								
Van	1													1								
Van	2							1						1	1							
Van	4						1															
Van	7																					
Van	9																					
Van	12																					
Van	18																					
Van	19																					
Van	20							1														
Van	21																					
Van	23																					
Van	24						1	1														
Van	35																					
Van	36																					
Van	37									1												
Van	38								1													
Van	41																					
Van	43						1															
Van	45														1							
Van	48													1								
Van	60						1															
Van	61							1	1					1								
Van	62																					
Van	63														1							
Van	64																		1			
Van	65							1														
Van	66													1					1			
Van	67																					
Van	68																					
Van	69																					
Van	70						1							1					1			
Van	71														1							

Alpha Test Summary

Employee	Section	FA0	FA1	FA10	FA2	FA11	FA12	FA13	FA14	FA15	FA16	FA17	FA18	FA19	FA20	FA21	FA22	FA23	FA24	FA25	FA26
Gold	1		1				1	1											1	1		1
Gold	2				1			1														1
Gold	4							1	1													1
Gold	7							1						1							1	
Gold	9				1		1												1			1
Gold	12							1											1			
Gold	18																					
Gold	19				1	1	1			1					1							
Gold	20													1								
Gold	21																					
Gold	23			1																		
Gold	24				1	1		1											1			1
Gold	35																					
Gold	36		1		1			1														
Gold	37				1				1			1							1			
Gold	38																		1			
Gold	41													1						1		
Gold	43				1			1														
Gold	45							1														
Gold	48							1						1				1				1
Gold	60																					
Gold	61		1		1			1				1					1		1	1	1	
Gold	62		1																			1
Gold	63		1																	1		
Gold	64																	1				
Gold	65				1			1				1										
Gold	66				1		1		1											1		
Gold	67																		1		1	1
Gold	68																					
Gold	69																				1	
Gold	70																					
Gold	71								1												1	
Linda	1		1					1						1								1
Linda	2							1						1				1				1
Linda	4							1	1					1								1
Linda	7													1								
Linda	9													1								1
Linda	12							1	1					1								1
Linda	18													1							1	1

Alpha Test Summary

Engineer	Scenario	CA79	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99
Linda	19													1							1	1
Linda	20													1								
Linda	21														1							
Linda	23																	1				
Linda	24													1				1			1	1
Linda	35							1						1								1
Linda	36																					
Linda	37																					
Linda	38																					
Linda	41																					
Linda	43							1						1								1
Linda	45							1											1			1
Linda	48							1						1								
Linda	60													1							1	1
Linda	61		1					1														1
Linda	62																					1
Linda	63							1											1			1
Linda	64																					1
Linda	65							1						1								1
Linda	66							1	1													1
Linda	67													1							1	1
Linda	68							1						1								
Linda	69																					
Linda	70													1								1
Linda	71							1										1				
Mward	1		1		1			1	1					1								1
Mward	2		1					1						1				1				1
Mward	4							1														1
Mward	7							1						1							1	1
Mward	9							1						1								1
Mward	12							1						1								
Mward	18				1			1						1							1	1
Mward	19																					
Mward	20				1									1								
Mward	21				1		1		1						1							
Mward	23							1												1		1
Mward	24		1					1						1				1				1
Mward	35		1				1							1							1	
Mward	36		1		1			1	1					1								1

Alpha Test Summary

Ergonomist	Scenario	CA79	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99
Mward	37				1				1					1	1		1	1				
Mward	38		1							1	1			1				1	1	1		1
Mward	41																					
Mward	43							1						1								1
Mward	45							1						1			1		1			1
Mward	49	1			1			1						1					1			1
Mward	60		1					1						1								1
Mward	61		1			1		1						1					1			1
Mward	62													1								1
Mward	63							1		1			1	1						1		1
Mward	64													1						1		1
Mward	65				1			1	1					1		1						1
Mward	66							1	1													1
Mward	67							1						1					1			1
Mward	68													1						1		1
Mward	69													1						1		
Mward	70													1							1	
Mward	71						1		1						1			1				
Paul	1																					
Paul	2																					
Paul	4																					
Paul	7																					
Paul	9				1			1						1								1
Paul	12																					
Paul	18							1														1
Paul	19																					
Paul	20																					
Paul	21																					
Paul	23																					
Paul	24																					
Paul	35							1						1							1	1
Paul	36		1		1			1						1								1
Paul	37				1				1													
Paul	38													1				1	1			1
Paul	41							1						1								1
Paul	43							1						1								1
Paul	45							1											1			1
Paul	48							1						1								1
Paul	60							1						1								1

Alpha Test Summary

Ergonomist	Scenario	CA79	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99
Paul	61							1											1			1
Paul	62													1								1
Paul	63		1					1											1			1
Paul	64							1						1								1
Paul	65																					
Paul	66						1	1	1													1
Paul	67							1						1								1
Paul	68							1						1								1
Paul	69							1						1								1
Paul	70													1								1
Paul	71						1	1	1						1							1
Rick	1													1								
Rick	2							1						1				1				1
Rick	4													1								1
Rick	7													1								
Rick	9													1								1
Rick	12				1									1								
Rick	18							1														1
Rick	19							1													1	1
Rick	20																					
Rick	21								1													
Rick	23					1																
Rick	24													1								1
Rick	35													1								
Rick	36				1									1								1
Rick	37								1									1				
Rick	38																					
Rick	41							1						1								1
Rick	43		1											1								1
Rick	45																					
Rick	48				1			1						1								1
Rick	60		1						1					1								
Rick	61																					1
Rick	62													1								1
Rick	63																					1
Rick	64													1								
Rick	65													1		1						
Rick	66																					
Rick	67													1					1			

Alpha Test Summary

Ergonomist	Scenario	CA79	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99
Rick	68													1								
Rick	69																					
Rick	70													1								
Rick	71	1																1				
Van	1							1						1								1
Van	2		1					1						1				1				1
Van	4							1	1					1							1	1
Van	7													1							1	
Van	9							1						1								1
Van	12							1						1								1
Van	18							1													1	1
Van	19																					
Van	20													1								
Van	21																					
Van	23																					1
Van	24													1								
Van	35													1								1
Van	36							1						1								1
Van	37				1				1								1					
Van	38													1								1
Van	41							1						1								1
Van	43							1						1								1
Van	45							1														1
Van	48							1						1								1
Van	60							1						1								1
Van	61							1														1
Van	62													1								1
Van	63							1												1		1
Van	64													1								1
Van	65							1	1					1								1
Van	66							1														1
Van	67													1					1		1	1
Van	68													1								1
Van	69													1								1
Van	70													1							1	1
Van	71							1										1		1		

Alpha Test Summary

Ergonomist	Scenario	CA100	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117
Gold	1																		
Gold	2																		
Gold	4					1													
Gold	7																		
Gold	9															1			
Gold	12	1														1			
Gold	18																		
Gold	19		1																
Gold	20					1													
Gold	21																		
Gold	23																		
Gold	24																		
Gold	35																		
Gold	36															1			
Gold	37																		
Gold	38																		
Gold	41																		
Gold	43																		
Gold	45																		
Gold	48																		
Gold	60	1														1			
Gold	61															1			
Gold	62															1			
Gold	63										1	1							
Gold	64																		
Gold	65					1													
Gold	66										1	1							
Gold	67																		
Gold	68																		
Gold	69																		
Gold	70										1								
Gold	71			1		1													
Linda	1								1										
Linda	2																		
Linda	4									1							1		
Linda	7									1									
Linda	9																		
Linda	12																		
Linda	18																		

Alpha Test Summary

Ergonomist	Scenario	CA100	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117
Linda	19		1								1								
Linda	20					1													
Linda	21																		
Linda	23										1								
Linda	24																		
Linda	35									1							1	1	
Linda	36																		
Linda	37																		
Linda	38																		
Linda	41																		
Linda	43																		
Linda	45																		
Linda	48																		
Linda	60																		
Linda	61																		
Linda	62																		
Linda	63															1			
Linda	64																		
Linda	65					1							1						
Linda	66					1													
Linda	67																		
Linda	68																		
Linda	69																		
Linda	70												1						
Linda	71																		
Mward	1																		
Mward	2					1													
Mward	4					1													
Mward	7					1												1	
Mward	9															1	1		
Mward	12	1														1		1	1
Mward	18										1								
Mward	19																		
Mward	20					1													
Mward	21																		
Mward	23										1			1					
Mward	24															1			
Mward	35					1										1		1	
Mward	36															1		1	

Alpha Test Summary

Ergonomist	Scenario	CA100	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117
Mward	37					1													
Mward	38										1								
Mward	41																		
Mward	43																		
Mward	45			1															
Mward	49																		
Mward	60															1		1	
Mward	61															1			
Mward	62																	1	
Mward	63															1			
Mward	64										1								
Mward	65																1		
Mward	66			1			1												
Mward	67									1									
Mward	68																	1	
Mward	69									1	1							1	1
Mward	70										1		1					1	1
Mward	71																		
Paul	1																		
Paul	2																		
Paul	4																		
Paul	7																		
Paul	9																		
Paul	12																		
Paul	18																		
Paul	19																		
Paul	20																		
Paul	21																		
Paul	23																		
Paul	24																		
Paul	35																		
Paul	36																		
Paul	37																		
Paul	38													1					
Paul	41																		
Paul	43																		
Paul	45																		
Paul	48																		
Paul	60																		

Alpha Test Summary

Ergonomist	Scenario	CA100	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117
Paul	61																		
Paul	62																		
Paul	63															1			
Paul	64																		
Paul	65																		
Paul	66					1													
Paul	67																	1	
Paul	68																		1
Paul	69										1							1	
Paul	70																		1
Paul	71																		
Rick	1																		
Rick	2																1		
Rick	4																1		1
Rick	7																	1	
Rick	9																		
Rick	12	1																	
Rick	18																		
Rick	19										1							1	
Rick	20																		
Rick	21																		
Rick	23									1	1								
Rick	24																		
Rick	35									1						1		1	
Rick	36																		
Rick	37																		
Rick	38																		
Rick	41																		
Rick	43																		
Rick	45																		
Rick	48																		
Rick	60															1			
Rick	61											1							
Rick	62																		
Rick	63										1								
Rick	64																		
Rick	65																		
Rick	66																		
Rick	67																		

Alpha Test Summary

Engineer	Script #	CA100	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117
Rick	68																		
Rick	69																		
Rick	70																		
Rick	71																		
Van	1																		
Van	2																		
Van	4					1												1	1
Van	7																	1	
Van	9																		
Van	12																		
Van	18										1								
Van	19																		
Van	20																		
Van	21					1													
Van	23																		
Van	24													1					
Van	35									1									
Van	36																		
Van	37																		
Van	38																		
Van	41																		
Van	43																		
Van	45																		
Van	48																		
Van	60					1													
Van	61																		
Van	62																		
Van	63										1								
Van	64										1								
Van	65					1							1						
Van	66					1													
Van	67																		
Van	68																		1
Van	69																	1	1
Van	70																	1	
Van	71																		

Alpha Test Summary

Ergonomist	Scenario	CA11	CA10	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35
Gold	1	1																	
Gold	2																		
Gold	4					1		1											
Gold	7																		
Gold	9																		
Gold	12																		
Gold	18																		
Gold	19						1												
Gold	20		1																
Gold	21																		
Gold	23																		
Gold	24									1						1			
Gold	35																		
Gold	36																		
Gold	37																		
Gold	38																		
Gold	41																		
Gold	43																		
Gold	45						1				1								
Gold	48																		
Gold	60																		
Gold	61									1									
Gold	62	1						1											
Gold	63																		
Gold	64																		
Gold	65																		
Gold	66			1													1		
Gold	67														1				
Gold	68		1																
Gold	69																		
Gold	70							1											
Gold	71																		
Linda	1																		
Linda	2																1		
Linda	4							1											
Linda	7																		
Linda	9																		
Linda	12							1											
Linda	18																		

Alpha Test Summary

Ergonomist	Scenario	CA119	CA119	CA120	CA121	CA122	CA123	CA124	CA125	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135
Linda	19									1	1								
Linda	20		1																
Linda	21																		
Linda	23																		
Linda	24												1				1		
Linda	35																		
Linda	36																		
Linda	37																		
Linda	38																		
Linda	41																		
Linda	43																		
Linda	45							1											
Linda	48																		
Linda	60							1											
Linda	61																		
Linda	62																		
Linda	63							1		1									
Linda	64																		
Linda	65																		
Linda	66														1				
Linda	67																		
Linda	68																		
Linda	69																		
Linda	70							1											
Linda	71					1													
Mward	1										1								
Mward	2																	1	
Mward	4							1			1								
Mward	7	1						1						1					
Mward	9							1			1							1	
Mward	12		1																1
Mward	18										1								
Mward	19																		
Mward	20											1		1					
Mward	21																		
Mward	23							1			1								
Mward	24	1										1						1	
Mward	35							1						1					
Mward	36										1								

Alpha Test Summary

Ergonomist	Scan No.	CA110	CA119	CA120	CA121	CA122	CA123	CA124	CA125	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135
Mward	37																		
Mward	38															1			1
Mward	41																		
Mward	43										1								
Mward	45																		
Mward	49																	1	
Mward	60							1				1						1	
Mward	61		1								1								
Mward	62																		
Mward	63							1								1			
Mward	64										1					1			
Mward	65							1											
Mward	66			1				1			1								
Mward	67							1											
Mward	68							1											
Mward	69															1			
Mward	70							1								1		1	1
Mward	71			1		1													
Paul	1																		
Paul	2																		
Paul	4																		
Paul	7																		
Paul	9									1									
Paul	12																		
Paul	18									1	1								
Paul	19																		
Paul	20																		
Paul	21																		
Paul	23																		
Paul	24																		
Paul	35																		
Paul	36									1									
Paul	37																		
Paul	38																	1	
Paul	41																		
Paul	43																		
Paul	45																		
Paul	48																1		
Paul	60							1		1									

Alpha Test Summary

Ergonomist	Scenario	CA119	CA110	CA120	CA121	CA122	CA123	CA124	CA125	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135
Paul	61																		
Paul	62																		
Paul	63																		
Paul	64									1									
Paul	65																		
Paul	66									1	1								
Paul	67																		
Paul	68																		
Paul	69																		
Paul	70							1							1				
Paul	71					1					1								
Rick	1																		
Rick	2																1		
Rick	4							1											
Rick	7																		
Rick	9									1	1								
Rick	12																		
Rick	18												1						
Rick	19									1	1								
Rick	20																		
Rick	21																		
Rick	23																		
Rick	24	1								1									
Rick	35							1											
Rick	36									1									
Rick	37																		
Rick	38																	1	
Rick	41																		
Rick	43																		
Rick	45																		
Rick	48									1							1		
Rick	60																		
Rick	61																		
Rick	62																		
Rick	63							1			1								
Rick	64																		
Rick	65																		
Rick	66																		
Rick	67							1											

Alpha Test Summary

Ergonomist	Scenario	CA118	CA119	CA120	CA121	CA122	CA123	CA124	CA125	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135
Rick	68																		
Rick	69														1				
Rick	70							1											
Rick	71																		
Van	1									1									
Van	2	1																	
Van	4							1		1									
Van	7																		
Van	9									1	1								
Van	12									1									
Van	18									1									
Van	19									1									
Van	20									1									
Van	21																		
Van	23									1								1	
Van	24									1			1						
Van	35		1																
Van	36									1									
Van	37																		
Van	38																		
Van	41																		
Van	43															1			
Van	45																		
Van	48										1						1		
Van	60							1		1									
Van	61										1								
Van	62																		
Van	63									1									
Van	64									1									
Van	65																		
Van	66									1									
Van	67																		
Van	68																		
Van	69														1				
Van	70							1							1				
Van	71									1									

Alpha Test Summary

Ergonomist	Scenario	CA136	CA137	CA138	CA139	CA140	CA141	CA142	CA143	CA144	CA145	CA146	CA147	CA148	CA149	CA150	CA151	CA152	CA153
Gold	1				1														
Gold	2																		
Gold	4				1												1		
Gold	7																1		
Gold	9				1														
Gold	12																1		
Gold	18																		
Gold	19				1														
Gold	20																		
Gold	21																		
Gold	23																		
Gold	24				1								1						
Gold	35																		
Gold	36																		
Gold	37																		
Gold	38																		
Gold	41																1		
Gold	43												1				1		
Gold	45																		
Gold	48																		
Gold	60																		
Gold	61																		
Gold	62																		
Gold	63															1		1	
Gold	64																		
Gold	65				1														
Gold	66																	1	
Gold	67									1									
Gold	68																		
Gold	69															1			
Gold	70																		
Gold	71													1					
Linda	1				1														
Linda	2				1														
Linda	4				1												1		
Linda	7																		
Linda	9				1														
Linda	12																		
Linda	18																		

Alpha Test Summary

Ergonomist	Scenario	CA136	CA137	CA138	CA139	CA140	CA141	CA142	CA143	CA144	CA145	CA146	CA147	CA148	CA149	CA150	CA151	CA152	CA153
Linda	19																	1	
Linda	20				1														
Linda	21				1														
Linda	23																		
Linda	24																		
Linda	35																		
Linda	36																		
Linda	37																		
Linda	38																		
Linda	41																		
Linda	43				1														
Linda	45																		
Linda	48																		
Linda	60																		
Linda	61				1														
Linda	62				1														
Linda	63				1														
Linda	64																		
Linda	65				1														
Linda	66																		
Linda	67																		
Linda	68																		
Linda	69																		
Linda	70																		
Linda	71				1			1											
Mward	1					1												1	
Mward	2					1													
Mward	4				1	1													
Mward	7					1													
Mward	9					1													
Mward	12					1												1	
Mward	18					1								1				1	1
Mward	19																		
Mward	20					1													
Mward	21					1													
Mward	23					1													
Mward	24					1													
Mward	35					1													
Mward	36					1												1	

Alpha Test Summary

Ergonomist	Scenario	CA136	CA137	CA138	CA139	CA140	CA141	CA142	CA143	CA144	CA145	CA146	CA147	CA148	CA149	CA150	CA151	CA152	CA153
Mward	37					1			1										
Mward	38									1							1		
Mward	41																		
Mward	43					1													
Mward	45					1													
Mward	49					1													
Mward	60					1													
Mward	61										1								
Mward	62					1													
Mward	63					1													
Mward	64					1													
Mward	65					1													
Mward	66					1													
Mward	67																		
Mward	68																		
Mward	69					1													1
Mward	70				1	1													
Mward	71					1			1										
Paul	1																		
Paul	2																		
Paul	4																		
Paul	7																		
Paul	9				1														
Paul	12																		
Paul	18				1														
Paul	19																		
Paul	20																		
Paul	21				1														
Paul	23																		
Paul	24																		
Paul	35																		
Paul	36				1														
Paul	37																		
Paul	38								1							1			
Paul	41				1														
Paul	43				1														
Paul	45																		
Paul	48				1														
Paul	60																		

Alpha Test Summary

Ergonomist	Scenario	CA136	CA137	CA138	CA139	CA140	CA141	CA142	CA143	CA144	CA145	CA146	CA147	CA148	CA149	CA150	CA151	CA152	CA153
Paul	61																		
Paul	62																		
Paul	63				1													1	
Paul	64				1														
Paul	65																		
Paul	66				1														
Paul	67																		
Paul	68																		
Paul	69																		
Paul	70																	1	
Paul	71				1			1											
Rick	1				1														
Rick	2																		
Rick	4				1												1		
Rick	7																		
Rick	9				1														
Rick	12				1														
Rick	18																		
Rick	19																	1	
Rick	20				1														
Rick	21				1														
Rick	23																		
Rick	24				1														
Rick	35																		
Rick	36				1														
Rick	37																		
Rick	38															1		1	
Rick	41				1														
Rick	43				1														
Rick	45																		
Rick	48																		
Rick	60																		
Rick	61																		
Rick	62																		
Rick	63				1														
Rick	64																		
Rick	65																		
Rick	66																		
Rick	67																		

Alpha Test Summary

Ergonomist	Scenario	CA136	CA137	CA138	CA139	CA140	CA141	CA142	CA143	CA144	CA145	CA146	CA147	CA148	CA149	CA150	CA151	CA152	CA153
Rick	68																		
Rick	69																		
Rick	70																		
Rick	71				1														
Van	1				1														
Van	2																		
Van	4				1														
Van	7																		
Van	9				1														
Van	12				1														
Van	18				1								1				1		
Van	19				1														
Van	20																		
Van	21				1														
Van	23																		
Van	24				1														
Van	35																		
Van	36				1														
Van	37																		
Van	38															1			
Van	41				1														
Van	43				1								1						
Van	45																		
Van	48																		
Van	60				1														
Van	61																		
Van	62																		
Van	63				1														
Van	64				1														
Van	65				1												1		
Van	66				1														
Van	67																		
Van	68																		
Van	69																		
Van	70			1															
Van	71																		1

Ergonomist	Scenario	CA154
Gold	1	
Gold	2	
Gold	4	
Gold	7	
Gold	9	
Gold	12	
Gold	18	
Gold	19	
Gold	20	1
Gold	21	
Gold	23	1
Gold	24	
Gold	35	
Gold	36	
Gold	37	
Gold	38	1
Gold	41	
Gold	43	
Gold	45	
Gold	48	
Gold	60	
Gold	61	
Gold	62	
Gold	63	
Gold	64	
Gold	65	
Gold	66	
Gold	67	
Gold	68	
Gold	69	
Gold	70	
Gold	71	
Linda	1	
Linda	2	
Linda	4	
Linda	7	
Linda	9	
Linda	12	
Linda	18	

Ergonomist	Scenario	CA154
Linda	19	
Linda	20	
Linda	21	
Linda	23	
Linda	24	
Linda	35	
Linda	36	
Linda	37	
Linda	38	
Linda	41	
Linda	43	
Linda	45	
Linda	48	
Linda	60	
Linda	61	
Linda	62	
Linda	63	
Linda	64	
Linda	65	
Linda	66	
Linda	67	
Linda	68	
Linda	69	
Linda	70	
Linda	71	
Mward	1	
Mward	2	
Mward	4	
Mward	7	
Mward	9	
Mward	12	
Mward	18	
Mward	19	
Mward	20	
Mward	21	
Mward	23	
Mward	24	
Mward	35	
Mward	36	

Ergonomist	Scenario	CA154
Mward	37	
Mward	38	
Mward	41	
Mward	43	
Mward	45	
Mward	49	
Mward	60	
Mward	61	
Mward	62	
Mward	63	
Mward	64	
Mward	65	
Mward	66	
Mward	67	
Mward	68	
Mward	69	
Mward	70	
Mward	71	
Paul	1	
Paul	2	
Paul	4	
Paul	7	
Paul	9	
Paul	12	
Paul	18	
Paul	19	
Paul	20	
Paul	21	
Paul	23	
Paul	24	
Paul	35	
Paul	36	
Paul	37	
Paul	38	
Paul	41	
Paul	43	
Paul	45	
Paul	48	
Paul	60	

Ergonomist	Scenario	CA164
Paul	61	
Paul	62	
Paul	63	
Paul	64	
Paul	65	
Paul	66	
Paul	67	
Paul	68	
Paul	69	
Paul	70	
Paul	71	
Rick	1	
Rick	2	
Rick	4	
Rick	7	
Rick	9	
Rick	12	
Rick	18	
Rick	19	
Rick	20	
Rick	21	
Rick	23	
Rick	24	
Rick	35	
Rick	36	
Rick	37	
Rick	38	
Rick	41	
Rick	43	
Rick	45	
Rick	48	
Rick	60	
Rick	61	
Rick	62	
Rick	63	
Rick	64	
Rick	65	
Rick	66	
Rick	67	

Ergonomist	Scenario	CA15
Rick	68	
Rick	69	
Rick	70	
Rick	71	
Van	1	
Van	2	
Van	4	
Van	7	
Van	9	
Van	12	
Van	18	
Van	19	
Van	20	
Van	21	
Van	23	
Van	24	
Van	35	
Van	36	
Van	37	
Van	38	
Van	41	
Van	43	
Van	45	
Van	48	
Van	60	
Van	61	
Van	62	
Van	63	
Van	64	
Van	65	
Van	66	
Van	67	
Van	68	
Van	69	
Van	70	
Van	71	

BETA TEST SUMMARY:
OVERALL AND CORRECTIVE ACTIONS

Appendix E

This page intentionally left blank

Appendix E

Beta Test Summary

Analyst	Scenario	cklst time	Sum Time	Order	25	26	27	28	29	30	SN Score	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating
Beta A	1	5	3	4	0	0	0	1	0	0	10	14	6	3	3	3	3
Beta A	2	10	10	2	0	0	0	0	0	0	14	19	8	5	0	3	3
Beta A	9	10	5	4	0	0	0	0	0	0	6	5	2	1	0	2	2
Beta A	18	25	10	4	0	0	0	0	0	0	5	5	4	2	1	2	2
Beta A	19	30	18	1	1	0	0	0	0	0	7	11	9	5	3	3	3
Beta A	20	5	5	4	0	0	0	0	0	0	8	6	6	0	3	3	2
Beta A	21	5	3	5	0	0	0	0	0	0	6	11	6	0	3	2	3
Beta A	23	25	5	2	0	0	0	0	0	0	2	0	3	1	1	1	1
Beta A	35	8	5	6	1	0	0	1	0	0	5	4	2	5	0	2	2
Beta A	36	15	8	6	0	0	0	1	0	0	6	2	2	2	2	2	1
Beta A	38	13	10	3	0	1	1	1	0	0	6	5	6	2	0	2	2
Beta A	41	5	5	6	0	0	0	0	0	0	14	10	5	4	2	3	3
Beta A	43	15	10	3	0	0	1	1	0	0	11	6	6	3	0	3	2
Beta A	45	10	5	3	0	0	0	1	0	0	13	5	6	13	0	3	2
Beta A	48	25	20	1	1	0	0	0	0	0	3	4	1	2	0	1	2
Beta A	60	30	25	2	0	0	0	0	0	0						2	1
Beta A	61	10	5	6	0	0	0	0	0	0	14	7	5	5	3	3	2
Beta A	62	5	5	6	0	0	0	0	0	0	14	8	6	3	0	3	3
Beta A	63	15	10	6	0	0	0	1	0	0	7	5	6	2	1	2	2
Beta A	64	20	9	2	0	0	0	0	0	0	9	9	5	2	0	3	3
Beta A	65	25	3	6	0	0	0	0	0	0	5	4	3	2	2	2	2
Beta A	66	30	20	4	0	0	0	0	0	0	4	4	5	0	1	2	2
Beta A	67	10	10	3	4	0	1	0	0	0	22	12	10	3	3	3	3
Beta A	68	18	10	3	0	0	0	0	0	0	13	9	6	7	0	3	3
Beta A	69	20	15	1	1	0	0	0	0	0	9	6	8	5	0	3	2
Beta A	71	20	12	5	0	0	0	0	0	0	6	4	5	2	2	2	2
Beta A	04\06	15	5	5	0	0	0	1	0	0	14	8	7	4	5	3	3
Beta A	07\08	20	10	5	0	0	0	0	0	0	13	12	6	7	3	3	3
Beta A	12\33	20	15	5	4	0	0	0	0	0	7	4	3	2	4	2	2
Beta A	24/25	20	10	2	0	0	0	1	0	0	9	15	3	8	0	3	3
BetaB	1	13	10	4	0	0	0	4	0	0	14	17	6	3	0	3	3
BetaB	2	11	14	2	0	0	0	4	0	0	10	17	9	8	3	3	3
BetaB	4	22	12	3	0	0	0	0	0	0	4	8	2	3	0	2	3
BetaB	9	12	11	4	0	0	1	0	4	0	2	5	2	4	0	1	2
BetaB	12	9	13	5	0	0	0	1	0	0	3	7	2	2	3	1	2
BetaB	18	30	16	2	0	0	0	0	0	0	2	5	2	2	0	1	2
BetaB	19	11	11	4	0	1	0	0	0	0	6	5	9	5	4	2	2
BetaB	20	13	7	5	0	0	0	0	0	0	9	11	0	0	5	3	3
BetaB	21	9	7	3	0	0	0	0	0	0	4	4	0	5	6	2	2

Beta Test Summary

Analyst	Scenario	cklst time	Sum Time	Order	25	26	27	28	29	30	SN Score	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating
BetaB	23	46	20	2	0	0	1	0	0	1	3	2	4	5	1	1	1
BetaB	24	14	13	3	4	0	0	1	0	0	8	16	5	6	2	3	3
BetaB	35	9	16	5	0	0	0	1	1	0	5	7	2	5	0	2	2
BetaB	36	14	16	5	0	0	1	1	4	0	3	4	2	3	2	1	2
BetaB	38	13	16	3	0	0	1	4	0	0	5	7	5	1	0	2	2
BetaB	41	12	8	5	0	0	0	1	0	0	6	10	0	3	0	2	3
BetaB	43	20	28	1	0	0	4	1	0	0	5	8	2	4	0	2	3
BetaB	45	9	10	2	0	0	0	4	1	0	9	7	6	8	0	3	2
BetaB	60	60	62	2	0	0	0	4	4	0	6	5	4	3	0	2	2
BetaB	61	16	22	2	0	0	1	4	4	0	16	14	13	7	2	3	3
BetaB	62	5	9	5	0	0	0	4	1	0	14	10	2	4	0	3	3
BetaB	63	13	16	4	1	0	0	1	1	0	6	7	4	3	1	2	2
BetaB	64	32	24	1	0	0	0	4	0	0	6	5	4	2	0	2	2
BetaB	65	23	14	5	1	1	0	1	1	0	3	5	0	3	3	1	2
BetaB	66	39	20	3	1	0	0	4	0	0	4	3	2	2	1	2	1
BetaB	67	9	12	5	1	0	0	0	0	0	11	7	17	5	3	3	2
BetaB	68	8	10	3	0	0	0	0	0	0	11	4	7	3	4	3	2
BetaB	69	8	5	3	1	0	0	0	0	0	6	7	4	4	1	2	2
BetaB	71	15	21	4	0	0	0	0	0	0	3	2	3	2	2	1	1
BetaB	07\08	16	12	3	0	0	0	0	0	0	8	6	4	4	1	3	3
BetaB	Summary	12	13	3	0	0	0	1	0	0	3	6	4	4	0	1	2
BetaC	1	11	8	4	0	0	0	1	0	0	11	16	6	3	3	3	3
BetaC	2	7	12	6	0	0	0	1	0	0	16	24	11	5	0	3	3
BetaC	9	13	9	4	0	0	0	0	1	0	5	5	2	2	0	2	2
BetaC	18	15	14	4	0	0	0	0	0	0	5	6	2	5	1	2	2
BetaC	19	9	8	5	1	0	0	0	0	0	14	10	15	9	3	3	3
BetaC	20	5	6	6	0	0	0	0	0	0	6	16	7	0	0	2	3
BetaC	21	4	13	3	0	0	0	0	0	0	6	11	6	5	3	2	3
BetaC	23	10	12	3	0	0	0	0	0	0	3	0	1	0	2	1	1
BetaC	35	7	7	7	4	0	0	1	0	0	4	7	4	5	3	2	2
BetaC	36	15	20	3	0	0	0	0	0	0	5	6	2	2	2	2	2
BetaC	38	7	9	5	0	1	1	1	0	0	9	7	7	2	0	3	2
BetaC	41	25	10	5	0	0	0	4	0	0	14	13	5	3	0	3	3
BetaC	43	8	14	3	0	0	1	1	4	0						3	3
BetaC	45	6	11	4	0	0	0	4	4	0	19	16	8	13	1	3	3
BetaC	48	20	15	2	0	0	0	1	0	0	6	7	4	2	0	2	2
BetaC	60	26	16	2	0	0	0	1	1	0	8	6	5	4	0	3	2
BetaC	61	16	12	2	0	0	1	4	1	0	21	12	13	5	0	3	3
BetaC	62	10	7	3	0	0	0	1	1	0	18	22	9	3	0	3	3

Beta Test Summary

Analyst	Scenario	ckist time	Sum Time	Order	25	26	27	28	29	30	SN Score	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating
BetaC	63	10	14	7	0	0	0	0	0	0	8	9	7	4	1	3	3
BetaC	64	13	9	7	0	0	0	0	0	0	7	3	10	2	0	2	1
BetaC	65	11	10	5	0	0	1	0	0	0	3	4	2	2	4	1	2
BetaC	66	25	15	4	1	0	0	1	1	0						1	2
BetaC	67	8	15	5	1	0	1	0	1	0	19	18	9	5	5	3	3
BetaC	68	40	30	1	0	0	0	0	0	0	10	13	13	8	0	3	3
BetaC	69	8	5	7	4	0	0	0	0	0	10	8	10	4	0	3	3
BetaC	71	35	19	2	0	0	0	0	0	0	5	5	4	1	1	2	2
BetaC	04\06	20	9	2	0	0	0	0	0	0	13	13	5	2	3	3	3
BetaC	07\08	13	14	3	0	0	0	0	0	0	12	15	9	7	0	3	3
BetaC	12\33	10	8	5	1	0	0	0	0	0	6	7	3	4	2	2	2
BetaC	24\25	20	20	2	1	0	0	4	0	0	7	17	7	7	0	2	3
BetaD	1	16	20	2	0	0	0	1	1	0	6	12	11	4	3	2	3
BetaD	2	12	7	4	0	0	0	1	0	0	17	21	9	8	2	3	3
BetaD	9	22	7	7	0	0	1	0	1	0	4	7	6	5	1	2	2
BetaD	18	64	20	2	0	0	0	0	0	0	6	5	4	4	1	2	2
BetaD	19	22	9	6	1	0	0	0	0	0	10	9	14	9	4	3	3
BetaD	20	16	8	5	1	0	0	1	0	0	14	10	13	0	1	3	3
BetaD	21	7	9	4	0	0	0	0	0	0	9	13	9	5	3	3	3
BetaD	23	32	10	3	0	1	1	0	0	0	5	0	16	6	0	2	1
BetaD	35	17	9	5	1	0	1	1	1	0	5	7	10	6	1	2	2
BetaD	36	28	20	3	0	0	1	1	1	0	6	7	4	3	2	2	2
BetaD	38	25	12	3	0	1	4	4	0	0	7	8	8	3	1	2	3
BetaD	41	22	11	7	0	0	0	1	0	0	17	14	8	5	1	3	3
BetaD	43	24	12	6	0	0	1	1	0	0	9	11	7	6	2	3	3
BetaD	45	18	10	3	0	0	0	1	1	0	9	7	11	8	1	3	2
BetaD	48	15	11	3	1	0	0	1	0	0	5	6	3	3	1	2	2
BetaD	60	28	13	4	1	0	1	1	0	0	7	10	7	5	1	2	3
BetaD	61	9	9	5	0	0	1	1	1	0	13	16	9	7	1	3	3
BetaD	62	25	12	2	0	0	1	1	0	0	14	15	9	5	0	3	3
BetaD	63	24	12	4	1	0	1	1	1	1	8	10	10	3	1	3	3
BetaD	64	27	17	2	0	0	1	1	1	0	11	8	17	1	0	3	3
BetaD	65	30	13	7	0	0	1	0	1	0	5	5	4	4	3	2	2
BetaD	66	38	15	5	1	0	0	1	1	1	3	2	4	4	1	1	1
BetaD	67	17	15	2	4	0	1	0	0	0	20	20	14	10	6	3	3
BetaD	68	28	15	3	1	0	1	1	1	1	11	14	21	10	1	3	3
BetaD	69	12	10	6	1	0	0	0	0	0	9	10	9	5	2	3	3
BetaD	71	35	20	3	1	0	0	1	0	1	7	4	6	4	1	2	2
BetaD	04\06	26	30	6	1	0	1	1	0	0	10	14	6	5	3	3	3

Beta Test Summary

Analyst	Scenario	cklst time	Sum Time	Order	25	26	27	28	29	30	SN Score	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating
BetaD	07\08	26	12	4	1	0	0	1	0	0	10	12	7	9	3	3	3
BetaD	12\33	47	20	2	0	0	1	1	1	0	4	4	2	4	4	2	2
BetaD	24\25	15	13	4	1	0	1	1	0	0	13	19	8	9	2	3	3
BetaE	1	7	6	3	0	0	0	0	0	0	5	5	1	0	0	2	2
BetaE	2	7	8	5	0	0	0	0	0	0	9	10	3	3	4	3	3
BetaE	9	8	4	5	0	0	0	0	0	0	4	3	2	2	0	2	1
BetaE	18	61	24	1	0	0	0	0	0	0	2	2	2	2	1	1	1
BetaE	19	16	7	2	1	0	0	0	0	0	3	2	2	3	2	1	1
BetaE	20	7	5	3	0	0	0	0	0	0	6	3	0	0	0	2	1
BetaE	21	5	5	4	0	0	0	0	0	0	3	4	2	1	0	1	2
BetaE	23	13	8	3	0	0	0	0	0	0	0	0	2	0	0	1	1
BetaE	35	9	5	2	0	0	0	0	0	0	4	2	0	2	0	2	1
BetaE	36	8	9	3	0	0	0	0	0	0	4	1	0	0	0	2	1
BetaE	38	23	8	3	0	0	0	1	0	0	3	2	3	0	0	1	1
BetaE	41	12	8	6	0	0	0	0	0	0	12	9	4	3	0	3	3
BetaE	43	10	9	5	0	0	1	0	0	0	12	7	4	3	0	3	2
BetaE	45	4	5	4	0	0	0	0	0	0	4	2	3	2	0	2	1
BetaE	48	15	12	2	0	0	0	0	0	0	4	2	1	0	0	2	1
BetaE	60	25	25	1	0	0	0	0	0	0	4	2	0	0	0	2	1
BetaE	61	6	6	4	0	0	0	0	0	0	10	5	0	2	0	3	2
BetaE	62	11	9	2	0	0	0	0	0	0	4	7	0	1	0	2	2
BetaE	63	20	14	2	0	0	0	0	0	0	3	1	4	0	0	1	1
BetaE	64	6	5	5	0	0	0	0	0	0	11	5	11	1	0	3	2
BetaE	65	14	9	4	0	0	0	0	0	0	3	0	0	1	1	1	1
BetaE	66	35	45	5	0	0	0	0	0	0	4	2	1	1	1	2	1
BetaE	67	4	5	4	4	0	1	0	0	0	8	3	2	5	3	3	1
BetaE	68	12	6	4	0	0	0	0	0	0	7	4	0	1	0	2	2
BetaE	69	10	7	6	1	0	0	0	0	0	6	6	5	4	0	2	2
BetaE	71	19	12	6	0	0	0	0	0	0	5	2	6	1	2	2	1
BetaE	04\06	11	8	5	0	0	0	0	0	0	10	8	2	5	3	3	3
BetaE	07\08	7	8	4	0	0	0	0	0	0	6	4	0	4	2	2	2
BetaE	12\33	8	10	3	1	0	0	0	0	0	3	2	1	0	2	1	1
BetaE	24\25	14	5	3	0	0	0	1	1	0	4	3	0	2	0	2	1
BetaF	1	15	8	2	0	0	0	1	0	0	6	11	2	3	2	2	3
BetaF	2	5	3	4	0	0	0	0	0	0	6	16	2	5	0	2	3
BetaF	4	10	10	4	0	0	0	0	0	0	5	1	1	1	0	2	1
BetaF	7	15	10	4	0	0	0	0	0	0	4	5	4	7	0	2	2
BetaF	9	10	10	5	0	0	0	0	0	0	2	2	2	3	0	1	1
BetaF	12	23	20	1	1	0	0	0	0	0	0	5	2	5	2	1	2

Beta Test Summary

Analyst	Scenario	ckist time	Sum Time	Order	25	26	27	28	29	30	SN Score	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating
BetaF	18	20	15	2	0	0	0	0	0	0	1	3	2	2	0	1	1
BetaF	19	10	10	5	0	0	0	0	0	0	5	3	5	8	3	2	1
BetaF	20	5	5	4	0	0	0	0	0	0	6	10	6	0	3	2	3
BetaF	21	10	10	4	0	0	0	0	0	0	3	1	1	2	3	1	1
BetaF	23	12	8	3	0	0	0	0	0	0	2	0	1	3	0	1	1
BetaF	24	20	10	4	0	0	0	4	0	0	3	6	1	4	0	1	2
BetaF	35	8	8	4	0	0	0	0	0	0	4	3	2	5	0	2	1
BetaF	36	15	15	3	0	0	0	0	0	0	3	1	0	2	0	1	1
BetaF	38	10	10	3	0	0	4	0	0	0	4	5	5	2	0	2	2
BetaF	41	10	10	5	0	0	0	0	0	0	9	10	0	2	0	3	3
BetaF	43	10	10	5	0	0	4	0	0	0	5	7	2	3	0	2	2
BetaF	45	15	10	2							5	4	8	6	0	2	2
BetaF	48	20	10	3	1	0	0	0	0	0	1	3	1	3	0	1	1
BetaF	60	20	15	6	0	0	0	0	0	0	5	2	2	2	0	2	1
BetaF	61	10	10	6	0	0	0	0	0	0	10	7	2	7	0	3	2
BetaF	62	20	35	2	0	1	0	0	0	0	14	10	4	4	0	3	3
BetaF	63	15	10	3	0	0	0	0	0	0	2	2	2	3	0	1	1
BetaF	64	30	12	1	0	0	0	0	0	0	3	6	5	1	0	2	2
BetaF	65	20	10	5	0	0	0	0	0	0	2	1	0	2	1	1	1
BetaF	66	15	10	6	0	0	0	0	0	0	2	3	1	4	0	1	1
BetaF	67	30	15	2	1	0	4	0	0	0	9	4	4	6	2	3	2
BetaF	68	20	10	3	0	0	0	0	0	0	5	5	2	3	0	2	2
BetaF	69	10	10	5	1	0	0	0	0	0	5	1	6	6	0	2	1
BetaF	71	15	10	3	0	0	0	0	0	0	2	2	3	3	0	1	1
BetaG	1	10	5	5	0	0	0	0	0	0	14	17	8	3	0	3	3
BetaG	2	5	5	5	0	0	0	0	0	0	10	17	8	5	0	3	3
BetaG	9	60	25	1	0	0	0	0	0	0	4	5	1	2	0	2	2
BetaG	18	15	5	5	0	0	0	0	0	0	4	6	2	2	0	2	2
BetaG	19	10	10	2	1	0	0	0	0	0	8	6	13	6	3	3	2
BetaG	20	10	20	2	0	0	0	0	0	0	8	16	6	0	1	3	3
BetaG	21	5	5	4	0	0	0	0	0	0	4	16	1	0	2	2	3
BetaG	23	20	10	2	0	0	0	0	0	0	5	1	7	4	1	2	1
BetaG	35	5	10	5	0	0	0	0	0	0	5	8	7	6	0	2	3
BetaG	36	10	10	5	0	0	0	0	0	0	6	7	2	2	0	2	2
BetaG	38	13	3	4	0	1	1	0	0	0	7	7	8	2	0	2	2
BetaG	41	10	10	3	0	0	0	0	0	0	15	11	2	3	0	3	3
BetaG	43	10	5	5	0	0	1	0	1	0	11	12	5	3	0	3	3
BetaG	45	8	7	3	0	0	0	0	0	0	6	4	9	3	0	2	2
BetaG	48	10	5	5	1	0	0	0	0	0	4	6	3	2	0	2	2

Beta Test Summary

Analyst	Scenario	cklst time	Sum Time	Order	25	26	27	28	29	30	SN Score	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating
BetaG	60	50	55	2	0	0	0	0	0	0	9	7	5	3	0	3	2
BetaG	61	8	11	4	0	0	0	0	0	0	12	11	7	4	0	3	3
BetaG	62	5	5	5	0	0	0	0	0	0	15	12	11	3	0	3	3
BetaG	63	25	15	3	0	0	0	0	0	0	8	7	2	4	0	3	2
BetaG	64	5	8	3	0	0	0	0	0	0	11	6	21	4	0	3	2
BetaG	65	34	13	3	0	0	1	0	0	0	3	2	0	2	3	1	1
BetaG	66	26	25	3	0	0	0	0	0	0	2	3	1	2	0	1	1
BetaG	67	5	8	4	1	0	1	0	0	0	12	13	6	10	4	3	3
BetaG	68	25	20	1	1	0	0	0	0	0	14	12	7	13	1	3	3
BetaG	69	13	10	2	1	0	0	0	0	0	5	8	4	4	0	2	3
BetaG	71	20	10	4	0	0	0	0	0	0	6	6	3	4	2	2	2
BetaG	04\06	13	10	4	0	0	0	0	0	0	7	9	5	6	1	2	3
BetaG	07\08	14	4	4	0	0	0	0	0	0	7	9	3	6	1	2	3
BetaG	12\33	10	12	4	1	0	0	0	0	0	2	7	2	2	0	1	2
BetaG	24\25	10	5	5	0	0	0	1	0	0	12	13	8	10	0	3	3
BetaH	1	10	12	4	0	0	0	0	0	0	9	7	2	3	0	3	2
BetaH	2	10	10	2	0	0	0	0	0	0	7	17	9	5	1	2	3
BetaH	9	10	10	5	0	0	0	0	0	0	3	2	1	2	0	1	1
BetaH	18	19	14	5	0	0	0	0	0	0	3	2	2	2	0	1	1
BetaH	19	14	10	6	0	0	0	0	0	0	2	1	12	6	2	1	1
BetaH	20	9	9	3	0	0	0	0	0	0	10	9	6	0	0	3	3
BetaH	21	25	20	2	0	0	0	0	0	0	4	10	2	5	0	2	3
BetaH	23	20	11	3	0	0	0	0	0	0	4	0	8	3	0	2	1
BetaH	35	19	15	3	0	0	1	0	0	0	5	5	4	4	0	2	2
BetaH	36	15	9	5	0	0	0	0	0	0	4	3	1	2	0	2	2
BetaH	38	20	19	2	0	1	1	1	0	0	6	6	9	3	0	2	2
BetaH	41	15	20	4	0	0	0	0	0	0	8	14	2	4	0	3	3
BetaH	43	12	7	6	0	0	0	0	0	0	8	7	5	3	0	3	2
BetaH	45	15	10	3	0	0	0	0	0	0	5	13	8	8	0	2	3
BetaH	48	19	15	4	0	0	0	0	0	0	4	4	1	2	0	2	2
BetaH	60	40	30	1	0	0	0	0	0	0	6	3	1	2	0	2	1
BetaH	61	15	16	4	0	0	0	0	0	0	9	5	8	4	0	3	2
BetaH	62	15	9	3	0	0	1	0	0	0	8	9	6	3	0	3	3
BetaH	63	15	25	3	0	0	0	0	0	0	4	6	6	5	0	2	2
BetaH	64	20	19	4	0	0	0	0	0	0	8	7	2	1	0	3	2
BetaH	65	15	9	5	0	0	0	0	0	0	3	3	1	2	0	1	1
BetaH	66	30	19	4	0	0	0	0	0	0	2	4	1	2	1	1	2
BetaH	67	15	14	6	1	0	1	0	0	0	9	8	10	8	2	3	3
BetaH	68	10	15	3	0	0	0	0	0	0	10	7	12	3	0	3	2

Beta Test Summary

Analyst	Scenario	cklst time	Sum Time	Order	25	26	27	28	29	30	SN Score	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating
BetaH	69	25	17	2	0	0	0	0	0	0	4	2	6	5	0	2	1
BetaH	71	20	14	4	0	0	0	0	0	0	3	2	4	2	0	1	1
BetaH	04\06	15	15	5	0	0	0	0	0	0	8	2	2	5	0	3	1
BetaH	07\08	15	25	2	0	0	0	0	0	0	6	10	9	7	0	2	3
BetaH	12\33	26	12	5	0	0	0	0	0	0	3	3	2	2	1	1	1
BetaH	24\25	37	30	1	0	0	0	0	0	0	11	15	9	6	0	3	3
Betal	1	19	8	4	0	0	0	0	0	0	4	14	10	3	0	2	3
Betal	2	8	7	5	0	0	0	0	0	0	9	14	10	5	0	3	3
Betal	9	12	10	3	0	0	1	0	1	0	3	9	0	0	0	1	3
Betal	18				0	0	0	0	0	1	2	4	5	3	0	1	2
Betal	19	15	9	3	1	0	0	0	0	0	0	8	5	8	5	1	3
Betal	20	9	5	3	1	0	0	1	0	0	14	15	6	0	5	3	3
Betal	21	7	8	3	0	0	0	0	0	0	3	7	6	0	0	1	2
Betal	23	19	9	2	1	0	0	1	0	1	0	0	9	4	4	1	1
Betal	35	14	6	5	1	0	0	0	0	0	4	9	4	6	3	2	3
Betal	36	18	8	5	0	0	1	0	0	0	5	9	3	1	2	2	3
Betal	38	13	4	4	0	1	1	0	0	0	4	7	6	2	0	2	2
Betal	41	15	10	3	0	0	0	0	0	0	8	10	1	0	0	3	3
Betal	43	13	8	7	0	0	1	1	0	0	4	11	4	4	0	2	3
Betal	45	13	13	2	0	0	0	0	1	0	10	8	6	3	2	3	3
Betal	48	19	11	5	0	0	0	1	0	0	3	4	3	2	2	1	2
Betal	60	35	8	7	1	0	0	0	0	1	7	9	3	4	2	2	3
Betal	61	11	9	7	1	0	0	0	1	0	14	11	10	3	0	3	3
Betal	62	9	4	7	0	0	0	0	1	0	14	13	7	3	4	3	3
Betal	63	35	13	2	0	0	0	0	0	0	2	6	2	2	0	1	2
Betal	64	6	4	5	0	0	0	0	0	0	6	6	12	2	0	2	2
Betal	65	14	7	6	1	0	0	0	0	0	5	6	4	5	2	2	2
Betal	66	30	13	4	0	0	0	0	0	0	3	6	3	1	2	1	2
Betal	67	10	5	7	1	0	0	0	0	0	16	17	2	13	0	3	3
Betal	68	25	16	1	0	0	0	0	0	0	9	9	5	9	3	3	3
Betal	69	14	16	2	1	0	0	0	0	0	9	9	6	4	0	3	3
Betal	71	45	20	1	0	0	0	0	0	0	1	1	4	1	0	1	1
Betal	04\06	28	11	2	0	0	0	0	0	1	7	8	2	4	5	3	2
Betal	07\08	10	9	3		0	0	0	0	0	8	11	0	7	2	3	3
Betal	12\33	11	10	4	1	0	0	1	0	0	6	10	2	6	4	2	3
Betal	24\25	15	8	4	0	0	0	4	0	1	5	16	9	10	2	2	3
BetaJ	1	7	16	3	0	0	0	4	0	0	15	17	6	3	0	3	3
BetaJ	2	7	4	5	0	0	0	4	0	0	15	20	6	3	4	3	3
BetaJ	9	51	8	5	0	0	0	4	4	0	5	4	5	4	0	2	2

Beta Test Summary

Analyst	Scenario	cklst time	Sum Time	Order	25	26	27	28	29	30	SN Score	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating
BetaJ	18	24	12	2	0	0	0	0	0	0	5	6	2	3	1	2	2
BetaJ	19	18	9	3	0	0	0	0	0	0	10	8	16	4	0	3	3
BetaJ	20	7	7	2	4	0	0	0	0	0	9	10	6	2	0	3	3
BetaJ	21	4	5	7	0	0	0	0	0	0	7	7	6	5	0	2	2
BetaJ	23	10	6	4	0	0	0	0	0	0	4	1	3	1	0	2	1
BetaJ	35	8	27	4	0	0	4	4	4	0	5	5	5	6	0	2	2
BetaJ	36	30	24	1	0	0	4	4	4	0	5	3	2	2	2	2	1
BetaJ	38	11	16	3	0	1	4	4	0	0	9	5	7	2	0	3	2
BetaJ	41	10	7	5	0	0	0	1	0	0	10	12	4	2	0	3	3
BetaJ	43	7	6	5	0	0	4	4	4	0	12	14	7	6	0	3	3
BetaJ	45	5	5	7	0	0	0	1	1	0	13	9	7	8	0	3	3
BetaJ	48	12	11	4	1	0	0	0	0	0	6	5	3	3	4	2	2
BetaJ	60	9	7	5	0	0	0	4	4	0	8	9	6	6	0	3	3
BetaJ	61	5	5	4	0	0	0	4	4	0	20	13	17	7	0	3	3
BetaJ	62	6	5	4	0	0	0	4	4	0	18	17	16	4	0	3	3
BetaJ	63	10	11	4	0	0	0	0	4	0	8	7	7	2	0	3	2
BetaJ	64	10	5	4	0	0	0	0	0	0	9	8	15	1	0	3	3
BetaJ	65	19	16	3	0	0	0	1	0	0	4	2	2	2	2	2	1
BetaJ	66	41	13	3	1	0	0	1	0	0	5	4	5	2	1	2	2
BetaJ	67	16	16	2	4	0	4	0	0	0	22	26	13	13	6	3	3
BetaJ	68	5	6	5	4	0	0	0	0	0	19	16	10	9	6	3	3
BetaJ	69	8	13	2	4	0	0	0	0	0	8	3	4	5	0	3	1
BetaJ	71	67	47	1	1	0	0	0	0	0	4	4	5	1	0	2	2
BetaJ	04\06	21	18	2	1	0	0	0	0	0	9	6	4	3	4	3	2
BetaJ	07\08	10	24	3	0	0	0	0	0	0	15	16	4	9	2	3	3
BetaJ	12\33	9	6	5	4	0	0	4	4	0	10	7	3	5	4	3	2
BetaJ	24\25	8	7	5	0	0	4	0	0	0	11	14	13	9	0	3	3

Beta Test Summary

Analyst	Scenario	BT Rating	LF Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15	CA16
Beta A	1	2	1	1	3						1										
Beta A	2	3	2	0	3																
Beta A	9	1	1	1	2			1										1			
Beta A	18	2	1	1	2					1								1			
Beta A	19	3	2	1	1	1		1		1								1			
Beta A	20	2	1	1	3													1			
Beta A	21	2	1	1	3									1							
Beta A	23	1	1	1	1																
Beta A	35	1	2	1	2									1	1			1			
Beta A	36	1	1	1	2																
Beta A	38	2	1	1	2												1	1			
Beta A	41	2	2	1	3											1		1			
Beta A	43	2	1	1	3											1		1			
Beta A	45	2	3	1	3									1							
Beta A	48	1	1	1	2													1			
Beta A	60	1	1	1	2									1	1	1		1			
Beta A	61	2	2	1	3									1							
Beta A	62	2	1	1	3													1			
Beta A	63	2	1	1	2									1							
Beta A	64	2	1	1	3									1		1		1			
Beta A	65	2	1	1	2						1		1	1				1			
Beta A	66	2	1	1	2					1				1		1		1			
Beta A	67	3	1	1	3									1				1			
Beta A	68	2	2	1	3									1							
Beta A	69	3	2	1	3									1				1			
Beta A	71	2	1	1	2	1								1				1	1		
Beta A	04\06	2	2	2	3									1				1			
Beta A	07\08	2	2	1	3									1				1			
Beta A	12\33	1	1	2	2						1										
Beta A	24/25	3	3	1	3									1				1			
BetaB	1	2	1	1	3						1										
BetaB	2	3	3	1	3									1							
BetaB	4	1	2	1	3									1				1			
BetaB	9	1	2	1	2			1													
BetaB	12	1	1	1	2																
BetaB	18	1	1	1	2									1				1			
BetaB	19	3	2	2	3					1								1			
BetaB	20	1	1	2	3									1				1			
BetaB	21	1	2	2	2									1							

Beta Test Summary

Analyst	Scenario	BT Rating	LF Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15	CA16
BetaB	23	2	2	1	2																
BetaB	24	2	3	1	3									1				1			
BetaB	35	1	2	1	2									1	1						
BetaB	36	1	1	1	2																
BetaB	38	2	1	1	2												1	1			
BetaB	41	1	1	1	3									1						1	
BetaB	43	1	2	1	3											1	1	1			
BetaB	45	2	3	1	3																
BetaB	60	2	1	1	2			1						1	1						
BetaB	61	3	2	1	3										1						
BetaB	62	1	2	1	3																
BetaB	63	2	1	1	2									1							
BetaB	64	2	1	1	2											1		1			
BetaB	65	1	1	1	2									1				1			
BetaB	66	1	1	1	2					1									1		
BetaB	67	3	2	1	3									1							
BetaB	68	2	1	2	3																
BetaB	69	2	2	1	2									1				1			
BetaB	71	1	1	1	1	1												1			
BetaB	07\08	2	2	1	3										1			1		1	
BetaB	Summary	2	2	1	2											1		1			
BetaC	1	2	1	1	3						1			1							
BetaC	2	3	2	1	3									1	1			1			
BetaC	9	1	1	1	2										1						
BetaC	18	1	2	1	2	1		1		1				1				1			
BetaC	19	3	3	1	3			1	1					1				1			
BetaC	20	2	1	1	3													1			
BetaC	21	2	2	1	3					1				1							
BetaC	23	1	1	1	1											1					
BetaC	35	2	2	1	2					1				1	1			1			
BetaC	36	1	1	1	2	1				1					1			1			
BetaC	38	2	1	1	3				1							1	1	1			
BetaC	41	2	1	1	3		1							1		1		1			
BetaC	43	3	2	1	2									1		1		1			
BetaC	45	3	3	1	3									1				1			
BetaC	48	2	1	1	2					1				1				1			
BetaC	60	2	2	1	3						1			1	1						
BetaC	61	3	2	1	3					1											
BetaC	62	3	1	0	3				1					1				1			

Beta Test Summary

Analyst	Scenario	BT Rating	LF Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15	CA16
BetaC	63	2	2	1	3				4							4		4			
BetaC	64	3	1	1	3											1		1			
BetaC	65	1	1	2	2	1				1							1	1			
BetaC	66	1	2	1	2									1		1					
BetaC	67	3	2	2	3		1	1						1		1	1	1			
BetaC	68	3	3	1	3									1							
BetaC	69	3	2	1	3					1				1				1			
BetaC	71	2	1	1	2	1								1				1			
BetaC	04\06	2	1	1	3																
BetaC	07\08	3	2	1	3									1				1			
BetaC	12\33	1	2	1	2	1	1							1	1	1		1			
BetaC	24\25	2	2	1	3					1				1	1			1			
BetaD	1	3	2	1	3							1			1						
BetaD	2	3	3	1	3													1			1
BetaD	9	2	2	1	2							1		1				1			
BetaD	18	2	2	1	3					1				1				1			
BetaD	19	3	3	2	3			1	1	1								1			
BetaD	20	3	1	1	3									1				1			
BetaD	21	3	2	1	3									1							
BetaD	23	3	2	1	3													1			
BetaD	35	3	2	1	3									1				1			
BetaD	36	2	1	1	3					1				1				1			
BetaD	38	3	1	1	3									1	1			1			
BetaD	41	3	2	1	3									1		1		1			
BetaD	43	2	2	1	3									1				1			
BetaD	45	3	3	1	3									1							
BetaD	48	1	1	1	3																
BetaD	60	2	2	1	3					1		1		1				1			
BetaD	61	3	2	1	3							1		1	1						
BetaD	62	3	2	1	3																
BetaD	63	3	1	1	3													1			
BetaD	64	3	1	1	3																
BetaD	65	2	2	1	2							1		1				1			
BetaD	66	2	2	1	2							1		1	1			1			
BetaD	67	3	3	2	3													1			
BetaD	68	3	3	1	3									1				1			
BetaD	69	3	2	1	3																
BetaD	71	2	2	1	3																
BetaD	04\06	2	2	1	3													1			

Beta Test Summary

Analyst	Scenario	BT Rating	LF Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15	CA16
BetaD	07\08	2	3	1	3									1				1			
BetaD	12\33	1	2	2	2							1			1						
BetaD	24\25	3	3	1	3																
BetaE	1	1	1	1	2																
BetaE	2	1	1	2	3																
BetaE	9	1	1	1	2													1			
BetaE	18	1	1	1	1																
BetaE	19	1	1	1	1					1								1			
BetaE	20	1	1	1	2													1			
BetaE	21	1	1	1	2									1							
BetaE	23	1	1	1	1																
BetaE	35	1	1	1	2																
BetaE	36	1	1	1	2																
BetaE	38	1	1	1	1												1	1			
BetaE	41	2	1	1	3											1		1			
BetaE	43	2	1	1	3											1		1			
BetaE	45	1	1	1	2																
BetaE	48	1	1	1	2													1			
BetaE	60	1	1	1	2																
BetaE	61	1	1	1	3																
BetaE	62	1	1	1	2																
BetaE	63	2	1	1	2													1			
BetaE	64	3	1	1	3											1		1			
BetaE	65	1	1	1	1													1			
BetaE	66	1	1	1	2										1			1			
BetaE	67	1	2	1	3	3												1			
BetaE	68	1	1	1	2																
BetaE	69	2	2	1	2									1							
BetaE	71	2	1	1	2													1			
BetaE	04\06	1	2	1	3													1			
BetaE	07\08	1	2	2	2															1	
BetaE	12\33	1	1	1	1																
BetaE	24\25	1	1	1	2																
BetaF	1	1	1	1	3																
BetaF	2	1	2	1	3																
BetaF	4	1	1	1	2													1			
BetaF	7	2	2	1	2									1				1			
BetaF	9	1	1	1	1									1				1			
BetaF	12	1	2	1	2									1							

Beta Test Summary

Analyst	Scenario	BT Rating	LF Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15	CA16
BetaF	18	1	1	1	1			1										1			
BetaF	19	2	3	1	3	1		1		1								1			
BetaF	20	2	1	1	3													1			
BetaF	21	1	1	1	1									1							
BetaF	23	1	1	1	1																
BetaF	24	1	2	1	2									1				1			
BetaF	35	1	2	1	2									1				1			
BetaF	36	1	1	1	1													1			
BetaF	38	2	1	1	2				1									1			
BetaF	41	1	1	1	3									1		1		1			
BetaF	43	1	1	1	2									1		1		1			
BetaF	45	3	2	1																	
BetaF	48	1	1	1	1													1			
BetaF	60	1	1	1	2									1							
BetaF	61	1	2	1	3					1				1							
BetaF	62	2	2	1	3													1			
BetaF	63	1	1	1	1									1				1			
BetaF	64	2	1	1	2									1						1	
BetaF	65	1	1	1	1								1					1			
BetaF	66	1	2	1	2					1				1				1			
BetaF	67	2	2	1	3									1				1			
BetaF	68	1	1	1	2									1							
BetaF	69	2	1	1	2									1							
BetaF	71	1	1	1	1	1								1				1			
BetaG	1	3	1	1	3						1										
BetaG	2	3	2	1	3																
BetaG	9	1	1	1	2			1													
BetaG	18	1	1	1	2					1								1			
BetaG	19	3	3	1	3	1				1								1			
BetaG	20	2	1	1	3													1			
BetaG	21	1	1	1	3									1							
BetaG	23	2	2	1	2											1					
BetaG	35	2	2	1	3						1			1	1	1			1		
BetaG	36	1	1	1	2						1				1	1		1			
BetaG	38	3	1	1	3				1								1	1			
BetaG	41	1	1	1	3											1		1			
BetaG	43	2	1	1	3										1	1	1	1			
BetaG	45	3	1	1	3																
BetaG	48	1	1	1	2											1		1			

Beta Test Summary

Analyst	Scenario	BT Rating	LF Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15	CA16
BetaG	60	2	1	1	3			1			1				1			1			
BetaG	61	2	2	1	3																
BetaG	62	3	1	1	3													1			
BetaG	63	1	1	1	3													1			
BetaG	64	3	2	1	3											1		1			
BetaG	65	1	1	1	1								1	1	1	1		1			
BetaG	66	1	1	1	1					1									1		
BetaG	67	2	3	2	3									1				1			
BetaG	68	2	3	1	3									1							
BetaG	69	2	2	1	3									1				1			
BetaG	71	1	2	1	2	1										1		1			
BetaG	04\06	2	2	1	3													1			
BetaG	07\08	1	2	1	3										1						
BetaG	12\33	1	1	1	2						1										
BetaG	24\25	3	3	1	3									1				1			
BetaH	1	1	1	1	3																
BetaH	2	3	2	1	3									1							
BetaH	9	1	1	1	1										1						
BetaH	18	1	1	1	1									1				1			
BetaH	19	3	2	1	3	1				1								1			
BetaH	20	2	1	1	3																
BetaH	21	1	2	1	3									1							
BetaH	23	3	1	1	3											1					
BetaH	35	2	2	1	2						1			1							
BetaH	36	1	1	1	2						1										
BetaH	38	3	1	1	3												1	1			
BetaH	41	1	2	1	3									1		1		1			
BetaH	43	2	1	1	3											1		1			
BetaH	45	3	3	1	3									1							
BetaH	48	1	1	1	2									1		1		1			
BetaH	60	1	1	1	2											1		1			
BetaH	61	3	2	1	3																
BetaH	62	2	1	1	3													1			
BetaH	63	2	2	1	2									1							
BetaH	64	1	1	1	3											1		1			
BetaH	65	1	1	1	1						1		1								
BetaH	66	1	1	1	2									1		1		1			
BetaH	67	3	3	1	3									1				1			
BetaH	68	3	1	1	3													1			

Beta Test Summary

Analyst	Scenario	BT Rating	LF Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15	CA16
BetaH	69	2	2	1	2													1			
BetaH	71	2	1	1	2									1							
BetaH	04\06	1	2	1	3									1				1			
BetaH	07\08	3	2	1	3													1			
BetaH	12\33	1	1	1	1									1							
BetaH	24\25	3	2	1	3									1							
Betal	1	3	1	1	3																
Betal	2	3	2	1	3																
Betal	9	1	1	1	3																
Betal	18	2	1	1	2					1								1			
Betal	19	2	3	2	3					1								1			
Betal	20	2	1	2	3													1			
Betal	21	2	1	1	2									1							
Betal	23	3	2	2	3											1					
Betal	35	2	2	1	3						1			1							
Betal	36	1	1	1	3						1			1	1						
Betal	38	2	1	1	2									1							
Betal	41	1	1	1	3											1		1			
Betal	43	2	2	1	3									1				1			
Betal	45	2	1	1	3									1							
Betal	48	1	1	1	2											1		1			
Betal	60	1	2	1	3													1			
Betal	61	3	1	1	3																
Betal	62	2	1	2	3									1				1			
Betal	63	1	1	1	2																
Betal	64	3	1	1	3											1		1			
Betal	65	2	2	1	2									1				1			
Betal	66	1	1	1	2																
Betal	67	1	3	1	3									1				1			
Betal	68	2	3	1	3									1							
Betal	69	2	2	1	3									1							
Betal	71	2	1	1	2																
Betal	04\06	1	2	2	3													1			
Betal	07\08	1	2	1	3													1			
Betal	12\33	1	2	2	3						1										
Betal	24\25	3	3	1	3																
BetaJ	1	2	1	1	3																
BetaJ	2	2	1	2	3									1							
BetaJ	9	2	2	1	2								1	1							

Beta Test Summary

Analyst	Scenario	BT Rating	LF Rating	HE Rating	Job Rating	CA1	CA2	CA3	CA4	CA5	CA6	CA7	CA8	CA9	CA10	CA11	CA12	CA13	CA14	CA15	CA16
BetaJ	18	1	1	1	2	1		1		1				1				1			
BetaJ	19	3	2	1	3	1		1		1				1				1			
BetaJ	20	2	1	1	3													1			
BetaJ	21	2	2	1	2									1							
BetaJ	23	1	1	1	2											1		1			
BetaJ	35	2	2	1	2									1		1		1			
BetaJ	36	1	1	1	2																
BetaJ	38	2	1	1	3				1					1			1	1			
BetaJ	41	2	1	1	3		1							1		1		1			
BetaJ	43	2	2	1	3		1							1		1	1	1			
BetaJ	45	2	3	1	3									1							
BetaJ	48	1	1	2	2									1		1		1			
BetaJ	60	2	2	1	3			1						1							
BetaJ	61	3	2	1	3					1				1	1						
BetaJ	62	3	2	1	3													1			
BetaJ	63	2	1	1	3									1							
BetaJ	64	3	1	1	3											1		1			
BetaJ	65	1	1	1	2									1				1			
BetaJ	66	2	1	1	2													1			
BetaJ	67	3	3	2	3									1				1			
BetaJ	68	3	3	2	3									1				1			
BetaJ	69	2	2	1	3									1				1			
BetaJ	71	2	1	1	2									1				1			
BetaJ	04\06	2	1	2	3																
BetaJ	07\08	2	3	2	3									1				1			
BetaJ	12\33	1	2	2	3									1	1						
BetaJ	24\25	3	3	1	3									1				1			

Beta Test Summary

Analyst	Scenario	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36	CA37
Beta A	1				1					1							1					
Beta A	2																					
Beta A	9				1																	
Beta A	18				1					1												
Beta A	19				1																	
Beta A	20				1																	
Beta A	21				1					1							1					
Beta A	23																					
Beta A	35															1	1					
Beta A	36				1					1						1	1					
Beta A	38				1														1			
Beta A	41																1		1			
Beta A	43																1					
Beta A	45																1					
Beta A	48																1					
Beta A	60				1											1						
Beta A	61				1					1						1	1					
Beta A	62				1												1					
Beta A	63				1					1							1					
Beta A	64															1						
Beta A	65				1		1			1												
Beta A	66				1		1			1							1					1
Beta A	67				1		1									1			1			
Beta A	68																					
Beta A	69																					
Beta A	71				1				1	1						1	1					
Beta A	04\06				1		1			1									1			
Beta A	07\08				1					1									1			
Beta A	12\33				1		1			1						1	1		1			
Beta A	24/25															1			1			
BetaB	1																1		1			
BetaB	2				1			1		1						1						
BetaB	4																1					
BetaB	9															1			1			
BetaB	12						1										1					
BetaB	18				1																	
BetaB	19				1		1															
BetaB	20				1												1					
BetaB	21				1		1			1												

Beta Test Summary

Analyst	Scenario	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36	CA37
BetaB	23						1															
BetaB	24						1										1				1	
BetaB	35							1								1	1					
BetaB	36				1		1			1						1	1		1			
BetaB	38				1														1			
BetaB	41																1					
BetaB	43																1					
BetaB	45																32					
BetaB	60	1														1	1		1			
BetaB	61						1										1					
BetaB	62	1			1											1	1		1			
BetaB	63						1										1		1			
BetaB	64																1					
BetaB	65						1	1		1												
BetaB	66		1		1		1			1		1			1	1	1					
BetaB	67				1		1									1	1		1			
BetaB	68				1		1			1							1					
BetaB	69						1									1						
BetaB	71												1		1		1					
BetaB	07\08						1															
BetaB	Summary															1			1			
BetaC	1				1					1							1		1			
BetaC	2																					
BetaC	9				1																	
BetaC	18				1																	
BetaC	19				1		1		1													1
BetaC	20				1														1			
BetaC	21				1					1							1					
BetaC	23		1				1															
BetaC	35				1												1					
BetaC	36																					
BetaC	38				1					1											1	
BetaC	41																		1			
BetaC	43																					
BetaC	45				1														1			
BetaC	48								1													
BetaC	60																		1			
BetaC	61															1						
BetaC	62	1			1												1		1			

Beta Test Summary

Analyst	Scenario	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36	CA37
BetaC	63																1					
BetaC	64				1																	
BetaC	65		1					1		1												
BetaC	66		1		1					1												
BetaC	67		1		1		1												1			
BetaC	68				1																	
BetaC	69				1																	
BetaC	71														1		1					
BetaC	04\06				1		1										1					
BetaC	07\08																					
BetaC	12\33						1		1													
BetaC	24\25																					
BetaD	1	1															1					
BetaD	2						1															
BetaD	9																					
BetaD	18				1											1	1					
BetaD	19	1					1		1													
BetaD	20				1																	
BetaD	21																					
BetaD	23																					
BetaD	35																					
BetaD	36															1	1					
BetaD	38																					
BetaD	41																					
BetaD	43																		1			
BetaD	45																					
BetaD	48															1	1					
BetaD	60																		1			
BetaD	61																					
BetaD	62	1			1											1	1		1			
BetaD	63																1		1			
BetaD	64																					
BetaD	65						1			1												
BetaD	66	1					1								1		1					
BetaD	67																		1			
BetaD	68																1		1			
BetaD	69																					
BetaD	71																1					
BetaD	04\06				1		1			1												

Beta Test Summary

Analyst	Scenario	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36	CA37
BetaD	07\08						1												1			
BetaD	12\33		1				1															
BetaD	24\25																					
BetaE	1																					
BetaE	2				1		1			1												
BetaE	9				1																	
BetaE	18				1																	
BetaE	19				1		1															
BetaE	20				1																	
BetaE	21				1					1												
BetaE	23																					
BetaE	35																					
BetaE	36																					
BetaE	38				1																	
BetaE	41																					
BetaE	43																1					
BetaE	45																					
BetaE	48					1													1			
BetaE	60																					
BetaE	61				1					1												
BetaE	62				1																	
BetaE	63																1					
BetaE	64																					
BetaE	65						1															
BetaE	66				1		1			1												
BetaE	67				1		1			1												
BetaE	68																1					
BetaE	69																					
BetaE	71				1				1								1					
BetaE	04\06				1		1										1					
BetaE	07\08				1		1															
BetaE	12\33						1															
BetaE	24\25				1														1			
BetaF	1				1												1					
BetaF	2																					
BetaF	4				1																	
BetaF	7				1																	
BetaF	9				1		1															
BetaF	12						1															

Beta Test Summary

Analyst	Scenario	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36	CA37
BetaF	18				1																	
BetaF	19				1		1															
BetaF	20				1																	
BetaF	21				1					1												
BetaF	23																					
BetaF	24																					
BetaF	35																					
BetaF	36																					
BetaF	38		1		1														1			
BetaF	41																1					
BetaF	43																					
BetaF	45																					
BetaF	48																		1			
BetaF	60																					
BetaF	61																1					
BetaF	62				1																	
BetaF	63																1		1			
BetaF	64					1																
BetaF	65				1		1			1												
BetaF	66				1					1												
BetaF	67																					
BetaF	68																1					
BetaF	69						1															
BetaF	71																					
BetaG	1				1												1		1			
BetaG	2				1																	
BetaG	9																1					
BetaG	18				1																	
BetaG	19				1																	
BetaG	20				1																	
BetaG	21				1		1															
BetaG	23																					
BetaG	35				1												1					
BetaG	36				1											1	1		1			
BetaG	38		1		1												1					
BetaG	41																1		1			
BetaG	43				1														1			
BetaG	45																					
BetaG	48				1												1					

Beta Test Summary

Analyst	Scenario	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36	CA37
BetaG	60				1											1	1		1			
BetaG	61				1												1					
BetaG	62				1											1	1					
BetaG	63																1					
BetaG	64																					
BetaG	65				1		1	1								1	1					
BetaG	66		1		1					1						1	1					
BetaG	67				1		1									1						
BetaG	68																					
BetaG	69				1		1															
BetaG	71				1								1				1					
BetaG	04\06				1												1					
BetaG	07\08				1												1		1			
BetaG	12\33															1	1					
BetaG	24\25																					
BetaH	1																					
BetaH	2						1															
BetaH	9																					
BetaH	18				1																	
BetaH	19				1		1															
BetaH	20				1																	
BetaH	21				1												1					
BetaH	23																					
BetaH	35																					
BetaH	36						1															
BetaH	38				1																	
BetaH	41																					
BetaH	43																					
BetaH	45						1															
BetaH	48																					
BetaH	60				1											1						
BetaH	61																					
BetaH	62				1																	
BetaH	63						1										1					
BetaH	64																					
BetaH	65						1															
BetaH	66				1		1										1					
BetaH	67				1		1			1												
BetaH	68																					

Beta Test Summary

Analyst	Scenario	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36	CA37
BetaH	69															1						
BetaH	71																1					
BetaH	04\06				1																	
BetaH	07\08															1						
BetaH	12\33																					
BetaH	24\25																					
Betal	1																					
Betal	2																					
Betal	9																		1			
Betal	18				1																	
Betal	19				1		1															
Betal	20											1							1			
Betal	21				1					1												
Betal	23																					
Betal	35				1					1									1			
Betal	36																		1			
Betal	38				1																	
Betal	41																					
Betal	43																		1			
Betal	45																1					
Betal	48																					
Betal	60																					
Betal	61				1					1												
Betal	62				1														1			
Betal	63																		1			
Betal	64																					
Betal	65				1		1			1												
Betal	66				1					1												
Betal	67																		1			
Betal	68																					
Betal	69																					
Betal	71																1					
Betal	04\06				1		1															
Betal	07\08																		1			
Betal	12\33				1					1									1			
Betal	24\25																		1			
BetaJ	1																					
BetaJ	2				1		1			1						1						
BetaJ	9				1																	

Beta Test Summary

Analyst	Scenario	CA17	CA18	CA19	CA20	CA21	CA22	CA23	CA24	CA25	CA26	CA27	CA28	CA29	CA30	CA31	CA32	CA33	CA34	CA35	CA36	CA37
BetaJ	18				1																	
BetaJ	19				1												1					
BetaJ	20				1																	
BetaJ	21				1					1			1			1						
BetaJ	23				1																	
BetaJ	35																					
BetaJ	36																1					
BetaJ	38	1			1																	
BetaJ	41																					
BetaJ	43				1					1												
BetaJ	45																1					
BetaJ	48						1															
BetaJ	60				1											1	1					
BetaJ	61				1					1												
BetaJ	62				1											1						
BetaJ	63																1					
BetaJ	64																					
BetaJ	65				1		1									1	1					
BetaJ	66				1								1				1					1
BetaJ	67				1		1									1						
BetaJ	68						1															
BetaJ	69			1																		
BetaJ	71																					
BetaJ	04\06				1		1						1			1		1				
BetaJ	07\08				1		1															
BetaJ	12\33						1			1							1					
BetaJ	24\25															1						

Beta Test Summary

Analyst	Scenario	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57	CA58
Beta A	1																	1				
Beta A	2				1											1						
Beta A	9	1			1													1				
Beta A	18	1			1																	
Beta A	19																		1			
Beta A	20																					
Beta A	21																					
Beta A	23																					
Beta A	35	1																				
Beta A	36	1			1													1				
Beta A	38	1																				
Beta A	41															1		1				
Beta A	43	1														1		1				
Beta A	45															1						
Beta A	48	1														1						
Beta A	60	1																1				
Beta A	61				1													1				
Beta A	62																	1				
Beta A	63																					
Beta A	64																	1				
Beta A	65	1														1		1				
Beta A	66	1			1								1									
Beta A	67																	1				
Beta A	68																					
Beta A	69																	1				
Beta A	71	1			1																	
Beta A	04\06	1																				
Beta A	07\08	1																1				
Beta A	12\33				1													1				
Beta A	24/25	1			1											1		1				
BetaB	1																	1				
BetaB	2	1			1																	
BetaB	4	1			1																	
BetaB	9	1			1																	
BetaB	12	1			1																	
BetaB	18																					
BetaB	19	1			1							1										
BetaB	20																	1				
BetaB	21																	1				

Beta Test Summary

Analyst	Scenario	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57	CA58
BetaB	23																					
BetaB	24	1			1																	
BetaB	35	1			1													1				
BetaB	36																					
BetaB	38	1																1				
BetaB	41																	1				
BetaB	43																	1				
BetaB	45																					
BetaB	60	1			1													1				
BetaB	61																	1				
BetaB	62																	1				
BetaB	63																	1				
BetaB	64																					
BetaB	65															1						
BetaB	66		1	1	1											1						
BetaB	67	1																				
BetaB	68	1			1																	
BetaB	69																					
BetaB	71				1				1													
BetaB	07\08	1																				
BetaB	Summary																					
BetaC	1																					
BetaC	2				1		1											1				
BetaC	9	1			1		1															
BetaC	18	1			1														1			
BetaC	19																					
BetaC	20					1										1		1				
BetaC	21																	1				
BetaC	23											1										
BetaC	35				1																	
BetaC	36						1															
BetaC	38																					
BetaC	41				1													1				
BetaC	43				1											1		1				
BetaC	45				1											1						
BetaC	48																					
BetaC	60	1					1															
BetaC	61																					
BetaC	62																	1				

Beta Test Summary

Analyst	Scenario	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57	CA58
BetaC	63																					
BetaC	64																					
BetaC	65													1								
BetaC	66													1		1						
BetaC	67																	1				
BetaC	68																					
BetaC	69																	1				
BetaC	71	1			1																	
BetaC	04\06	1																				
BetaC	07\08				1													1				
BetaC	12\33																					
BetaC	24\25																					
BetaD	1																					
BetaD	2																					
BetaD	9																					
BetaD	18	1																				
BetaD	19																					
BetaD	20	1			1													1				
BetaD	21																	1				
BetaD	23	1										1										
BetaD	35																					
BetaD	36				1																	
BetaD	38																					
BetaD	41																	1				
BetaD	43				1																	
BetaD	45	1			1																	
BetaD	48																					
BetaD	60	1					1															
BetaD	61																					
BetaD	62																	1				
BetaD	63											1										
BetaD	64	1			1																	
BetaD	65																					
BetaD	66													1								
BetaD	67	1									1							1				
BetaD	68	1			1						1							1				
BetaD	69										1											
BetaD	71	1			1																	
BetaD	04\06										1	1										

Beta Test Summary

Analyst	Scenario	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57	CA58
BetaD	07\08										1							1				
BetaD	12\33																					
BetaD	24\25	1			1																	
BetaE	1																					
BetaE	2																					
BetaE	9																					
BetaE	18																					
BetaE	19																					
BetaE	20					1																
BetaE	21																	1				
BetaE	23																					
BetaE	35	1																				
BetaE	36																					
BetaE	38																					
BetaE	41																	1				
BetaE	43																					
BetaE	45																					
BetaE	48																					
BetaE	60	1																				
BetaE	61																					
BetaE	62																	1				
BetaE	63																					
BetaE	64																					
BetaE	65																					
BetaE	66																					
BetaE	67	1									1	1										
BetaE	68																					
BetaE	69																					
BetaE	71	1			1																	
BetaE	04\06																					
BetaE	07\08																					
BetaE	12\33				1																	
BetaE	24\25																	1				
BetaF	1																					
BetaF	2																					
BetaF	4																					
BetaF	7																	1				
BetaF	9																	1				
BetaF	12																					

Beta Test Summary

Analyst	Scenario	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57	CA58
BetaF	18																		1			
BetaF	19																		1			
BetaF	20	1				1												1				
BetaF	21																					
BetaF	23																					
BetaF	24																					
BetaF	35																					
BetaF	36	1																				
BetaF	38	1																1				
BetaF	41																					
BetaF	43																					
BetaF	45																					
BetaF	48															1						
BetaF	60																					
BetaF	61																	1				
BetaF	62																	1				
BetaF	63																	1				
BetaF	64																	1				
BetaF	65																					
BetaF	66																					
BetaF	67										1											
BetaF	68																					
BetaF	69	1																				
BetaF	71											1				1						
BetaG	1	1																1				
BetaG	2	1			1											1						
BetaG	9																					
BetaG	18	1			1																	
BetaG	19				1							1										
BetaG	20					1																
BetaG	21																	1				
BetaG	23																					
BetaG	35	1			1													1				
BetaG	36	1			1													1				
BetaG	38	1																1				
BetaG	41																	1				
BetaG	43	1														1		1				
BetaG	45																					
BetaG	48	1			1											1						

Beta Test Summary

Analyst	Scenario	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57	CA58
BetaG	60	1			1													1				
BetaG	61	1			1													1				
BetaG	62	1			1													1				
BetaG	63	1			1							1						1				
BetaG	64																	1				
BetaG	65	1																1				
BetaG	66		1																			
BetaG	67	1									1	1						1				
BetaG	68											1										
BetaG	69											1										
BetaG	71	1			1				1									1				
BetaG	04\06	1																1				
BetaG	07\08	1																1				
BetaG	12\33	1			1													1				
BetaG	24\25	1			1											1		1				
BetaH	1																					
BetaH	2				1																	
BetaH	9																					
BetaH	18																					
BetaH	19																					
BetaH	20																	1				
BetaH	21																	1				
BetaH	23																					
BetaH	35				1																	
BetaH	36																	1				
BetaH	38																	1				
BetaH	41																					
BetaH	43																					
BetaH	45																					
BetaH	48																					
BetaH	60																					
BetaH	61																					
BetaH	62																	4				
BetaH	63																					
BetaH	64																	1				
BetaH	65																					
BetaH	66																					
BetaH	67																	1				
BetaH	68																					

Beta Test Summary

Analyst	Scenario	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57	CA58
BetaH	69																					
BetaH	71	1			1																	
BetaH	04\06																					
BetaH	07\08																					
BetaH	12\33																					
BetaH	24\25	1			1																	
Betal	1																					
Betal	2				1																	
Betal	9																					
Betal	18																					
Betal	19																					
Betal	20																	1				
Betal	21																					
Betal	23											1										
Betal	35																					
Betal	36																	1				
Betal	38																					
Betal	41																					
Betal	43																	1				
Betal	45																					
Betal	48																	1				
Betal	60																	1				
Betal	61																					
Betal	62																					
Betal	63																					
Betal	64																	1				
Betal	65																					
Betal	66																					
Betal	67																					
Betal	68																					
Betal	69																					
Betal	71				1																	
Betal	04\06																					
Betal	07\08											1										
Betal	12\33	1			1																	
Betal	24\25				1													1				
BetaJ	1																	1				
BetaJ	2				1																	
BetaJ	9																	1				

Beta Test Summary

Analyst	Scenario	CA38	CA39	CA40	CA41	CA42	CA43	CA44	CA45	CA46	CA47	CA48	CA49	CA50	CA51	CA52	CA53	CA54	CA55	CA56	CA57	CA58
BetaJ	18																		1			
BetaJ	19											1										
BetaJ	20					1																
BetaJ	21																	1				
BetaJ	23											1							1			
BetaJ	35	1			1													1				
BetaJ	36																					
BetaJ	38																	1				
BetaJ	41																	1				
BetaJ	43																	1				
BetaJ	45																					
BetaJ	48	1														1		1				
BetaJ	60	1																1				
BetaJ	61																					
BetaJ	62																	1				
BetaJ	63	1																1				
BetaJ	64																	1				
BetaJ	65																	1				
BetaJ	66											1										
BetaJ	67										1											
BetaJ	68											1						1				
BetaJ	69																					
BetaJ	71	1										1										
BetaJ	04\06																					
BetaJ	07\08																	1				
BetaJ	12\33																					
BetaJ	24\25																	1				

Beta Test Summary

Analyst	Scenario	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78	CA79
Beta A	1	1			1												1					1
Beta A	2	1			1										1		1			1		
Beta A	9																			1		1
Beta A	18																					
Beta A	19					1																
Beta A	20																			1		
Beta A	21																			1		
Beta A	23																					
Beta A	35				1															1		
Beta A	36	1			1															1		1
Beta A	38																					
Beta A	41	1							1								1			1		
Beta A	43				1												1			1		
Beta A	45																					
Beta A	48								1								1			1		
Beta A	60				1												1		1	1		
Beta A	61	1																		1		
Beta A	62	1			1																	
Beta A	63			1																1		
Beta A	64	1															1		1	1		
Beta A	65	1			1															1		
Beta A	66																					
Beta A	67	1							1										1	1		
Beta A	68																		1	1		
Beta A	69			1		1			1									1	1	1		
Beta A	71			1				1														
Beta A	04\06								1											1		
Beta A	07\08	1				1			1										1	1		
Beta A	12\33	1							1								1			1		1
Beta A	24/25	1			1										1		1			1		
BetaB	1				1				1								1					1
BetaB	2	1															1					
BetaB	4	1							1											1		
BetaB	9	1							1								1		1	1		
BetaB	12	1							1								1					
BetaB	18			1																		
BetaB	19			1																		
BetaB	20								1											1		
BetaB	21																					

Beta Test Summary

Analyst	Scenario	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78	CA79
BetaB	23																					
BetaB	24				1												1			1		
BetaB	35	1			1		1		1										1	1		
BetaB	36				1				1								1					1
BetaB	38	1															1					
BetaB	41								1													
BetaB	43																1					
BetaB	45				1																	
BetaB	60	1			1				1	1										1		
BetaB	61	1															1			1		
BetaB	62	1			1																	
BetaB	63			1	1				1								1			1		
BetaB	64	1															1		1			
BetaB	65		1																			
BetaB	66			1																		
BetaB	67	1				1			1										1			
BetaB	68	1		1		1											1	1	1			
BetaB	69	1				1											1	1	1	1		
BetaB	71																			1		
BetaB	07\08	1				1			1										1	1		
BetaB	Summary	1			1				1								1		1	1		
BetaC	1	1			1												1			1		1
BetaC	2				1														1	1		1
BetaC	9	1			1												1		1	1		
BetaC	18								1													
BetaC	19																					
BetaC	20								1											1		1
BetaC	21						1															1
BetaC	23																					
BetaC	35																					
BetaC	36	1			1													1	1	1		1
BetaC	38	1		1													1		1	1	1	
BetaC	41								1								1			1		
BetaC	43	1															1			1		
BetaC	45																		1			
BetaC	48								1								1		1	1		1
BetaC	60				1				1								1			1		
BetaC	61																			1		
BetaC	62	1			1																	

Beta Test Summary

Analyst	Scenario	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78	CA79
BetaC	63			1																1		
BetaC	64																					
BetaC	65		1				1															
BetaC	66			1			1										1					
BetaC	67	1							1								1		1			
BetaC	68					1														1		
BetaC	69					1								1					1			
BetaC	71							1														
BetaC	04\06								1													
BetaC	07\08								1								1		1	1		
BetaC	12\33	1							1										1	1		
BetaC	24\25				1		1										1			1		
BetaD	1								1								1					1
BetaD	2	1			1										1		1			1		1
BetaD	9														1		1		1			1
BetaD	18																					
BetaD	19			1																		
BetaD	20								1											1		
BetaD	21								1										1	1		1
BetaD	23																				1	
BetaD	35				1	1	1										1	1	1	1		
BetaD	36																			1		
BetaD	38																1	1	1	1		
BetaD	41	1															1					
BetaD	43	1							1								1		1	1		1
BetaD	45																					1
BetaD	48								1										1	1		
BetaD	60	1		1		1	1		1								1		1	1		
BetaD	61	1			1												1			1		
BetaD	62	1			1																	
BetaD	63	1			1				1								1			1		
BetaD	64																1					
BetaD	65	1															1		1	1		1
BetaD	66				1														1	1		
BetaD	67	1				1			1											1		
BetaD	68			1		1	1		1								1		1	1		
BetaD	69					1			1									1	1	1		
BetaD	71								1										1	1		1
BetaD	04\06								1										1	1		

Beta Test Summary

Analyst	Scenario	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78	CA79
BetaD	07\08					1	1		1										1	1		
BetaD	12\33								1													
BetaD	24\25	1			1										1		1			1		1
BetaE	1																1					1
BetaE	2	1			1												1					1
BetaE	9				1												1					
BetaE	18																					
BetaE	19																					
BetaE	20																					
BetaE	21																					
BetaE	23																					
BetaE	35					1											1					
BetaE	36																1					
BetaE	38	1															1					
BetaE	41	1															1					
BetaE	43	1															1					
BetaE	45																1					
BetaE	48	1							1								1			1		
BetaE	60	1															1					
BetaE	61	1																				
BetaE	62	1																				
BetaE	63			1																		
BetaE	64	1															1					
BetaE	65	1	1																			
BetaE	66				1																	
BetaE	67	1							1										1			
BetaE	68																		1			
BetaE	69								1								1		1			
BetaE	71								1										1			
BetaE	04\06								1													
BetaE	07\08								1										1			
BetaE	12\33	1															1					
BetaE	24\25	1			1												1					
BetaF	1	1			1															1		
BetaF	2																1					1
BetaF	4																					
BetaF	7					1			1										1	1		
BetaF	9																			1		1
BetaF	12				1				1								1					

Beta Test Summary

Analyst	Scenario	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78	CA79
BetaF	18																					
BetaF	19																					
BetaF	20								1											1		
BetaF	21						1															
BetaF	23																					
BetaF	24				1												1			1		
BetaF	35						1													1		
BetaF	36	1															1			1		1
BetaF	38	1															1					
BetaF	41	1							1								1			1		
BetaF	43																1			1		
BetaF	45																					
BetaF	48						1										1			1		
BetaF	60				1												1			1		
BetaF	61	1																		1		
BetaF	62	1																				
BetaF	63																			1		
BetaF	64								1													
BetaF	65																			1		
BetaF	66																					1
BetaF	67	1				1														1		
BetaF	68																		1	1		
BetaF	69					1																
BetaF	71						1															
BetaG	1	1			1	1			1								1			1		1
BetaG	2	1			1										1		1			1		1
BetaG	9				1												1					
BetaG	18																					
BetaG	19			1	1																	
BetaG	20																1					
BetaG	21																			1		
BetaG	23																					
BetaG	35	1			1	1	1		1	1							1			1		1
BetaG	36	1			1												1			1		1
BetaG	38	1															1					
BetaG	41	1							1								1			1		
BetaG	43	1			1												1			1		
BetaG	45																					
BetaG	48	1			1		1		1								1			1		

Beta Test Summary

Analyst	Scenario	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78	CA79
BetaG	60	1			1	1			1	1							1		1	1		1
BetaG	61																1			1		
BetaG	62	1			1																	
BetaG	63			1					1										1	1		
BetaG	64																1					
BetaG	65		1		1															1		
BetaG	66																1					
BetaG	67	1							1										1	1		
BetaG	68																		1			
BetaG	69					1			1								1		1	1		
BetaG	71	1						1											1			
BetaG	04\06	1				1			1										1	1		
BetaG	07\08	1			1	1			1										1	1		
BetaG	12\33	1			1				1								1			1		1
BetaG	24\25	1			1										1					1		1
BetaH	1				1												1			1		
BetaH	2	1			1												1					
BetaH	9				1												1			1		
BetaH	18								1													
BetaH	19			1																		
BetaH	20								1											1		
BetaH	21																					
BetaH	23																					
BetaH	35				1	1											1					1
BetaH	36				1															1		1
BetaH	38																1					
BetaH	41	1							1								1					
BetaH	43																1			1		
BetaH	45				1																	
BetaH	48				1												1			1		
BetaH	60				1		1										1		1			1
BetaH	61	1																		1		
BetaH	62				1																	
BetaH	63			1															1	1		
BetaH	64																1					
BetaH	65																			1		
BetaH	66																1					1
BetaH	67	1							1										1	1		
BetaH	68																		1	1		

Beta Test Summary

Analyst	Scenario	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78	CA79
BetaH	69			1		1													1	1		
BetaH	71						1													1		
BetaH	04\06								1													
BetaH	07\08								1										1			
BetaH	12\33								1								1			1		1
BetaH	24\25	1			1												1			1		
Betal	1				1												1					
Betal	2				1												1					
Betal	9																1					
Betal	18																					
Betal	19																					
Betal	20																					
Betal	21																					
Betal	23																					
Betal	35								1								1					
Betal	36								1								1					1
Betal	38																					
Betal	41																					
Betal	43																1					
Betal	45								1													
Betal	48			1													1					
Betal	60																		1	1		
Betal	61														1					1		
Betal	62	1			1																	
Betal	63																			1		
Betal	64	1															1					
Betal	65		1														1			1		
Betal	66																					
Betal	67								1										1			
Betal	68			1															1			
Betal	69								1								1	1	1			
Betal	71			1																		
Betal	04\06								1													
Betal	07\08								1										1			
Betal	12\33								1								1					
Betal	24\25				1												1			1		
BetaJ	1	1			1												1					1
BetaJ	2	1															1			1		1
BetaJ	9				1												1		1	1		

Beta Test Summary

Analyst	Scenario	CA59	CA60	CA61	CA62	CA63	CA64	CA65	CA66	CA67	CA68	CA69	CA70	CA71	CA72	CA73	CA74	CA75	CA76	CA77	CA78	CA79
BetaJ	18																					
BetaJ	19			1																		
BetaJ	20																			1		
BetaJ	21						1															
BetaJ	23			1																		
BetaJ	35	1			1	1				1										1		1
BetaJ	36	1																				1
BetaJ	38	1															1					
BetaJ	41	1							1								1			1		
BetaJ	43	1			1												1			1		
BetaJ	45				1												1					
BetaJ	48																1					
BetaJ	60	1					1													1		
BetaJ	61	1			1															1		
BetaJ	62	1			1																	
BetaJ	63	1		1	1												1			1		
BetaJ	64	1															1					
BetaJ	65	1					1										1			1		
BetaJ	66			1																		1
BetaJ	67	1				1			1										1	1		
BetaJ	68	1							1									1	1	1		
BetaJ	69					1											1			1		
BetaJ	71								1											1		
BetaJ	04\06																		1			
BetaJ	07\08								1										1	1		
BetaJ	12\33	1			1	1			1								1					1
BetaJ	24\25	1			1												1			1		

Beta Test Summary

Analyst	Scenario	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99	CA100
Beta A	1				1			1										1				
Beta A	2							1										1		1		
Beta A	9							1										1				
Beta A	18							1										1				
Beta A	19							1									1					
Beta A	20								1													
Beta A	21																					
Beta A	23																					
Beta A	35							1	1								1	1				
Beta A	36				1			1	1	1								1				
Beta A	38									1					1			1				
Beta A	41							1	1									1				
Beta A	43							1		1								1				
Beta A	45							1										1				
Beta A	48							1										1				
Beta A	60							1	1								1	1				
Beta A	61								1													
Beta A	62									1								1				
Beta A	63							1										1				
Beta A	64									1												
Beta A	65					1		1	1	1								1				
Beta A	66			1	1			1		1						1		1				
Beta A	67							1		1					1			1				
Beta A	68					1		1										1				
Beta A	69							1									1	1				
Beta A	71							1								1		1				
Beta A	04\06							1									1	1				
Beta A	07\08									1							1					
Beta A	12\33				1			1	1					1				1		1		
Beta A	24/25							1										1				
BetaB	1				1			1		1				1				1				
BetaB	2							1		1												
BetaB	4							1		1	1							1				
BetaB	9							1										1				
BetaB	12							1	1									1	1			
BetaB	18							1										1				
BetaB	19							1									1	1				
BetaB	20									1												
BetaB	21																					

Beta Test Summary

Analyst	Scenario	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99	CA100
BetaB	23				1												1					
BetaB	24							1		1								1				
BetaB	35						1		1								1	1				
BetaB	36				1	1		1	1	1				1				1				
BetaB	38								1	1					1			1				
BetaB	41							1										1				
BetaB	43							1										1				
BetaB	45							1				1						1				
BetaB	60						1	1									1	1				
BetaB	61							1	1	1								1				
BetaB	62									1								1				
BetaB	63						1	1		1								1				
BetaB	64							1										1				
BetaB	65					1		1	1													
BetaB	66	1						1	1									1				
BetaB	67							1										1				
BetaB	68							1										1				
BetaB	69							1			1							1				
BetaB	71						1		1									1				
BetaB	07\08									1	1						1					
BetaB	Summary						1			1								1				
BetaC	1				1			1						1				1				
BetaC	2				1			1														
BetaC	9							1								1						
BetaC	18							1										1				
BetaC	19			1	1			1									1	1				
BetaC	20								1	1												
BetaC	21	1							1													
BetaC	23				1																	
BetaC	35							1									1					
BetaC	36							1					1			1		1				
BetaC	38														1			1				
BetaC	41							1							1			1				
BetaC	43				1			1										1				
BetaC	45							1										1				
BetaC	48			1				1							1							
BetaC	60							1					1	1	1			1				
BetaC	61									1								1				
BetaC	62																	1				

Beta Test Summary

Analyst	Scenario	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99	CA100
BetaC	63				1			1		1				1				1				
BetaC	64																					
BetaC	65				1			1	1						1			1				
BetaC	66							1										1				
BetaC	67									1					1	1	1					
BetaC	68																	1				
BetaC	69																	1				
BetaC	71						1		1													
BetaC	04\06							1										1				
BetaC	07\08																1					
BetaC	12\33			1	1											1						
BetaC	24\25								1						1		1					
BetaD	1				1			1					1		1							
BetaD	2									1										1		
BetaD	9				1			1							1			1				
BetaD	18							1	1									1				
BetaD	19			1				1									1					
BetaD	20									1												
BetaD	21	1			1																	
BetaD	23				1												1	1				
BetaD	35							1							1		1	1				
BetaD	36							1										1				
BetaD	38							1					1		1	1		1				
BetaD	41																					
BetaD	43				1			1										1				
BetaD	45							1				1						1				
BetaD	48							1	1		1							1				
BetaD	60							1							1			1				
BetaD	61									1					1			1				
BetaD	62									1												
BetaD	63							1	1						1			1				
BetaD	64				1																	
BetaD	65							1	1									1				
BetaD	66							1	1						1			1				
BetaD	67									1												
BetaD	68							1		1	1							1				
BetaD	69					1					1						1	1	1			
BetaD	71	1		1				1	1									1				
BetaD	04\06																					

Beta Test Summary

Analyst	Scenario	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99	CA100
BetaD	07\08									1	1											
BetaD	12\33				1																	
BetaD	24\25									1										1		
BetaE	1							1										1				
BetaE	2							1		1								1		1		
BetaE	9							1										1				
BetaE	18							1										1				
BetaE	19							1										1				
BetaE	20																					
BetaE	21																					
BetaE	23																					
BetaE	35																1					
BetaE	36																					
BetaE	38																	1				
BetaE	41							1										1				
BetaE	43																					
BetaE	45							1										1				
BetaE	48																					
BetaE	60																					
BetaE	61							1										1				
BetaE	62																					
BetaE	63																					
BetaE	64							1										1				
BetaE	65							1										1				
BetaE	66							1	1									1				
BetaE	67														1							
BetaE	68							1										1				
BetaE	69																					
BetaE	71							1										1				1
BetaE	04\06							1										1				
BetaE	07\08																1					
BetaE	12\33							1										1				
BetaE	24\25																					
BetaF	1							1		1				1								
BetaF	2							1		1												
BetaF	4							1														
BetaF	7																1					
BetaF	9							1														
BetaF	12							1											1			

Beta Test Summary

Analyst	Scenario	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99	CA100
BetaF	18							1														
BetaF	19							1									1					
BetaF	20								1	1												
BetaF	21																					
BetaF	23																					
BetaF	24							1														
BetaF	35				1		1										1					
BetaF	36							1						1								
BetaF	38																	1				
BetaF	41							1														
BetaF	43							1														
BetaF	45																					
BetaF	48						1															
BetaF	60							1									1	1				
BetaF	61							1														
BetaF	62																	1				
BetaF	63						1															
BetaF	64									1												
BetaF	65						1		1													
BetaF	66	1						1	1													
BetaF	67																1					
BetaF	68																	1				
BetaF	69							1									1					
BetaF	71						1															
BetaG	1			1				1	1	1				1				1				
BetaG	2							1		1								1				
BetaG	9							1														
BetaG	18							1										1				
BetaG	19							1									1					
BetaG	20								1	1												
BetaG	21	1																				
BetaG	23				1																	
BetaG	35				1			1	1	1							1	1				
BetaG	36				1			1	1	1				1				1				
BetaG	38								1	1					1			1				
BetaG	41							1	1									1				
BetaG	43							1		1					1			1				
BetaG	45							1										1				
BetaG	48							1		1								1				

Beta Test Summary

Analyst	Scenario	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99	CA100
BetaG	60				1			1	1					1	1			1				
BetaG	61							1										1				
BetaG	62									1								1				
BetaG	63					1		1		1												
BetaG	64							1										1				
BetaG	65					1		1	1	1								1				
BetaG	66				1		1	1										1				
BetaG	67							1		1	1				1		1	1				
BetaG	68										1											
BetaG	69					1		1			1						1	1				
BetaG	71	1						1	1	1								1				
BetaG	04\06							1		1	1							1				
BetaG	07\08							1		1	1						1	1				
BetaG	12\33				1			1	1	1								1	1			
BetaG	24\25							1		1								1		1		
BetaH	1				1			1						1				1				
BetaH	2							1		1												
BetaH	9							1										1				
BetaH	18							1										1				
BetaH	19							1									1					
BetaH	20									1												
BetaH	21																					
BetaH	23				1																	
BetaH	35				1			1									1	1				
BetaH	36							1										1				
BetaH	38																	1				
BetaH	41							1										1				
BetaH	43							1										1				
BetaH	45							1														
BetaH	48							1										1				
BetaH	60																	1				
BetaH	61							1										1				
BetaH	62																	1				
BetaH	63						1	1										1				
BetaH	64							1										1				
BetaH	65							1										1				
BetaH	66	1						1										1				
BetaH	67							1										1				
BetaH	68							1														

Beta Test Summary

Analyst	Scenario	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99	CA100
BetaH	69							1			1						1					
BetaH	71							1										1				
BetaH	04\06							1										1				
BetaH	07\08										1						1					
BetaH	12\33				1			1	1					1				1				
BetaH	24\25							1										1		1		
Betal	1									1												
Betal	2							1														
Betal	9																					
Betal	18							1														
Betal	19																1					
Betal	20									1												
Betal	21																					
Betal	23				1												1					
Betal	35							1									1					
Betal	36													1								
Betal	38																					
Betal	41																					
Betal	43																					
Betal	45											1										
Betal	48								1													
Betal	60																					
Betal	61																					
Betal	62																	1				
Betal	63																					
Betal	64																					
Betal	65																					
Betal	66																					
Betal	67										1											
Betal	68																	1				
Betal	69					1											1					
Betal	71																					
Betal	04\06							1										1				
Betal	07\08							1									1					
Betal	12\33							1						1			1	1				
Betal	24\25																			1		
BetaJ	1																					
BetaJ	2							1		1										1		
BetaJ	9							1										1				

Beta Test Summary

Analyst	Scenario	CA80	CA81	CA82	CA83	CA84	CA85	CA86	CA87	CA88	CA89	CA90	CA91	CA92	CA93	CA94	CA95	CA96	CA97	CA98	CA99	CA100
BetaJ	18							1														
BetaJ	19																1					
BetaJ	20									1												
BetaJ	21																					
BetaJ	23																	1				
BetaJ	35				1			1							1		1	1				
BetaJ	36							1														
BetaJ	38									1					1			1				
BetaJ	41							1										1				
BetaJ	43							1		1					1			1				
BetaJ	45							1				1						1				
BetaJ	48							1	1													
BetaJ	60				1			1						1			1	1				
BetaJ	61							1		1								1				
BetaJ	62									1								1				
BetaJ	63							1		1							1	1				
BetaJ	64							1										1				
BetaJ	65							1														
BetaJ	66				1											1						
BetaJ	67							1			1				1		1	1				
BetaJ	68									1	1											
BetaJ	69							1			1						1					
BetaJ	71																					
BetaJ	04\06							1														
BetaJ	07\08							1									1	1				
BetaJ	12\33				1			1	1			1						1	1			
BetaJ	24\25							1		1							1			1		

Beta Test Summary

Analyst	Scenario	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117	CA118
Beta A	1															1	1		1
Beta A	2																		1
Beta A	9			1															
Beta A	18																		
Beta A	19															1			
Beta A	20																		
Beta A	21															1			
Beta A	23																		
Beta A	35															1			
Beta A	36															1	1		
Beta A	38			1		1					1								
Beta A	41																		
Beta A	43																1	1	1
Beta A	45																		
Beta A	48															1			1
Beta A	60													1			1		
Beta A	61													1			1		1
Beta A	62																		
Beta A	63																1	1	1
Beta A	64																		
Beta A	65												1			1	1		1
Beta A	66												1				1		
Beta A	67			1															
Beta A	68			1											1			1	
Beta A	69			1											1			1	1
Beta A	71											1	1			1			
Beta A	04\06			1									1		1	1			
Beta A	07\08			1									1			1		1	
Beta A	12\33															1			
Beta A	24/25			1												1		1	1
BetaB	1																		
BetaB	2			1													1		1
BetaB	4			1									1					1	
BetaB	9																		
BetaB	12																1	1	
BetaB	18																		1
BetaB	19															1			1
BetaB	20																	1	
BetaB	21																		1

Beta Test Summary

Analyst	Scenario	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117	CA118
BetaB	23																		
BetaB	24																	1	
BetaB	35													1	1	1	1		1
BetaB	36												1						1
BetaB	38	1														1			
BetaB	41																		
BetaB	43					1													
BetaB	45																		
BetaB	60												1	1	1	1	1	1	
BetaB	61													1			1		1
BetaB	62																		
BetaB	63																		1
BetaB	64																		
BetaB	65					1													1
BetaB	66								1	1			1			1	1		1
BetaB	67														1	1		1	
BetaB	68			1											1			1	
BetaB	69														1				1
BetaB	71															1	1	1	1
BetaB	07\08												1		1			1	
BetaB	Summary															1			
BetaC	1															1	1		
BetaC	2																		
BetaC	9													1					
BetaC	18												1			1			
BetaC	19						1									1			
BetaC	20																		
BetaC	21																		1
BetaC	23																		
BetaC	35															1			
BetaC	36															1	1		
BetaC	38					1	1	1			1					1			
BetaC	41															1			
BetaC	43																		
BetaC	45															1			
BetaC	48															1			
BetaC	60												1		1	1		1	1
BetaC	61															1	1		
BetaC	62																	1	

Beta Test Summary

Analyst	Scenario	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117	CA118
BetaC	63						1									1			
BetaC	64						1									1			
BetaC	65					1			1					1		1			
BetaC	66												1			1	1		1
BetaC	67				1	1										1			
BetaC	68														1			1	
BetaC	69															1			
BetaC	71											1							
BetaC	04\06												1			1			
BetaC	07\08															1	1		
BetaC	12\33													1		1	1		
BetaC	24\25															1		1	
BetaD	1																		
BetaD	2												1	1			1		1
BetaD	9													1					
BetaD	18															1			
BetaD	19															1			
BetaD	20																	1	
BetaD	21																		1
BetaD	23															1		1	
BetaD	35																		
BetaD	36												1						
BetaD	38															1		1	
BetaD	41																		
BetaD	43																		
BetaD	45																	1	
BetaD	48						1						1					1	
BetaD	60			1															
BetaD	61													1			1		
BetaD	62																		
BetaD	63																		
BetaD	64																		
BetaD	65								1					1			1		
BetaD	66																		
BetaD	67			1									1		1		1	1	
BetaD	68			1														1	1
BetaD	69			1															
BetaD	71																		
BetaD	04\06																		

Beta Test Summary

Analyst	Scenario	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117	CA118
BetaD	07\08																		
BetaD	12\33																		
BetaD	24\25												1	1			1		
BetaE	1																		1
BetaE	2												1						
BetaE	9																		
BetaE	18																		
BetaE	19																		
BetaE	20																		
BetaE	21																		
BetaE	23																		
BetaE	35															1			1
BetaE	36																1		
BetaE	38					1					1								
BetaE	41																		
BetaE	43																	1	
BetaE	45																		1
BetaE	48																		1
BetaE	60												1				1		1
BetaE	61													1			1		1
BetaE	62																		
BetaE	63												1						1
BetaE	64																		
BetaE	65																		
BetaE	66												1				1		
BetaE	67			1															
BetaE	68														1				
BetaE	69																		
BetaE	71											1				1			
BetaE	04\06												1					1	
BetaE	07\08																		
BetaE	12\33																		
BetaE	24\25																	1	
BetaF	1												1						
BetaF	2												1	1			1		
BetaF	4			1									1						
BetaF	7												1						
BetaF	9																		
BetaF	12															1			

Beta Test Summary

Analyst	Scenario	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117	CA118
BetaF	18																		
BetaF	19																		
BetaF	20																	1	
BetaF	21															1			
BetaF	23																		
BetaF	24																1	1	
BetaF	35													1					
BetaF	36												1	1			1		
BetaF	38			1															
BetaF	41																		
BetaF	43																		
BetaF	45																		
BetaF	48																		1
BetaF	60												1		1				
BetaF	61													1			1		
BetaF	62																		
BetaF	63												1	1			1		1
BetaF	64																		
BetaF	65												1	1		1			
BetaF	66												1			1	1		
BetaF	67			1															
BetaF	68			1											1				
BetaF	69														1			1	
BetaF	71															1			
BetaG	1												1			1	1		
BetaG	2			1									1	1			1		1
BetaG	9																		
BetaG	18												1						
BetaG	19																		
BetaG	20																		
BetaG	21																		
BetaG	23																		
BetaG	35												1	1	1	1	1	1	
BetaG	36												1			1	1		
BetaG	38	1		1		1					1					1			
BetaG	41															1	1	1	
BetaG	43					1					1					1		1	1
BetaG	45																		
BetaG	48															1			1

Beta Test Summary

Analyst	Scenario	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117	CA118
BetaG	60													1	1	1	1	1	
BetaG	61													1		1	1		
BetaG	62																	1	
BetaG	63			1			1												1
BetaG	64															1			
BetaG	65					1					1		1	1		1	1		
BetaG	66												1			1			
BetaG	67			1											1	1		1	
BetaG	68																		
BetaG	69			1														1	1
BetaG	71												1			1			
BetaG	04\06			1									1					1	1
BetaG	07\08			1									1		1	1		1	
BetaG	12\33															1		1	
BetaG	24\25			1									1			1	1	1	1
BetaH	1																1		
BetaH	2																1		1
BetaH	9																		
BetaH	18																		
BetaH	19															1			
BetaH	20																		
BetaH	21															1			1
BetaH	23																		
BetaH	35																		
BetaH	36																		
BetaH	38			1															
BetaH	41																		
BetaH	43																		
BetaH	45																		
BetaH	48																		
BetaH	60																		
BetaH	61													1			1		
BetaH	62																		
BetaH	63																1	1	1
BetaH	64																		
BetaH	65																		
BetaH	66																1		1
BetaH	67																1	1	
BetaH	68														1			1	

Beta Test Summary

Analyst	Scenario	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117	CA118
BetaH	69																	1	1
BetaH	71																		
BetaH	04\06																		
BetaH	07\08																	1	
BetaH	12\33															1			
BetaH	24\25																1		1
Betal	1																		
Betal	2																		1
Betal	9																		
Betal	18																		
Betal	19															1			
Betal	20																		
Betal	21																		1
Betal	23																		
Betal	35																		
Betal	36																		
Betal	38																		
Betal	41																		
Betal	43																1	1	
Betal	45																		
Betal	48																		
Betal	60						1						1		1		1		
Betal	61													1		1	1		1
Betal	62																		
Betal	63																		
Betal	64																		
Betal	65																		
Betal	66																1		
Betal	67												1						
Betal	68																	1	
Betal	69																	1	
Betal	71													1					
Betal	04\06																		
Betal	07\08																		
Betal	12\33																		
Betal	24\25																		1
BetaJ	1																1		
BetaJ	2												1				1		
BetaJ	9			1															

Beta Test Summary

Analyst	Scenario	CA101	CA102	CA103	CA104	CA105	CA106	CA107	CA108	CA109	CA110	CA111	CA112	CA113	CA114	CA115	CA116	CA117	CA118
BetaJ	18																		
BetaJ	19																		
BetaJ	20																	1	
BetaJ	21															1			
BetaJ	23																		
BetaJ	35												1	1		1	1	1	1
BetaJ	36																		
BetaJ	38			1		1					1								
BetaJ	41																		
BetaJ	43					1					1						1	1	1
BetaJ	45																		1
BetaJ	48															1			
BetaJ	60												1		1		1		
BetaJ	61																1		1
BetaJ	62																	1	
BetaJ	63												1				1		1
BetaJ	64																		1
BetaJ	65															1	1	1	
BetaJ	66																		
BetaJ	67			1									1			1	1	1	
BetaJ	68														1			1	1
BetaJ	69																	1	1
BetaJ	71																	1	1
BetaJ	04\06			1									1			1			
BetaJ	07\08												1				1	1	1
BetaJ	12\33																	1	
BetaJ	24\25												1				1	1	1

Beta Test Summary

Analyst	Scenario	CA119	CA120	CA121	CA122	CA123	CA124	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135	CA136	CA137
Beta A	1					1												1	
Beta A	2																	1	
Beta A	9						1											1	
Beta A	18													1				1	
Beta A	19						1												
Beta A	20					1													
Beta A	21																		
Beta A	23																		
Beta A	35					1													
Beta A	36					1	1											1	
Beta A	38																		
Beta A	41					1	1												
Beta A	43					1								1				1	
Beta A	45					1													
Beta A	48						1												
Beta A	60					1	1											1	
Beta A	61					1	1											1	
Beta A	62					1												1	
Beta A	63																	1	
Beta A	64						1											1	
Beta A	65						1											1	
Beta A	66		1			1				1						1		1	
Beta A	67									1									
Beta A	68					1													
Beta A	69					1								1					
Beta A	71		1			1	1							1				1	
Beta A	04\06					1												1	
Beta A	07\08																		
Beta A	12\33					1												1	
Beta A	24/25						1											1	
BetaB	1					1													
BetaB	2						1											1	
BetaB	4					1	1											1	
BetaB	9						1								1				
BetaB	12					1													
BetaB	18																		
BetaB	19						1											1	
BetaB	20					1	1												
BetaB	21						1											1	

Beta Test Summary

Analyst	Scenario	CA119	CA120	CA121	CA122	CA123	CA124	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135	CA136	CA137
BetaB	23						1												
BetaB	24						1											1	
BetaB	35					1	1											1	
BetaB	36					1	1												
BetaB	38							1						1					
BetaB	41																		
BetaB	43																	1	
BetaB	45																		
BetaB	60					1								1	1				
BetaB	61						1											1	
BetaB	62					1													
BetaB	63					1	1								1			1	
BetaB	64																	1	
BetaB	65																	1	
BetaB	66					1	1									1		1	
BetaB	67					1													
BetaB	68																		
BetaB	69						1												
BetaB	71					1	1	1										1	
BetaB	07\08						1												
BetaB	Summary						1												
BetaC	1																	1	
BetaC	2																	1	
BetaC	9						1								1				
BetaC	18																		
BetaC	19						1												
BetaC	20		1															1	
BetaC	21						1											1	
BetaC	23																		
BetaC	35					1												1	
BetaC	36																		
BetaC	38							1											
BetaC	41																	1	
BetaC	43																	1	
BetaC	45																		1
BetaC	48													1	1				1
BetaC	60					1													
BetaC	61						1											1	
BetaC	62					1												1	

Beta Test Summary

Analyst	Scenario	CA119	CA120	CA121	CA122	CA123	CA124	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135	CA136	CA137
BetaC	63							1				1							
BetaC	64																		
BetaC	65															1			
BetaC	66					1	1									1		1	
BetaC	67									1									
BetaC	68					1													
BetaC	69													1					
BetaC	71																	1	
BetaC	04\06					1	1											1	
BetaC	07\08																	1	
BetaC	12\33												1						
BetaC	24\25						1											1	
BetaD	1																		
BetaD	2																	1	
BetaD	9																		
BetaD	18					1	1												
BetaD	19							1						1					
BetaD	20						1												
BetaD	21						1											1	
BetaD	23							1						1					
BetaD	35													1					
BetaD	36					1	1							1	1			1	
BetaD	38							1											
BetaD	41																		
BetaD	43													1				1	
BetaD	45																		
BetaD	48																	1	
BetaD	60													1					
BetaD	61																	1	
BetaD	62					1													
BetaD	63						1	1						1	1			1	
BetaD	64																		
BetaD	65																		
BetaD	66																1		
BetaD	67					1													
BetaD	68					1								1					
BetaD	69																		
BetaD	71					1	1											1	
BetaD	04\06																		

Beta Test Summary

Analyst	Scenario	CA119	CA120	CA121	CA122	CA123	CA124	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135	CA136	CA137
BetaD	07\08																		
BetaD	12\33																		
BetaD	24\25																	1	
BetaE	1						1												
BetaE	2																		
BetaE	9						1												
BetaE	18						1												
BetaE	19						1												
BetaE	20																		
BetaE	21						1												
BetaE	23																		
BetaE	35																		
BetaE	36						1												
BetaE	38																		
BetaE	41																		
BetaE	43					1													
BetaE	45																		
BetaE	48																		
BetaE	60					1													
BetaE	61						1												
BetaE	62																		
BetaE	63					1													
BetaE	64																		
BetaE	65						1												
BetaE	66					1	1												
BetaE	67																		
BetaE	68					1													
BetaE	69							1											
BetaE	71					1													
BetaE	04\06																		
BetaE	07\08																		
BetaE	12\33						1												
BetaE	24\25																		
BetaF	1																		
BetaF	2																	1	
BetaF	4					1													
BetaF	7																		
BetaF	9						1												
BetaF	12																	1	

Beta Test Summary

Analyst	Scenario	CA119	CA120	CA121	CA122	CA123	CA124	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135	CA136	CA137
BetaF	18																		
BetaF	19						1												
BetaF	20																	1	
BetaF	21																		
BetaF	23																		
BetaF	24						1												
BetaF	35																	1	
BetaF	36						1												
BetaF	38				1			1											
BetaF	41																		
BetaF	43					1								1				1	
BetaF	45																		
BetaF	48													1					
BetaF	60					1									1				
BetaF	61																	1	
BetaF	62																		
BetaF	63														1				
BetaF	64						1												
BetaF	65						1												
BetaF	66					1										1		1	
BetaF	67																		
BetaF	68																		
BetaF	69																	1	
BetaF	71		1				1												
BetaG	1																		
BetaG	2																		
BetaG	9						1												
BetaG	18						1							1					
BetaG	19	1					1											1	
BetaG	20																	1	
BetaG	21																	1	
BetaG	23					1	1												
BetaG	35					1	1											1	
BetaG	36					1													
BetaG	38				1	1		1											
BetaG	41					1													
BetaG	43													1					
BetaG	45					1													
BetaG	48						1							1				1	

Beta Test Summary

Analyst	Scenario	CA119	CA120	CA121	CA122	CA123	CA124	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135	CA136	CA137
BetaG	60					1	1											1	
BetaG	61						1											1	
BetaG	62					1								1				1	
BetaG	63						1								1			1	
BetaG	64																		
BetaG	65					1													
BetaG	66					1	1											1	
BetaG	67					1							1						
BetaG	68					1													
BetaG	69																		
BetaG	71				1		1							1					
BetaG	04\06					1	1												
BetaG	07\08																		
BetaG	12\33																	1	
BetaG	24\25						1							1				1	
BetaH	1						1											1	
BetaH	2						1												
BetaH	9						1												
BetaH	18						1												
BetaH	19						1												
BetaH	20						1											1	
BetaH	21																	1	
BetaH	23					1							1						
BetaH	35						1											1	
BetaH	36						1											1	
BetaH	38							1											
BetaH	41						1												
BetaH	43																	1	
BetaH	45					1													
BetaH	48					1												1	
BetaH	60					1													
BetaH	61																	1	
BetaH	62					1													
BetaH	63					1	1											1	
BetaH	64						1												
BetaH	65																		
BetaH	66						1											1	
BetaH	67																		
BetaH	68					1													

Beta Test Summary

Analyst	Scenario	CA119	CA120	CA121	CA122	CA123	CA124	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135	CA136	CA137
BetaH	69																		
BetaH	71																		
BetaH	04\06						1											1	
BetaH	07\08																		
BetaH	12\33																	1	
BetaH	24\25						1												
Betal	1																		
Betal	2																		
Betal	9																		
Betal	18						1												
Betal	19																		
Betal	20						1											1	
Betal	21																		
Betal	23						1												
Betal	35																		
Betal	36																		
Betal	38							1											
Betal	41																		
Betal	43																		
Betal	45																		
Betal	48																	1	
Betal	60					1													
Betal	61																	1	
Betal	62																		
Betal	63														1			1	
Betal	64						1												
Betal	65																	1	
Betal	66																		
Betal	67																		
Betal	68					1													
Betal	69																		
Betal	71																		
Betal	04\06					1													
Betal	07\08																		
Betal	12\33					1													
Betal	24\25						1												
BetaJ	1						1												
BetaJ	2						1												
BetaJ	9																	1	

Beta Test Summary

Analyst	Scenario	CA119	CA120	CA121	CA122	CA123	CA124	CA126	CA127	CA128	CA129	CA130	CA131	CA132	CA133	CA134	CA135	CA136	CA137
BetaJ	18						1												
BetaJ	19						1												
BetaJ	20						1											1	
BetaJ	21						1												
BetaJ	23						1						1						
BetaJ	35																		
BetaJ	36					1	1											1	
BetaJ	38				1			1											
BetaJ	41																		
BetaJ	43																		
BetaJ	45																		
BetaJ	48													1				1	
BetaJ	60					1	1								1				
BetaJ	61						1												
BetaJ	62					1												1	
BetaJ	63					1													
BetaJ	64																		
BetaJ	65						1												
BetaJ	66					1	1	1										1	
BetaJ	67					1													
BetaJ	68					1													
BetaJ	69													1					
BetaJ	71												1						
BetaJ	04\06					1	1											1	
BetaJ	07\08					1													
BetaJ	12\33					1													
BetaJ	24\25						1											1	

Analyst	Scenario	CA138	CA139	CA140	CA141	CA142	CA143
Beta A	1						
Beta A	2						
Beta A	9						
Beta A	18						
Beta A	19						
Beta A	20						
Beta A	21						
Beta A	23						
Beta A	35						
Beta A	36						
Beta A	38						
Beta A	41						
Beta A	43						
Beta A	45						
Beta A	48						
Beta A	60						
Beta A	61						
Beta A	62						
Beta A	63					1	
Beta A	64						
Beta A	65						
Beta A	66						
Beta A	67						
Beta A	68						
Beta A	69						
Beta A	71						
Beta A	04\06						
Beta A	07\08						
Beta A	12\33						
Beta A	24/25						
BetaB	1						
BetaB	2						
BetaB	4						
BetaB	9						
BetaB	12						
BetaB	18						
BetaB	19					1	
BetaB	20						
BetaB	21						

Analyst	Scenario	CA138	CA139	CA140	CA141	CA142	CA143
BetaB	23						
BetaB	24						
BetaB	35						
BetaB	36						
BetaB	38				1		
BetaB	41						
BetaB	43						
BetaB	45						
BetaB	60						
BetaB	61						
BetaB	62						
BetaB	63					1	
BetaB	64						
BetaB	65						
BetaB	66						
BetaB	67						
BetaB	68						
BetaB	69						
BetaB	71						
BetaB	07\08						
BetaB	Summary						
BetaC	1						
BetaC	2						
BetaC	9						
BetaC	18						
BetaC	19						
BetaC	20						
BetaC	21						
BetaC	23						
BetaC	35						
BetaC	36						
BetaC	38				1		
BetaC	41						
BetaC	43						
BetaC	45						
BetaC	48						
BetaC	60						
BetaC	61						
BetaC	62						

Analyst	Scenario	CA138	CA139	CA140	CA141	CA142	CA143
BetaC	63						
BetaC	64						
BetaC	65						
BetaC	66						
BetaC	67						
BetaC	68						
BetaC	69						
BetaC	71						
BetaC	04\06						
BetaC	07\08						
BetaC	12\33						
BetaC	24\25						
BetaD	1						
BetaD	2						
BetaD	9						
BetaD	18						
BetaD	19						
BetaD	20						
BetaD	21		1				
BetaD	23						
BetaD	35						
BetaD	36						
BetaD	38						
BetaD	41						
BetaD	43						
BetaD	45						
BetaD	48						
BetaD	60						
BetaD	61						
BetaD	62						
BetaD	63					1	
BetaD	64						
BetaD	65						
BetaD	66						
BetaD	67						
BetaD	68						
BetaD	69						
BetaD	71						
BetaD	04\06						

Analyst	Scenario	CA138	CA139	CA140	CA141	CA142	CA143
BetaD	07\08						
BetaD	12\33						
BetaD	24\25						
BetaE	1						
BetaE	2						
BetaE	9						
BetaE	18						
BetaE	19						
BetaE	20						
BetaE	21		1				
BetaE	23						
BetaE	35						
BetaE	36						
BetaE	38						
BetaE	41						
BetaE	43						
BetaE	45						
BetaE	48						
BetaE	60						
BetaE	61						
BetaE	62						
BetaE	63					1	
BetaE	64						
BetaE	65						
BetaE	66						
BetaE	67						
BetaE	68						
BetaE	69						
BetaE	71						
BetaE	04\06						
BetaE	07\08						
BetaE	12\33						
BetaE	24\25						
BetaF	1						
BetaF	2						
BetaF	4						
BetaF	7						
BetaF	9						
BetaF	12						

Beta Test Summary

Analyst	Scenario	CA138	CA139	CA140	CA141	CA142	CA143
BetaF	18						
BetaF	19						
BetaF	20						
BetaF	21						
BetaF	23						
BetaF	24						
BetaF	35						
BetaF	36						
BetaF	38				1		
BetaF	41						
BetaF	43						
BetaF	45						
BetaF	48						
BetaF	60						
BetaF	61						
BetaF	62						
BetaF	63						
BetaF	64						
BetaF	65						
BetaF	66	1					
BetaF	67						
BetaF	68					1	
BetaF	69					1	
BetaF	71						
BetaG	1						
BetaG	2						
BetaG	9						
BetaG	18						
BetaG	19					1	
BetaG	20						
BetaG	21		1				
BetaG	23						
BetaG	35						
BetaG	36						
BetaG	38				1		
BetaG	41						
BetaG	43						
BetaG	45						
BetaG	48	1					

Analyst	Scenario	CA138	CA139	CA140	CA141	CA142	CA143
BetaG	60						
BetaG	61						
BetaG	62						
BetaG	63					1	
BetaG	64		1				
BetaG	65						
BetaG	66						
BetaG	67						
BetaG	68						
BetaG	69						
BetaG	71						
BetaG	04\06						
BetaG	07\08						
BetaG	12\33						
BetaG	24\25						
BetaH	1						
BetaH	2						
BetaH	9						
BetaH	18						
BetaH	19						
BetaH	20						
BetaH	21						
BetaH	23						
BetaH	35						
BetaH	36						
BetaH	38				1		
BetaH	41						
BetaH	43						
BetaH	45						
BetaH	48						
BetaH	60						
BetaH	61						
BetaH	62						
BetaH	63					1	
BetaH	64		1				
BetaH	65						
BetaH	66	1					
BetaH	67						
BetaH	68					1	

Beta Test Summary

Analyst	Scenario	CA138	CA139	CA140	CA141	CA142	CA143
BetaH	69						
BetaH	71						
BetaH	04\06			1			
BetaH	07\08						
BetaH	12\33						
BetaH	24\25						
Betal	1						
Betal	2						
Betal	9						
Betal	18						
Betal	19						
Betal	20						
Betal	21						
Betal	23						
Betal	35						
Betal	36						
Betal	38						
Betal	41						
Betal	43						
Betal	45						
Betal	48						
Betal	60						
Betal	61						
Betal	62						
Betal	63					1	
Betal	64						
Betal	65						
Betal	66						
Betal	67						
Betal	68						
Betal	69					1	
Betal	71					1	
Betal	04\06						
Betal	07\08						
Betal	12\33						
Betal	24\25						
BetaJ	1						
BetaJ	2						
BetaJ	9						

Analyst	Scenario	CA138	CA139	CA140	CA141	CA142	CA143
BetaJ	18						
BetaJ	19					1	
BetaJ	20						
BetaJ	21		1				
BetaJ	23						
BetaJ	35						
BetaJ	36						
BetaJ	38				1		
BetaJ	41						
BetaJ	43						
BetaJ	45						
BetaJ	48						
BetaJ	60						
BetaJ	61						
BetaJ	62						
BetaJ	63					1	
BetaJ	64						
BetaJ	65						
BetaJ	66	1				1	
BetaJ	67						
BetaJ	68						
BetaJ	69					1	
BetaJ	71						
BetaJ	04\06						
BetaJ	07\08						
BetaJ	12\33						
BetaJ	24\25						

BETA TEST BY SUBJECT

Appendix E

This page intentionally left blank

Appendix E

Beta Subject A

1	86	2	0	2	0	6	2	0	3	4	5	0	0	0	0	0	6	0	0	0	0	3	0	0	0	0	3	10	14	6
2	103	3	3	5	0	3	5	2	3	4	5	0	0	2	0	0	6	0	0	0	0	3	0	2	0	0	0	14	19	8
4	114	1	3	0	2	3	2	1	0	0	3	0	0	0	3	0	2	0	0	0	0	0	0	2	0	2	2	9	6	5
4	119	3	3	0	5	6	5	0	0	0	5	0	0	1	1	0	6	0	0	0	0	3	2	1	0	3	2	19	10	8
7	68	1	2	0	2	3	2	0	0	3	3	0	0	0	1	0	2	0	0	0	0	0	2	2	0	0	2	8	8	3
7	119	3	3	0	5	6	5	1	0	4	5	0	0	0	2	0	6	0	0	0	0	0	5	5	0	0	3	17	15	8
9	71	1	2	0	2	3	2	0	0	0	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	8	5	2
9	100	1	0	0	2	3	0	0	0	0	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	6	3	2
9	104	1	0	0	0	3	2	0	0	1	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4	6	2
12	86	1	2	2	0	3	2	0	0	1	3	0	0	0	1	0	2	0	0	0	0	2	0	0	0	2	2	8	6	3
12	110	1	1	0	1	3	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	2	2	6	1	2
18	84	1	1	0	1	3	2	1	0	3	0	0	0	1	1	0	2	0	0	0	0	1	0	0	0	0	2	6	6	4
18	99	1	1	0	0	3	2	1	0	3	1	0	0	1	0	0	2	0	0	0	0	2	0	0	0	0	0	5	7	3
18	114	1	0	0	0	3	2	1	0	0	0	0	0	1	1	0	2	0	0	0	0	2	0	0	0	0	2	4	3	4
19	84	3	1	1	0	3	5	2	3	4	2	0	0	3	1	2	6	0	0	0	0	0	2	5	0	3	0	8	16	12
19	99	1	1	1	0	2	2	1	0	3	0	0	0	2	1	1	2	0	0	0	0	0	1	2	0	2	0	5	6	6
20	71	2	0	0	0	6	5	1	0	0	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	3	8	6	6
21	73	3	0	0	0	3	5	1	0	0	0	5	0	0	0	0	6	0	0	0	0	0	0	0	0	0	3	6	11	6
23	131	1	1	0	0	0	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	1	0	0	1	2	0	3
24	79	1	1	0	0	2	1	0	1	1	3	2	0	2	1	0	2	0	0	0	0	2	0	0	0	0	0	4	8	5
24	103	3	4	5	0	1	5	0	3	4	5	5	0	2	0	0	6	0	0	0	0	3	5	5	0	0	0	13	22	8
35	86	1	0	0	0	3	2	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	2	2	0	0	0	4	4	2
35	116	1	2	0	0	3	2	0	1	0	0	0	0	0	0	0	2	0	0	0	0	2	2	2	0	0	0	6	3	2
36	83	1	0	0	0	3	1	0	1	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	2	4	2	2
36	86	1	3	2	1	3	1	0	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	1	10	4	2
36	116	1	0	0	0	3	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	2	4	1	2
38	70	0	0	0	0	3	1	0	0	3	3	0	0	0	0	0	2	0	0	0	2	2	0	0	0	0	0	3	7	4
38	81	1	3	1	2	2	2	0	0	0	0	0	0	2	1	3	0	2	0	0	0	0	0	1	0	0	0	9	2	8
41	87	3	3	0	5	6	5	0	0	4	5	0	0	2	0	0	6	0	0	0	0	3	0	0	0	0	3	17	14	8
41	94	1	3	2	2	3	0	0	0	3	3	0	0	0	0	0	2	0	0	0	0	2	0	2	0	0	0	11	6	2
43	79	1	3	0	0	3	2	0	1	1	0	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	0	7	4	4
43	87	3	0	0	5	6	0	2	0	0	5	0	0	1	0	0	6	0	0	0	0	3	0	0	0	0	0	14	7	7
45	105	3	4	0	0	6	0	0	0	0	5	0	0	0	0	0	6	0	0	0	0	3	5	5	0	0	0	13	5	6
48	77	3	0	0	0	2	2	0	1	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	3	6	2

48	87	1	0	0	0	0	2	0	0	0	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	1	5	2
48	91	4	2	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4	2	0
60	86	1	3	0	0	3	0	0	1	0	3	0	0	2	3	0	1	0	0	0	0	1	2	2	0	0	0	7	4	6
60	100	1	2	0	0	3	1	0	1	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	6	3	2
60	104	1	0	0	0	3	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4	1	0
60	131	1	0	0	0	3	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4	1	2
60	132	1	3	0	0	2	1	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	6	2	2
61	126	3	1	5	0	6	2	0	0	4	0	1	0	1	2	0	2	0	0	0	0	2	2	1	0	0	3	14	7	5
62	72	3	0	5	0	6	1	0	3	4	0	0	0	0	0	0	6	0	0	0	0	3	0	0	0	0	0	14	8	6
63	66	3	3	0	0	6	1	0	0	0	5	2	0	0	1	0	6	0	0	0	0	3	0	0	0	0	2	12	8	7
63	100	1	0	0	0	3	0	0	1	0	3	2	0	1	0	0	2	0	0	0	0	2	0	0	0	0	2	4	6	3
63	121	1	0	1	0	3	0	0	0	0	0	0	0	1	0	0	1	0	5	0	0	1	0	0	0	0	0	5	0	7
64	87	1	3	2	2	1	2	0	0	3	3	0	0	2	0	3	0	0	0	0	0	0	0	2	0	0	0	9	8	5
65	86	1	2	0	0	2	1	0	1	3	0	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	2	5	5	4
65	116	1	1	0	0	3	2	0	0	0	0	2	0	0	0	0	2	0	0	0	0	2	0	0	1	0	2	5	4	2
65	130	1	0	0	0	3	2	0	1	0	0	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	2	4	3	4
66	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0
66	123	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	2	1
66	124	1	3	0	2	3	2	1	0	0	1	2	0	0	0	0	2	0	0	0	0	2	0	0	0	1	2	9	6	2
66	125	1	0	0	0	2	0	0	0	3	3	2	0	0	0	0	2	0	0	0	0	2	0	0	1	0	2	3	8	2
67	119	3	3	5	5	6	5	0	1	4	5	2	0	0	2	0	6	2	0	0	0	3	0	0	0	3	0	22	12	10
68	121	3	4	0	0	6	2	2	0	0	0	5	0	0	4	0	2	0	0	0	0	1	5	1	0	0	0	13	9	6
69	121	1	3	1	2	2	2	0	0	1	3	0	0	0	0	0	2	2	4	0	0	2	1	2	0	0	0	9	6	8
71	122	1	3	0	0	3	1	0	0	1	1	0	0	1	1	0	2	3	0	0	0	2	0	1	0	0	1	7	3	7
71	123	1	2	0	0	2	2	1	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	5	5	2

Scenario	Task	LF Score	HE Score	SN Rating	HWA Rating	BT Rating	LF Rating	HE Rating
1	86	3	3	3	3	2	1	1
2	103	5	0	3	3	3	2	0
4	114	2	4	3	2	2	1	2
4	119	6	5	3	3	3	2	2
7	68	4	2	3	3	2	2	1
7	119	10	3	3	3	3	3	1
9	71	0	0	3	2	1	1	1
9	100	0	0	2	1	1	1	1
9	104	2	0	2	2	1	1	1
12	86	2	4	3	2	1	1	2
12	110	2	4	2	1	1	1	2
18	84	1	2	2	2	2	1	1
18	99	2	0	2	2	1	1	1
18	114	2	2	2	1	2	1	1
19	84	7	3	3	3	3	2	1
19	99	3	2	2	2	2	1	1
20	71	0	3	3	2	2	1	1
21	73	0	3	2	3	2	1	1
23	131	1	1	1	1	1	1	1
24	79	2	0	2	3	2	1	1
24	103	13	0	3	3	3	3	1
35	86	4	0	2	2	1	2	1
35	116	6	0	2	1	1	2	1
36	83	2	2	2	1	1	1	1
36	86	2	1	3	2	1	1	1
36	116	2	2	2	1	1	1	1
38	70	2	0	1	2	2	1	1
38	81	1	0	3	1	3	1	1
41	87	3	3	3	3	3	1	1
41	94	4	0	3	2	1	2	1
43	79	2	0	2	2	2	1	1
43	87	3	0	3	2	2	1	1
45	105	13	0	3	2	2	3	1
48	77	2	0	1	2	1	1	1

Scenario	Task	LF Score	HE Score	SN Rating	HWA Rating	BT Rating	LF Rating	HE Rating
48	87	2	0	1	2	1	1	1
48	91	2	0	2	1	1	1	1
60	86	5	0	3	2	2	2	1
60	100	2	0	2	1	1	1	1
60	104	0	0	2	1	1	1	1
60	131	2	0	2	1	1	1	1
60	132	2	0	2	1	1	1	1
61	126	5	3	3	2	2	2	1
62	72	3	0	3	3	2	1	1
63	66	3	2	3	3	2	1	1
63	100	2	2	2	2	1	1	1
63	121	1	0	2	1	2	1	1
64	87	2	0	3	3	2	1	1
65	86	2	2	2	2	2	1	1
65	116	3	2	2	2	1	1	1
65	130	2	2	2	1	2	1	1
66	95	0	2	1	2	1	1	1
66	123	0	0	1	2	1	1	1
66	124	2	3	3	2	1	1	1
66	125	3	2	1	3	1	1	1
67	119	3	3	3	3	3	1	1
68	121	7	0	3	3	2	2	1
69	121	5	0	3	2	3	2	1
71	122	3	1	2	1	2	1	1
71	123	0	2	2	2	1	1	1

Beta Subject B

1	86	3	0	5	0	6	5	0	3	4	5	0	0	0	0	0	6	0	0	0	0	3	0	0	0	0	0	14
2	103	3	0	5	1	1	0	0	3	4	5	5	0	3	0	0	6	0	0	0	0	3	0	5	0	0	3	10
4	114	1	2	0	0	0	1	1	1	3	0	1	0	0	0	0	1	0	0	0	0	1	0	1	0	0	0	3
4	119	2	3	0	0	0	5	0	3	2	0	0	0	0	0	0	2	0	0	0	0	3	0	1	0	0	0	5
7	68	1	0	1	0	3	1	0	1	1	0	0	0	0	0	0	2	0	0	0	0	0	2	0	0	0	0	5
7	119	3	0	2	0	6	2	0	3	2	0	1	0	0	0	0	6	0	0	0	0	0	5	0	0	1	0	11
9	71	1	0	0	0	0	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	2	0	0	0	1
9	100	1	0	0	0	0	2	0	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	2	0	0	0	1
9	104	1	0	2	0	0	1	0	0	3	3	0	0	0	0	0	2	0	0	0	0	2	0	2	0	0	0	3
12	86	1	0	1	0	1	1	0	1	3	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	2	2	3
12	110	1	0	0	0	1	2	0	1	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	2	1	2
18	84	1	1	1	0	0	2	0	0	1	3	1	0	0	0	1	2	0	0	0	0	2	2	0	0	0	0	3
18	99	1	0	1	0	0	1	0	0	1	1	1	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	2
18	114	1	0	1	0	0	0	0	0	1	1	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	2
19	84	3	0	2	0	1	2	0	0	4	0	0	0	2	2	0	6	3	0	0	0	2	0	5	0	3	1	6
19	99	1	0	2	0	2	1	0	0	3	0	0	0	1	1	0	2	2	0	0	0	1	0	2	0	2	0	5
20	71	3	0	0	0	6	2	0	0	4	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0	2	3	9
21	73	3	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	5	0	0	3	3	4
23	131	1	0	1	0	1	0	0	0	1	0	1	0	1	0	0	1	2	0	0	0	2	0	2	1	1	0	3
24	79	1	0	2	0	2	2	0	1	3	3	0	0	0	0	0	2	0	0	0	0	2	0	2	0	1	0	5
24	103	3	0	5	0	3	5	0	3	4	5	5	0	1	0	0	6	0	0	0	0	3	0	5	0	2	0	11
35	86	1	0	2	0	3	0	0	1	3	0	0	0	0	0	0	1	0	0	0	0	1	2	2	0	0	0	6
35	116	1	0	0	0	3	2	0	1	3	3	1	0	0	0	0	2	0	0	0	0	1	2	2	0	0	0	4
36	83	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	4
36	86	1	0	2	0	1	2	0	1	3	3	0	0	0	0	0	1	0	0	0	0	2	0	0	0	1	1	4
36	116	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	1	0	2	2	2
38	70	1	0	2	0	3	0	0	0	3	3	0	1	1	0	0	2	0	0	0	2	2	0	0	0	0	0	6
38	81	0	2	2	0	0	0	0	0	3	3	0	1	1	0	3	0	2	0	0	0	0	0	0	0	0	0	4
41	87	3	0	0	5	0	2	0	0	4	5	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	8
41	94	1	0	2	2	0	1	0	0	3	3	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	5
43	79	1	0	1	0	0	2	0	1	3	0	0	0	0	0	0	2	0	0	0	0	2	1	0	0	0	0	2
43	87	2	0	0	5	0	0	0	0	4	5	0	2	0	0	0	2	0	0	0	0	3	2	0	0	0	0	7
45	105	3	0	0	0	6	0	0	3	4	0	0	0	0	0	0	6	0	0	0	0	3	5	0	0	0	0	9
48	77	1	0	0	0	1	2	0	1	3	3	2	0	2	0	0	2	0	0	0	0	2	2	0	0	0	0	2

48	87	1	0	0	2	2	1	0	0	3	3	0	0	2	0	0	2	0	0	0	0	2	2	0	0	0	0	5
48	91	1	0	1	0	1	0	0	0	1	0	0	0	1	1	0	2	0	0	0	0	1	2	0	0	0	0	3
60	86	1	3	2	0	1	1	0	0	0	3	0	0	1	1	0	1	0	0	0	0	2	0	1	0	0	0	7
60	100	1	2	0	0	2	2	0	1	3	0	0	0	1	1	1	2	2	0	0	0	2	0	1	0	0	0	5
60	104	1	2	2	0	2	1	0	0	1	3	0	0	1	1	0	1	0	0	0	0	2	0	1	0	0	0	7
60	131	1	2	0	0	2	1	0	0	1	0	0	0	1	1	0	1	0	0	0	0	2	0	1	0	0	0	5
60	132	1	2	0	0	1	1	0	1	3	1	0	0	1	0	0	1	0	0	0	0	2	0	1	0	0	0	4
61	126	3	0	5	2	6	2	0	3	4	5	0	0	2	2	0	1	4	0	0	4	3	2	2	0	2	0	16
62	72	3	3	5	0	3	0	0	1	4	5	0	0	0	0	0	2	0	0	0	0	3	0	1	0	0	0	14
63	66	3	0	5	0	3	2	0	3	4	5	0	0	0	0	0	2	0	0	0	0	3	0	0	0	0	0	11
63	100	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	2
63	121	1	0	1	0	2	1	0	0	3	0	1	0	1	0	0	2	2	5	0	0	2	0	0	0	1	0	4
64	87	0	1	2	1	2	1	0	0	3	1	0	0	0	0	0	0	0	4	0	0	2	0	0	0	0	0	6
65	86	1	0	0	0	1	1	0	1	3	3	0	1	0	0	0	0	0	0	0	0	2	0	0	2	2	1	2
65	116	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	1	0	1	2	1	2
65	130	1	0	0	0	3	1	0	1	3	0	0	1	0	0	0	1	0	0	0	0	2	0	0	2	2	2	4
66	95	1	0	0	0	3	2	0	0	1	0	0	0	1	0	1	1	0	0	0	0	2	0	2	0	1	0	4
66	123	1	0	0	0	2	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	2	1	3
66	124	1	0	0	0	1	1	1	0	0	0	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	2
66	125	1	2	2	0	2	2	0	0	1	0	0	0	1	0	0	1	0	0	0	0	2	0	0	1	2	0	7
67	119	3	0	5	0	3	2	0	0	0	0	5	0	3	2	0	6	0	6	0	0	3	0	2	0	3	0	11
68	121	1	4	0	0	6	2	0	0	2	0	0	0	1	0	0	6	0	0	0	0	3	0	0	0	3	1	11
69	121	1	3	0	0	2	1	0	1	3	0	2	0	2	0	0	2	0	0	0	0	2	0	2	0	1	0	6
71	122	1	1	0	0	2	1	0	0	1	0	0	0	1	1	0	1	2	0	0	0	2	0	1	0	0	2	4
71	123	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1

1	86	17	6	3	0	3	3	2	1	1
2	103	17	9	8	3	3	3	3	3	1
4	114	7	1	2	0	1	3	1	1	1
4	119	10	2	4	0	2	3	1	2	1
7	68	3	2	2	0	2	2	1	1	1
7	119	8	6	5	1	3	3	2	2	1
9	71	2	2	4	0	1	1	1	2	1
9	100	5	2	4	0	1	2	1	2	1
9	104	7	2	4	0	1	2	1	2	1
12	86	8	2	2	4	1	3	1	1	2
12	110	6	2	2	3	1	2	1	1	1
18	84	7	3	4	0	1	2	1	2	1
18	99	4	1	2	0	1	2	1	1	1
18	114	3	1	1	0	1	1	1	1	1
19	84	6	13	7	4	2	2	3	2	2
19	99	4	6	3	3	2	2	2	1	1
20	71	11	0	0	5	3	3	1	1	2
21	73	4	0	5	6	2	2	1	2	2
23	131	2	4	5	1	1	1	2	2	1
24	79	9	2	4	1	2	3	1	2	1
24	103	22	7	8	2	3	3	2	3	1
35	86	4	1	5	0	2	2	1	2	1
35	116	10	2	5	0	2	3	1	2	1
36	83	1	1	2	0	2	1	1	1	1
36	86	9	1	2	2	2	3	1	1	1
36	116	1	2	3	4	1	1	1	1	2
38	70	7	5	2	0	2	2	2	1	1
38	81	7	5	0	0	2	2	2	1	1
41	87	11	0	3	0	3	3	1	1	1
41	94	9	0	2	0	2	3	1	1	1
43	79	6	2	3	0	1	2	1	1	1
43	87	11	2	5	0	2	3	1	2	1
45	105	7	6	8	0	3	2	2	3	1
48	77	11	4	4	0	1	3	2	2	1

48	87	7	4	4	0	2	2	2	2	1
48	91	1	4	3	0	1	1	2	1	1
60	86	4	3	3	0	2	2	1	1	1
60	100	6	7	3	0	2	2	2	1	1
60	104	5	3	3	0	2	2	1	1	1
60	131	2	3	3	0	2	1	1	1	1
60	132	6	2	3	0	2	2	1	1	1
61	126	14	13	7	2	3	3	3	2	1
62	72	10	2	4	0	3	3	1	2	1
63	66	14	2	3	0	3	3	1	1	1
63	100	0	1	2	0	1	1	1	1	1
63	121	5	10	2	1	2	2	3	1	1
64	87	5	4	2	0	2	2	2	1	1
65	86	9	0	2	3	1	3	1	1	1
65	116	1	0	4	3	1	1	1	2	1
65	130	6	1	2	4	2	2	1	1	2
66	95	3	3	4	1	2	1	1	2	1
66	123	3	2	2	3	1	1	1	1	1
66	124	3	2	0	0	1	1	1	1	1
66	125	3	2	3	2	2	1	1	1	1
67	119	7	17	5	3	3	2	3	2	1
68	121	4	7	3	4	3	2	2	1	2
69	121	7	4	4	1	2	2	2	2	1
71	122	2	5	3	2	2	1	2	1	1
71	123	1	1	0	2	1	1	1	1	1

Beta Subject C

Subject	Trial	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	SNIScore
1	86	0	0	5	0	6	5	0	3	4	2	2	0	0	0	0	6	0	0	0	0	3	0	0	0	0	3	11
2	103	3	0	5	2	6	5	2	3	4	5	5	0	3	2	0	6	0	0	0	0	3	0	2	0	0	0	16
4	114	0	3	0	2	3	2	1	1	3	3	0	0	2	0	0	2	0	0	0	0	0	0	0	0	2	0	8
4	119	3	4	5	0	6	5	0	0	4	2	5	0	0	0	0	6	0	0	0	0	3	0	0	0	3	0	18
7	68	1	0	2	2	3	2	0	1	3	3	1	0	2	3	0	2	0	0	0	0	0	2	2	0	0	0	8
7	119	0	0	5	5	6	5	0	0	4	5	5	0	3	1	0	6	0	0	0	0	0	5	5	0	0	0	16
9	71	1	0	0	2	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	1	0	0	0	6
9	100	1	0	0	0	3	2	0	1	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4
9	104	1	0	2	0	3	2	0	1	3	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	6
12	86	0	0	2	0	3	2	0	1	3	3	0	0	0	1	0	2	0	0	0	0	2	0	0	0	2	0	5
12	110	1	0	0	2	3	1	0	0	3	1	0	0	0	0	0	2	0	0	0	0	2	2	2	0	2	0	6
18	84	1	0	0	0	3	2	1	0	3	0	0	0	0	0	0	2	0	0	0	0	2	2	2	0	0	1	4
18	99	1	3	0	1	3	2	1	1	3	0	0	0	0	1	0	2	0	0	0	0	2	0	2	0	0	0	8
18	114	1	0	0	0	3	2	1	0	3	0	0	0	0	0	0	2	0	0	0	0	2	2	2	0	0	2	4
19	84	3	0	5	5	6	5	0	0	2	5	0	0	3	4	4	6	4	0	0	0	3	5	5	0	3	0	19
19	99	1	0	2	2	3	2	0	0	3	3	0	0	2	1	0	2	2	0	1	0	2	1	2	0	2	0	8
20	71	0	0	0	0	6	5	2	0	4	0	5	0	0	1	0	6	0	0	0	0	0	0	0	0	0	0	6
21	73	0	0	0	0	6	5	2	0	4	0	0	0	0	0	0	6	0	0	0	0	0	5	0	0	0	3	6
23	131	0	0	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	3
24	79	0	0	2	0	1	2	0	1	3	3	2	0	2	0	0	2	0	0	0	0	1	1	1	0	0	0	3
24	103	3	0	5	0	3	5	0	3	4	5	5	0	3	0	0	6	0	0	0	0	1	5	5	0	0	0	11
35	86	1	0	0	0	3	2	0	1	3	0	2	0	2	0	0	1	0	0	0	0	0	2	2	0	0	1	4
35	116	1	0	0	0	3	2	0	1	3	0	2	0	2	0	0	2	0	0	0	0	1	2	2	0	2	2	4
36	83	0	0	0	0	3	2	0	1	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	2	3
36	86	0	3	2	1	3	2	0	1	3	3	1	0	1	0	0	2	0	0	0	0	2	0	0	0	0	2	9
36	116	1	0	0	0	3	2	0	1	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	2	4
38	70	1	0	2	2	3	2	0	1	0	3	0	0	0	0	1	2	0	0	0	2	2	0	0	0	0	0	8
38	81	1	1	2	2	3	2	0	0	3	3	0	0	2	1	0	2	3	0	0	0	0	0	2	0	0	0	9
41	87	3	0	5	5	6	5	0	0	4	5	1	0	2	0	0	6	0	0	0	0	3	0	0	0	0	0	19
41	94	1	0	2	2	3	2	0	0	3	3	2	0	0	0	0	2	0	0	0	0	2	0	1	0	0	0	8
43	79	1	0	1	0	3	2	1	1	3	3	1	0	2	0	0	2	0	0	0	0	2	0	0	0	0	0	15
43	87	3	0	1	5	6	5	2	0	2	5	2	0	3	0	0	6	0	0	0	0	3	0	5	0	0	0	15
45	105	3	0	5	5	6	2	0	0	4	5	5	0	2	0	0	6	0	0	0	0	3	5	5	0	0	1	19
48	77	1	0	0	0	3	2	0	1	3	0	2	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4

Scan No	GSR	A	B	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	SN Seed
48	87	1	0	2	2	3	2	0	0	3	3	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	8
48	91	1	0	1	0	3	2	0	0	1	0	2	0	2	3	0	2	0	0	0	0	2	0	0	0	0	5
60	86	1	3	2	2	3	2	0	1	3	3	0	0	2	0	0	2	0	0	0	0	2	1	1	0	0	11
60	100	1	0	2	0	3	2	0	1	3	0	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	6
60	104	1	3	2	0	3	2	0	1	3	3	0	0	2	3	0	2	0	0	0	0	2	2	2	0	0	9
60	131	1	3	0	0	3	2	1	0	1	0	0	0	2	3	0	2	0	0	0	0	2	2	0	0	0	7
60	132	0	3	0	2	3	2	0	1	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	8
61	126	2	3	5	5	6	5	0	3	4	0	0	0	3	4	0	6	0	0	0	0	1	2	2	0	0	21
62	72	3	4	5	0	6	5	0	3	4	5	5	0	0	1	0	6	2	0	0	0	3	0	0	0	0	18
63	66	2	3	2	2	6	5	0	3	4	5	5	0	0	0	0	6	0	0	0	0	3	0	5	0	0	15
63	100	0	0	0	0	3	2	0	0	0	0	1	0	0	0	0	2	0	0	0	0	2	0	0	0	0	3
63	121	1	0	2	1	3	0	0	0	3	0	0	0	2	3	3	1	0	6	0	0	0	0	2	0	0	7
64	87	0	0	2	2	3	0	0	0	0	3	0	0	2	0	3	0	0	5	0	0	0	0	2	0	0	7
65	86	0	0	0	0	3	2	0	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	2	3
65	116	1	0	0	0	3	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	2	4
65	130	0	0	0	0	3	2	0	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	2	3
66	95	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0
66	123	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	1
66	124	0	2	0	0	3	2	1	0	3	0	2	0	1	1	0	1	0	0	0	0	1	2	1	0	0	2
66	125	0	3	0	0	3	2	0	0	3	0	2	0	0	0	0	2	0	0	0	0	2	1	2	1	2	2
67	119	3	0	5	5	6	5	0	0	2	5	5	1	3	0	0	6	0	0	0	0	3	0	2	0	3	2
68	121	0	4	0	0	6	5	2	1	0	0	5	0	3	4	0	6	0	0	0	0	3	5	0	0	0	0
69	121	1	3	2	1	3	2	0	0	3	1	2	0	2	1	3	2	2	0	0	0	2	0	2	0	0	0
71	122	0	3	1	0	3	2	1	0	3	0	1	0	1	0	0	1	0	6	0	0	2	0	0	0	0	0
71	123	0	0	0	0	3	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1

Scenario	Task	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating	BT Rating	LF Rating	HE Rating
1	86	16	6	3	3	3	3	2	1	1
2	103	24	11	5	0	3	3	3	2	1
4	114	10	4	0	2	3	3	2	1	1
4	119	16	6	3	3	3	3	2	1	1
7	68	10	7	4	0	3	3	2	2	1
7	119	19	10	10	0	3	3	3	3	1
9	71	0	2	3	0	2	1	1	1	1
9	100	6	2	2	0	2	2	1	1	1
9	104	9	2	2	0	2	3	1	1	1
12	86	9	3	2	2	2	3	1	1	1
12	110	5	2	6	2	2	2	1	2	1
18	84	6	2	6	1	2	2	1	2	1
18	99	7	3	4	0	3	2	1	2	1
18	114	6	2	6	2	2	2	1	2	1
19	84	12	21	13	3	3	3	3	3	1
19	99	8	8	5	2	3	3	3	2	1
20	71	16	7	0	0	2	3	2	1	1
21	73	11	6	5	3	2	3	2	2	1
23	131	0	1	0	2	1	1	1	1	1
24	79	11	4	3	0	2	3	2	2	1
24	103	22	9	11	0	3	3	3	3	1
35	86	8	3	4	1	2	3	1	2	1
35	116	6	4	5	4	2	2	2	2	2
36	83	3	2	2	2	1	1	1	1	1
36	86	10	3	2	2	3	3	1	1	1
36	116	4	2	2	2	2	2	1	1	1
38	70	6	5	2	0	3	2	2	1	1
38	81	8	8	2	0	3	3	3	1	1
41	87	15	8	3	0	3	3	3	1	1
41	94	10	2	3	0	3	3	1	1	1
43	79	11	4	2	0	2	3	2	1	1
43	87	16	9	8	0	3	3	3	3	1
45	105	16	8	13	1	3	3	3	3	1
48	77	8	2	2	0	2	3	1	1	1

Scenario	Task	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating	BT Rating	LF Rating	HE Rating
48	87	8	4	2	0	3	3	2	1	1
48	91	5	7	2	0	2	2	2	1	1
60	86	9	4	4	0	3	3	2	2	1
60	100	6	4	2	0	2	2	2	1	1
60	104	9	7	6	0	3	3	2	2	1
60	131	4	7	4	0	2	2	2	2	1
60	132	3	2	2	0	3	1	1	1	1
61	126	12	13	5	0	3	3	3	2	1
62	72	22	9	3	0	3	3	3	1	0
63	66	22	6	8	3	3	3	2	3	1
63	100	3	2	2	0	1	1	1	1	1
63	121	3	15	2	0	2	1	3	1	1
64	87	3	10	2	0	2	1	3	1	1
65	86	5	2	2	4	1	2	1	1	2
65	116	2	2	2	4	2	1	1	1	2
65	130	5	2	2	4	1	2	1	1	2
66	95	0	0	2	1	1	1	1	1	1
66	123	1	2	2	2	1	1	1	1	1
66	124	9	3	4	2	2	3	1	2	1
66	125	7	2	6	4	2	2	1	2	2
67	119	18	9	5	5	3	3	3	2	2
68	121	13	13	8	0	3	3	3	3	1
69	121	8	10	4	0	3	3	3	2	1
71	122	7	8	2	0	2	2	3	1	1
71	123	3	0	0	1	1	1	1	1	1

Beta Subject D

1	86	3	0	1	1	1	0	0	3	1	5	1	2	2	1	0	6	2	0	0	0	3	1	0	0	0	3	6
2	103	3	3	5	0	6	5	2	3	4	5	0	2	3	0	0	6	0	0	0	0	3	0	5	0	0	2	17
4	114	1	3	0	0	3	2	1	0	3	3	2	0	2	0	0	2	0	0	0	0	1	2	1	0	1	1	7
4	119	3	4	0	0	6	5	2	0	4	1	5	0	3	0	0	6	0	0	0	0	3	2	2	0	2	2	13
7	68	1	0	0	2	3	2	1	0	1	0	2	0	2	0	0	2	0	0	0	0	1	2	2	0	1	1	6
7	119	3	0	0	5	6	5	2	1	2	2	5	0	3	0	0	6	0	0	0	0	2	5	5	0	2	2	14
9	71	1	0	0	0	3	2	0	0	3	0	0	0	2	1	0	2	0	0	0	0	2	2	1	0	0	1	4
9	100	1	0	0	0	3	2	0	1	3	0	0	1	2	1	0	2	0	0	0	0	2	2	1	0	0	1	4
9	104	1	0	0	0	3	2	0	1	3	3	0	1	2	3	0	2	0	0	0	0	2	2	1	0	0	1	4
12	86	1	1	1	0	2	0	0	1	0	3	2	1	0	0	0	2	0	0	0	0	2	1	1	0	2	2	5
12	110	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	1	0	0	2	2	2
18	84	1	2	0	0	3	0	1	0	3	1	0	0	2	1	0	2	0	0	0	0	2	1	0	0	0	1	6
18	99	1	3	0	0	3	0	0	0	1	0	0	0	0	1	0	2	2	0	0	0	2	2	1	0	0	1	7
18	114	1	0	0	1	3	2	1	0	3	3	1	0	0	0	0	2	0	0	0	0	2	2	0	0	0	2	5
19	84	3	0	0	5	6	5	2	0	0	5	0	0	3	2	2	6	3	0	3	0	3	5	5	0	3	2	14
19	99	1	0	0	2	3	2	1	0	0	3	0	0	2	1	1	2	2	0	2	0	2	2	2	0	2	1	6
20	71	3	0	0	5	6	5	0	1	4	0	0	0	3	4	0	6	0	0	0	0	0	0	0	0	0	1	14
21	73	3	0	0	0	6	5	2	0	4	0	2	0	3	0	0	6	0	0	0	0	0	5	0	0	0	3	9
23	131	1	0	1	0	3	0	0	0	0	0	0	0	2	1	3	2	2	6	0	0	2	2	2	0	0	0	5
24	79	1	2	2	0	3	2	0	1	3	3	2	1	2	0	0	2	0	0	0	0	2	2	2	0	0	1	8
24	103	3	4	5	0	6	5	2	3	4	5	5	2	2	0	2	6	3	0	0	0	3	5	5	0	0	2	18
35	86	1	0	0	0	3	2	0	0	3	3	1	1	2	3	3	2	0	0	0	0	1	2	2	0	0	1	4
35	116	1	2	0	0	3	2	0	1	0	0	1	0	2	3	3	2	0	0	0	0	2	2	2	0	0	1	6
36	83	1	0	0	0	3	2	1	1	3	0	1	0	1	1	0	2	0	0	0	0	2	1	0	0	0	2	4
36	86	1	2	2	0	3	0	0	1	3	3	2	1	2	1	0	2	0	0	0	0	2	1	0	0	0	1	8
36	116	1	0	0	1	3	2	0	0	0	0	2	0	2	1	0	2	0	0	0	0	2	1	0	0	0	2	5
38	70	1	0	2	1	3	2	0	1	3	3	2	1	1	0	0	2	3	0	0	2	2	0	1	0	0	1	7
38	81	1	3	0	0	3	1	0	0	0	0	2	0	2	1	0	2	3	0	0	0	2	0	1	0	0	1	7
41	87	3	4	5	5	6	5	0	0	4	5	5	0	3	2	0	6	0	0	0	0	3	2	2	0	0	2	23
41	94	1	3	2	2	3	2	0	0	3	3	2	0	2	1	0	2	0	0	0	0	2	1	1	0	0	1	11
43	79	1	1	0	0	3	2	0	1	3	1	1	0	1	0	1	2	0	0	0	0	2	2	0	0	0	1	5
43	87	3	0	0	5	6	2	1	0	4	2	5	0	2	0	2	6	0	0	0	0	3	5	0	0	0	2	14
45	105	3	0	0	0	6	0	0	0	2	5	0	0	3	2	0	6	0	0	0	0	3	5	0	0	0	1	9
48	77	1	2	0	0	3	2	0	1	3	0	2	0	1	1	0	2	0	0	0	0	2	1	0	0	0	1	6

48	87	1	0	0	0	3	2	0	0	0	1	1	0	0	0	0	2	0	0	0	0	2	1	0	0	0	1	4
48	91	1	2	0	0	3	1	0	0	3	0	2	0	0	0	0	2	0	0	0	0	2	1	0	1	0	1	6
60	86	1	3	1	0	3	2	0	1	3	3	1	1	2	0	0	2	3	0	0	0	2	1	2	0	0	1	8
60	100	1	3	0	0	3	2	0	1	3	3	2	1	2	1	0	2	3	0	0	0	2	1	2	0	0	1	7
60	104	1	3	0	0	3	2	0	1	3	3	2	1	2	1	0	2	3	0	0	0	2	1	2	0	0	1	7
60	131	1	2	0	0	3	2	0	0	0	0	0	0	2	1	0	2	0	0	0	0	2	1	2	0	0	1	6
60	132	1	3	0	0	3	2	0	1	3	3	1	1	2	0	0	2	3	0	0	0	2	1	2	0	0	0	7
61	126	3	4	0	0	6	5	0	3	4	0	2	2	3	0	0	6	0	0	0	0	3	2	2	0	0	1	13
62	72	3	3	2	0	6	1	0	3	4	5	0	2	2	1	0	6	0	0	0	0	3	1	1	0	0	0	14
63	66	3	4	0	0	6	2	0	3	4	5	5	2	0	0	0	6	0	0	0	0	3	0	0	0	0	2	13
63	100	1	0	0	0	3	0	0	1	3	0	2	0	2	0	0	2	2	0	0	0	2	2	0	0	0	1	4
63	121	1	0	2	0	3	2	0	1	0	0	0	0	2	3	3	2	3	6	0	0	2	0	2	0	0	1	6
64	87	1	3	2	2	3	0	0	0	3	3	2	0	2	3	3	2	2	5	0	0	1	0	0	0	0	0	11
65	86	1	2	0	0	3	2	0	1	3	3	0	1	2	0	0	2	0	0	0	0	2	2	1	0	1	1	6
65	116	1	0	0	0	3	1	0	0	1	0	2	0	2	0	0	2	0	0	0	0	2	1	1	0	2	2	4
65	130	1	2	0	1	3	1	0	0	0	1	1	0	2	0	0	2	0	0	0	0	2	1	1	0	2	2	7
66	95	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	2
66	123	1	0	0	0	3	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	1	0	0	0	0	4
66	124	1	0	0	0	3	2	0	0	0	0	0	0	2	3	3	2	0	0	0	0	2	2	1	0	2	1	4
66	125	1	0	0	0	3	1	0	0	3	0	0	1	1	0	0	2	0	0	0	0	2	2	1	1	0	1	4
67	119	3	4	5	2	6	5	2	1	4	2	5	1	2	2	1	2	3	4	0	0	3	2	5	0	3	3	20
68	121	2	4	2	0	3	5	2	0	0	2	5	0	2	2	4	6	3	4	0	0	3	5	2	0	0	1	11
69	121	1	3	0	2	3	2	1	1	3	1	2	0	2	1	1	2	3	0	0	0	2	1	2	0	1	1	9
71	122	1	3	1	1	3	2	1	0	0	0	0	0	1	1	1	2	2	6	0	0	2	2	2	0	0	1	9
71	123	1	0	0	0	3	2	1	1	0	0	0	0	1	0	0	2	0	0	0	0	0	2	0	0	0	1	4

1	86	12	11	4	3	2	3	3	2	1
2	103	21	9	8	2	3	3	3	3	1
4	114	11	4	4	2	2	3	2	2	1
4	119	17	9	7	4	3	3	3	2	2
7	68	6	4	5	2	2	2	2	2	1
7	119	17	9	12	4	3	3	3	3	2
9	71	5	5	5	1	2	2	2	2	1
9	100	7	8	5	1	2	2	3	2	1
9	104	10	7	5	1	2	3	2	2	1
12	86	7	2	4	4	2	2	1	2	2
12	110	0	2	3	4	1	1	1	1	2
18	84	5	5	3	1	2	2	2	1	1
18	99	1	5	5	1	2	1	2	2	1
18	114	10	2	4	2	2	3	1	2	1
19	84	12	19	13	5	3	3	3	3	2
19	99	6	10	6	3	2	2	3	2	1
20	71	10	13	0	1	3	3	3	1	1
21	73	13	9	5	3	3	3	3	2	1
23	131	0	16	6	0	2	1	3	2	1
24	79	12	4	6	1	3	3	2	2	1
24	103	26	13	13	2	3	3	3	3	1
35	86	10	10	5	1	2	3	3	2	1
35	116	4	10	6	1	2	2	3	2	1
36	83	8	4	3	2	2	3	2	1	1
36	86	10	5	3	1	3	3	2	1	1
36	116	4	5	3	2	2	2	2	1	1
38	70	12	8	3	1	2	3	3	1	1
38	81	3	8	3	1	2	1	3	1	1
41	87	19	11	7	2	3	3	3	2	1
41	94	10	5	4	1	3	3	2	2	1
43	79	8	4	4	1	2	3	2	2	1
43	87	14	10	8	2	3	3	3	3	1
45	105	7	11	8	1	3	2	3	3	1
48	77	8	4	3	1	2	3	2	1	1

48	87	4	2	3	1	2	2	1	1	1
48	91	6	2	4	1	2	2	1	2	1
60	86	11	7	5	1	3	3	2	2	1
60	100	12	8	5	1	2	3	3	2	1
60	104	12	8	5	1	2	3	3	2	1
60	131	2	5	5	1	2	1	2	2	1
60	132	11	7	5	0	2	3	2	2	1
61	126	16	9	7	1	3	3	3	2	1
62	72	15	9	5	0	3	3	3	2	1
63	66	21	6	3	2	3	3	2	1	1
63	100	6	6	4	1	2	2	2	2	1
63	121	3	19	4	1	2	1	3	2	1
64	87	8	17	1	0	3	3	3	1	1
65	86	10	4	5	2	2	3	2	2	1
65	116	4	4	4	4	2	2	2	2	2
65	130	3	4	4	4	2	1	2	2	2
66	95	0	1	2	0	1	1	1	1	1
66	123	3	2	3	0	2	1	1	1	1
66	124	2	10	5	3	2	1	3	2	1
66	125	5	3	6	1	2	2	1	2	1
67	119	20	14	10	6	3	3	3	3	2
68	121	14	21	10	1	3	3	3	3	1
69	121	10	9	5	2	3	3	3	2	1
71	122	3	13	6	1	3	1	3	2	1
71	123	4	3	2	1	2	2	1	1	1

Beta Subject E

Scenario	Time	A	B	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	SN Score
1	86	2	0	0	0	3	1	0	0	2	2	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	5
2	103	2	0	1	0	6	2	1	3	2	2	0	0	0	0	0	2	0	0	0	1	3	0	0	0	2	9
4	114	1	3	0	0	3	2	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	2	0	1	7
4	119	3	4	0	0	6	5	0	0	2	5	0	0	0	0	0	2	0	0	0	0	2	0	5	0	2	13
7	68	1	0	0	1	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	4
7	119	2	0	0	2	3	2	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	7
9	71	1	0	0	0	3	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	4
9	100	1	0	0	0	3	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	4
9	104	1	0	0	0	3	2	0	1	1	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	4
12	86	1	0	0	0	2	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	3
12	110	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	3
18		0	0	0	0	2	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	1	2
18		0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	2	2
18		0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	1	2
19	84	1	0	0	0	3	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	0	2	4
19	99	0	0	0	0	2	1	1	0	0	0	0	0	0	0	0	0	2	0	1	0	0	0	1	0	2	2
20	71	3	0	0	0	3	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6
21	73	0	0	0	0	3	0	2	0	0	0	2	0	0	0	0	2	0	0	0	0	0	1	0	0	0	3
23	131	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0
24	79	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	3
24	103	2	0	0	0	3	1	0	0	1	2	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	5
35	86	1	0	1	0	2	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	4
35	116	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	3
36	29	1	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
36	30	1	0	0	0	3	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
36	44	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
38	70	0	0	0	0	3	0	0	0	0	3	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	3
38	81	0	0	1	0	1	0	0	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	1	0	0	2
41	87	3	0	2	5	6	2	0	0	2	5	2	0	0	0	0	6	0	0	0	0	3	0	0	0	0	16
41	94	1	0	1	2	3	1	0	0	1	3	1	0	0	0	0	2	0	0	0	0	2	0	0	0	0	7
43	79	1	0	0	0	3	2	0	1	0	1	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	4
43	87	3	0	5	5	6	5	0	0	0	5	0	0	0	0	0	6	0	0	0	0	3	0	0	0	0	19
45	105	1	0	0	0	3	0	0	0	0	2	0	0	0	0	0	2	0	0	0	1	2	0	0	0	0	4
48	77	1	0	0	0	2	0	0	1	1	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	3

Scenario	Task	A	B	2	D	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	SN Score
48	87	1	0	0	2	2	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	5
48	91	1	0	0	0	2	1	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	3
60	86	1	2	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
60	100	1	0	0	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
60	104	1	3	1	0	2	1	0	0	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7
60	131	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	1
60	132	0	2	0	0	2	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
61	126	2	0	5	0	3	0	0	0	4	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	10
62	72	2	1	0	0	4	0	0	1	4	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	4
63	66	2	0	0	0	3	0	0	0	1	2	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	5
63	100	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2
63	121	0	0	0	0	1	0	0	0	0	0	0	0	2	1	1	0	0	4	0	0	0	0	0	0	0	1
64	87	1	3	2	2	3	1	0	0	1	3	0	0	1	3	3	1	3	0	0	0	1	0	0	0	0	11
65	86	1	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1	1	0	3
65	116	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	1	0	3
65	130	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	3
66	95	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
66	123	1	0	0	0	3	1	1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	4
66	124	1	0	0	0	3	1	1	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1	0	0	1	1	4
66	125	1	0	1	0	3	1	0	0	1	1	0	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	5
67	119	1	0	2	2	3	0	0	0	2	0	0	1	0	0	0	0	2	0	0	0	0	0	5	0	3	0	8
68	121	0	4	0	0	3	2	2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	7
69	121	1	0	1	1	3	2	0	0	3	0	1	0	1	0	0	2	2	0	0	0	2	0	2	0	0	0	6
71	122	1	0	2	0	2	1	1	0	0	0	0	0	0	1	0	2	3	6	0	0	2	0	0	0	0	2	5
71	123	1	0	0	0	3	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	4

Scenario	Task	SWA Score	ET Score	LF Score	HE Score	SN Rating	SWA Rating	ET Rating	LF Rating	HE Rating
1	86	5	1	0	0	2	2	1	1	1
2	103	10	3	3	4	3	3	1	1	2
4	114	3	1	3	2	2	1	1	1	1
4	119	12	2	7	4	3	3	1	2	2
7	68	2	0	2	1	2	1	1	1	1
7	119	5	0	5	2	2	2	1	2	2
9	71	2	2	2	0	2	1	1	1	1
9	100	1	2	2	0	2	1	1	1	1
9	104	7	2	2	0	2	2	1	1	1
12	86	3	1	0	2	1	1	1	1	1
12	110	0	1	0	2	1	1	1	1	1
18		1	2	2	1	1	1	1	1	1
18		2	2	2	2	1	1	1	1	1
18		2	2	2	1	1	1	1	1	1
19	84	2	0	5	2	2	1	1	2	1
19	99	2	3	1	2	1	1	1	1	1
20	71	3	0	0	0	2	1	1	1	1
21	73	4	2	1	0	1	2	1	1	1
23	131	0	2	0	0	1	1	1	1	1
24	79	1	0	1	0	1	1	1	1	1
24	103	4	0	2	0	2	2	1	1	1
35	86	2	0	2	0	2	1	1	1	1
35	116	1	0	2	0	1	1	1	1	1
36	29	1	0	0	0	2	1	1	1	1
36	30	1	0	0	0	2	1	1	1	1
36	44	1	0	0	0	1	1	1	1	1
38	70	3	3	0	0	1	1	1	1	1
38	81	0	3	1	0	1	1	1	1	1
41	87	11	6	3	0	3	3	2	1	1
41	94	6	2	2	0	2	2	1	1	1
43	79	4	2	2	0	2	2	1	1	1
43	87	10	6	3	0	3	3	2	1	1
45	105	2	3	2	0	2	1	1	1	1
48	77	2	2	0	0	1	1	1	1	1

Scenario	Task	SWA Score	BT Score	LF Score	HE Score	SN Rating	SWA Rating	BT Rating	LF Rating	HE Rating
48	87	3	1	0	0	2	1	1	1	1
48	91	2	1	0	0	1	1	1	1	1
60	86	1	0	0	0	2	1	1	1	1
60	100	2	0	0	0	1	1	1	1	1
60	104	5	0	0	0	2	2	1	1	1
60	131	1	2	0	0	1	1	1	1	1
60	132	2	0	0	0	2	1	1	1	1
61	126	5	0	2	0	3	2	1	1	1
62	72	7	0	1	0	2	2	1	1	1
63	66	3	2	1	0	2	1	1	1	1
63	100	1	1	0	0	1	1	1	1	1
63	121	0	8	0	0	1	1	3	1	1
64	87	5	11	1	0	3	2	3	1	1
65	86	1	0	2	1	1	1	1	1	1
65	116	0	0	1	1	1	1	1	1	1
65	130	0	0	0	2	1	1	1	1	1
66	95	0	0	0	2	1	1	1	1	1
66	123	2	1	1	1	2	1	1	1	1
66	124	3	1	2	2	2	1	1	1	1
66	125	3	2	1	0	2	1	1	1	1
67	119	3	2	5	3	3	1	1	2	1
68	121	4	0	1	0	2	2	1	1	1
69	121	6	5	4	0	2	2	2	2	1
71	122	2	12	2	2	2	1	3	1	1
71	123	1	0	0	2	2	1	1	1	1

1	86	3	0	2	0	1	1	0	3	2	5	0	0	0	0	0	2	0	0	0	0	3	0	0	0	0	2	6
2	103	3	0	2	0	1	2	0	0	4	5	5	0	0	0	0	2	0	0	0	0	3	2	0	0	0	0	6
4	114	0	3	0	0	2	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	5
4	119	2	3	0	0	1	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3	0	0	0	0	0	6
7	68	0	0	2	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	2	2	0	0	0	4
7	119	2	0	2	0	1	5	1	0	2	2	0	0	0	0	0	6	0	0	0	0	0	5	5	0	0	0	5
9	71	0	0	0	0	2	1	0	0	0	0	1	0	0	0	0	2	0	0	0	0	2	2	0	0	0	0	2
9	100	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	3
9	104	0	0	0	0	3	2	0	0	0	3	0	0	0	0	0	2	0	0	0	0	2	1	0	0	0	0	3
12	86	0	0	0	0	0	0	0	1	0	3	0	0	0	0	0	2	0	0	0	0	2	2	0	0	2	0	0
12	110	0	0	0	0	0	2	0	0	3	0	0	0	0	0	0	2	0	0	0	0	2	2	1	0	2	0	0
18	84	0	0	0	0	0	1	1	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	0
18	114	1	0	0	0	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	2
18	131	0	0	2	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	0	2	0	0	0	0	0	2
19	84	1	0	0	0	6	2	0	0	0	0	0	0	2	0	0	6	0	0	0	0	2	5	5	0	3	0	7
19	99	0	0	1	0	2	0	1	0	3	0	0	0	1	0	0	2	0	0	0	0	2	1	1	0	2	0	3
20	71	3	0	0	0	3	5	1	0	4	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	3	6
21	73	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	2	0	0	0	3	3
23	131	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	1	0	0	0	2
24	79	0	1	0	0	2	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	1	1	1	0	0	0	3
24	103	1	0	1	0	1	1	0	1	2	5	2	0	0	0	0	2	0	0	0	0	2	2	2	0	0	0	3
35	86	1	0	0	0	3	2	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	2	2	0	0	0	4
35	116	1	0	0	0	3	2	0	0	0	0	1	0	0	0	0	2	0	0	0	0	2	2	2	0	0	0	4
36	83	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
36	86	1	2	1	0	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	5
36	116	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	3
38	70	0	0	2	0	3	0	0	0	3	3	0	0	0	0	0	2	0	0	0	2	2	0	0	0	0	0	5
38	81	1	0	2	0	0	0	0	0	3	0	0	0	2	1	0	0	2	0	0	0	2	0	0	0	0	0	3
41	87	3	0	5	5	0	5	0	0	4	5	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	13
41	94	1	0	2	2	0	1	0	0	3	3	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	5
43	79	1	0	0	0	1	2	0	0	0	3	0	0	0	0	0	2	0	0	0	0	2	1	0	0	0	0	2
43	87	2	0	0	5	0	5	0	0	0	5	0	0	0	0	0	2	0	0	0	0	3	1	0	0	0	0	7
45	105																											
48	77	1	0	0	0	0	2	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1

48	87	1	0	1	0	0	2	0	0	0	1	0	0	0	0	0	2	0	0	0	0	2	1	0	0	0	2
48	91	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	1	0	0	0	1
60	86	1	3	0	0	3	0	0	0	1	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	7
60	100	1	1	0	0	2	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	4
60	104	1	3	0	0	3	0	0	0	0	3	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	7
60	131	0	1	0	0	2	1	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	1	1	0	0	3
60	132	1	2	0	0	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	6
61	126	2	3	5	0	0	1	0	0	4	0	2	0	0	0	0	2	0	0	0	0	3	2	2	0	0	10
62	72	3	0	5	0	6	1	0	0	4	5	0	0	1	0	0	1	2	0	0	0	3	0	1	0	0	14
63	66	0	0	0	0	1	1	0	0	0	5	0	0	0	0	0	1	0	0	0	0	3	1	0	0	0	1
63	100	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	3
63	121	0	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	4	0	0	2	0	0	0	0	2
64	87	0	0	2	2	0	0	0	0	3	3	0	0	2	0	3	0	0	0	1	0	0	0	2	0	0	4
65	86	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
65	116	1	0	0	0	2	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	3
65	130	1	0	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	2	1	1	2	2
66	95	1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	1	0	0	0	1
66	123	1	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	1	0	0	0	0	1
66	124	0	0	0	0	3	2	0	0	1	0	2	0	0	0	0	1	0	0	0	0	1	1	0	0	0	0	3
66	125	1	0	0	0	0	0	0	0	0	3	2	0	0	0	0	2	0	0	0	0	2	2	2	1	0	0	1
67	119	2	1	5	1	0	1	0	0	0	1	2	0	1	0	0	1	2	0	0	0	2	2	2	0	2	0	9
68	121	0	4	0	0	12	2	1	0	0	0	2	0	0	0	0	0	2	0	0	0	3	0	0	0	0	0	5
69	121	1	2	0	0	2	0	0	0	0	0	1	0	0	0	0	2	0	4	0	0	2	2	2	0	0	0	5
71	122	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2	4	0	0	2	2	2	0	0	0	3
71	123	1	0	0	0	0	0	1	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1

1	86	11	2	3	2	2	3	1	1	1
2	103	16	2	5	0	2	3	1	2	1
4	114	1	1	0	0	2	1	1	1	1
4	119	2	2	3	0	2	1	1	1	1
7	68	0	2	4	0	2	1	1	2	1
7	119	10	6	10	0	2	3	2	3	1
9	71	2	2	4	0	1	1	1	2	1
9	100	0	2	2	0	1	1	1	1	1
9	104	5	2	3	0	1	2	1	1	1
12	86	4	2	4	2	1	2	1	2	1
12	110	5	2	5	2	1	2	1	2	1
18	84	5	2	2	0	1	2	1	1	1
18	114	3	1	2	0	1	1	1	1	1
18	131	1	2	2	0	1	1	1	1	1
19	84	2	8	12	3	2	1	3	3	1
19	99	4	3	4	2	1	2	1	2	1
20	71	10	6	0	3	2	3	2	1	1
21	73	1	1	2	3	1	1	1	1	1
23	131	0	1	3	0	1	1	1	1	1
24	79	2	1	3	0	1	1	1	1	1
24	103	11	2	6	0	1	3	1	2	1
35	86	3	2	4	0	2	1	1	2	1
35	116	3	2	6	0	2	1	1	2	1
36	83	1	0	2	0	1	1	1	1	1
36	86	2	0	2	0	2	1	1	1	1
36	116	1	1	2	0	1	1	1	1	1
38	70	6	4	2	0	2	2	2	1	1
38	81	3	5	2	0	1	1	2	1	1
41	87	14	0	3	0	3	3	1	1	1
41	94	9	0	2	0	2	3	1	1	1
43	79	5	2	3	0	1	2	1	1	1
43	87	10	2	4	0	2	3	1	2	1
45	105									
48	77	5	0	2	0	1	2	1	1	1

48	87	3	2	3	0	1	1	1	1	1
48	91	1	1	3	0	1	1	1	1	1
60	86	4	2	2	0	2	2	1	1	1
60	100	2	2	2	0	2	1	1	1	1
60	104	3	1	2	0	2	1	1	1	1
60	131	2	2	4	0	1	1	1	2	1
60	132	0	1	2	0	2	1	1	1	1
61	126	7	2	7	0	3	2	1	2	1
62	72	10	4	4	0	3	3	2	2	1
63	66	6	1	4	0	1	2	1	2	1
63	100	0	0	2	0	1	1	2	1	1
63	121	1	5	2	0	1	1	1	1	1
64	87	6	6	2	0	2	2	2	1	1
65	86	0	0	0	0	1	1	1	1	1
65	116	2	1	2	0	1	1	1	1	1
65	130	2	0	5	3	1	1	1	2	1
66	95	1	0	4	0	1	1	1	2	1
66	123	2	0	3	0	1	1	1	1	1
66	124	5	1	2	0	1	2	1	1	1
66	125	5	2	7	0	1	2	1	2	1
67	119	4	4	6	2	3	2	2	2	1
68	121	5	2	3	0	2	2	1	1	1
69	121	1	6	6	0	2	1	2	1	1
71	122	1	6	6	0	1	1	2	2	1
71	123	3	0	1	0	1	1	1	1	1

1	86	3	0	5	0	6	5	0	3	4	5	0	0	2	0	0	6	0	0	0	0	3	0	0	0	0	0	14
2	103	3	1	5	0	1	5	0	3	4	5	0	0	2	0	0	6	0	0	0	0	3	0	2	0	0	0	10
4	114	1	3	0	0	3	2	1	1	3	0	0	0	0	0	0	2	0	0	0	0	2	0	2	0	0	0	7
4	119	3	4	0	0	1	5	2	0	4	0	0	0	1	0	0	6	0	0	0	0	3	0	5	0	0	1	7
7	68	1	0	0	0	3	2	1	1	3	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	4
7	119	3	0	0	0	6	5	0	0	4	2	0	0	0	0	0	6	0	0	0	0	1	5	5	0	0	1	9
9	71	1	0	0	0	3	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	4
9	100	1	0	0	0	3	0	0	1	3	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	4
9	104	1	0	0	0	3	2	1	1	3	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4
12	86	1	0	0	0	1	2	0	1	3	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	2
12	110	1	0	0	0	1	2	0	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	2
18	84	1	0	0	0	3	2	1	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4
18	99	1	0	0	0	3	2	1	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4
18	114	1	0	0	0	3	2	1	0	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	1	4
19	84	3	0	2	0	6	5	1	0	2	0	0	0	3	4	0	6	4	0	2	0	3	0	5	0	3	0	11
19	131	1	0	0	0	3	2	0	0	1	0	0	0	2	3	0	2	0	0	0	0	2	0	2	0	2	0	4
20	71	1	1	0	0	6	5	2	3	4	2	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	1	8
21	73	3	0	0	0	1	5	2	0	4	0	5	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	4
23	131	1	0	2	0	2	0	0	0	1	0	0	0	2	3	0	2	0	0	0	0	2	0	2	0	0	2	5
24	79	1	1	2	0	3	2	0	1	3	0	2	0	2	1	0	2	0	0	0	0	2	2	2	0	0	0	9
24	103	3	1	5	0	6	5	1	3	4	0	5	0	2	2	0	6	0	0	0	0	3	5	5	0	0	0	15
35	86	1	0	0	0	3	2	0	1	3	3	0	0	2	0	0	2	0	0	0	0	2	2	2	0	0	0	4
35	116	1	0	1	0	3	2	0	1	3	0	0	0	2	3	3	2	0	0	0	0	2	2	2	0	0	0	5
36	83	1	0	0	0	3	2	0	1	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4
36	86	1	3	2	0	3	2	0	1	3	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	9
36	116	1	0	0	0	3	2	0	1	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	1	4
38	70	1	0	2	0	3	2	0	1	3	3	0	0	1	0	3	2	3	0	0	2	2	0	0	0	0	0	6
38	81	1	3	2	0	3	2	0	0	3	0	0	0	1	1	0	2	0	0	0	0	2	0	0	0	0	0	9
41	87	3	1	5	5	6	5	0	0	4	5	0	0	0	1	0	2	0	0	0	0	3	0	0	0	0	0	20
41	94	1	1	2	2	3	2	0	0	3	3	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	9
43	79	1	0	2	0	2	2	0	1	3	3	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	5
43	87	3	0	5	5	3	5	0	0	4	5	0	0	1	1	0	6	0	0	0	0	3	0	0	0	0	0	16
45	105	3	0	0	0	3	0	0	0	4	0	0	0	3	0	0	6	0	0	0	0	3	0	0	0	0	0	6
48	77	1	1	0	0	1	2	0	1	3	0	0	0	0	1	0	2	0	0	0	0	2	0	0	0	0	0	2
48	87	1	0	2	2	1	2	0	0	3	3	0	0	0	1	0	2	0	0	0	0	2	0	0	0	0	0	6
48	91	1	0	0	0	3	2	0	0	3	0	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	0	4
60	86	1	3	2	2	3	2	0	1	3	3	0	0	2	3	0	2	0	0	0	0	2	0	2	0	0	0	11
60	100	1	3	2	0	3	2	0	1	3	0	0	0	0	0	0	2	0	0	0	0	2	0	1	0	0	0	9
60	104	1	3	2	2	3	2	0	1	3	3	0	0	2	3	0	2	0	0	0	0	2	0	2	0	0	0	8

60	124	1	3	0	0	3	2	1	0	3	0	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	0	7
60	128	1	3	2	2	3	2	0	1	3	0	0	0	2	3	0	0	0	0	0	0	2	0	2	0	0	0	11
61	126	3	1	5	0	3	2	0	0	4	5	0	0	1	0	0	6	0	0	0	0	3	0	1	0	0	0	12
62	72	3	1	5	0	6	5	0	3	4	0	0	0	2	2	1	6	0	0	0	0	3	0	0	0	0	0	15
63	66	3	3	5	0	6	5	0	0	4	5	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	18
63	100	1	0	0	0	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	4
63	121	1	0	2	0	3	2	0	0	3	0	0	0	2	0	0	2	3	0	0	0	2	0	0	0	0	0	6
64	87	1	3	2	2	3	0	0	0	3	3	0	0	2	3	3	2	3	6	0	2	2	0	2	0	0	0	11
65	86	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	1	2	0	2
65	116	1	1	0	0	2	1	0	0	3	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	4
65	130	1	0	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	2	2	4
66	95	0	0	0	0	1	0	0	0	0	0	0	0	0	0		0	0	0	0	0	0	0	0	0	0	1	1
66	123	1	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	1
66	124	1	0	0	0	2	2	1	0	0	0	2	0	0	0	0	1	0	0	0	0	1	0	0	0	0	0	3
66	125	1	0	0	0	3	2	0	0	0	3	0	0	0	0	0	2	0	0	0	0	2	0	0	1	0	0	4
67	119	3	1	2	0	6	5	0	3	4	0	1	0	0	0	0	6	0	0	0	0	3	2	5	0	3	1	12
68	121	2	4	2	0	6	5	2	1	4	0	0	0	1	0	0	6	0	0	0	0	3	5	5	0	0	1	14
69	121	1	2	0	0	2	2	1	1	3	1	0	0	2	0	0	2	0	0	0	0	2	0	2	0	0	0	5
71		1	3	1	0	3	2	1	0	3	0	0	0	1	0	0	2	0	0	0	0	2	0	2	0	0	1	7
71		1	1	1	0	3	2	1	0	3	0	0	0	1	0	0	2	0	0	0	0	2	0	2	0	0	2	5

1	86	17	8	3	0	3	3	3	1	1
2	103	17	8	5	0	3	3	3	2	1
4	114	7	2	4	0	2	2	1	2	1
4	119	11	7	8	1	2	3	2	3	1
7	68	7	0	0	0	2	2	1	1	1
7	119	11	6	11	1	3	3	2	3	1
9	71	2	1	2	0	2	1	1	1	1
9	100	4	1	2	0	2	2	1	1	1
9	104	10	2	2	0	2	3	1	1	1
12	86	9	2	2	0	1	3	1	1	1
12	110	5	2	2	0	1	2	1	1	1
18	84	6	2	2	0	2	2	1	1	1
18	99	6	2	2	0	2	2	1	1	1
18	114	6	2	2	1	2	2	1	1	1
19	84	8	19	8	3	3	3	3	3	1
19	131	3	7	4	2	2	1	2	2	1
20	71	16	6	0	1	3	3	2	1	1
21	73	16	1	0	2	2	3	1	1	1
23	131	1	7	4	1	2	1	2	2	1
24	79	8	5	6	0	3	3	2	2	1
24	103	18	10	13	0	3	3	3	3	1
35	86	9	4	6	0	2	3	2	2	1
35	116	6	10	6	0	2	2	3	2	1
36	83	6	2	2	0	2	2	1	1	1
36	86	9	2	2	0	3	3	1	1	1
36	116	6	2	2	1	2	2	1	1	1
38	70	9	11	2	0	2	3	3	1	1
38	81	5	4	2	0	3	2	2	1	1
41	87	14	3	3	0	3	3	1	1	1
41	94	8	1	2	0	3	3	1	1	1
43	79	9	2	2	0	2	3	1	1	1
43	87	14	8	3	0	3	3	3	1	1
45	105	4	9	3	0	2	2	3	1	1
48	77	6	3	2	0	1	2	1	1	1
48	87	8	3	2	0	2	3	1	1	1
48	91	5	4	2	0	2	2	2	1	1
60	86	9	7	4	0	3	3	2	2	1
60	100	6	2	3	0	3	2	1	1	1
60	104	9	6	4	0	3	3	2	1	1

60	124	6	4	2	0	2	2	2	1	1
60	128	6	5	4	0	3	2	2	2	1
61	126	11	7	4	0	3	3	2	2	1
62	72	12	11	3	0	3	3	3	1	1
63	66	14	0	3	0	3	3	1	1	1
63	100	2	0	2	0	2	2	1	1	1
63	121	5	7	2	0	2	2	2	1	1
64	87	6	21	4	0	3	2	3	2	1
65	86	0	0	3	2	1	1	1	1	1
65	116	4	0	2	2	2	2	1	1	1
65	130	1	0	2	4	2	1	1	1	2
66	95	0	0	0	1	1	1	1	1	1
66	123	3	0	2	0	1	1	1	1	1
66	124	5	1	1	0	1	2	1	1	1
66	125	5	2	3	0	2	2	1	1	1
67	119	13	6	10	4	3	3	2	3	2
68	121	12	7	13	1	3	3	2	3	1
69	121	8	4	4	0	2	3	2	2	1
71		6	3	4	1	2	2	1	2	1
71		6	3	4	2	2	2	1	2	1

Beta Subject H

Scan No	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	86	1	0	5	0	3	2	0	1	2	2	0	0	0	0	0	2	0	0	0	0	3	0	0	0	0	0	9
2	103	2	0	5	0	0	2	0	3	2	5	5	0	2	1	0	2	0	0	0	4	3	0	2	0	1	0	7
4	114	0	3	0	0	2	1	0	0	0	0	1	0	0	0	0	1	0	0	0	0	2	1	0	0	0	0	5
4	119	2	3	2	0	3	1	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2	2	2	0	0	0	10
7	68	0	0	2	0	1	2	0	0	3	1	0	0	2	0	0	2	0	0	2	0	0	2	2	0	0	0	3
7	119	1	0	5	1	1	5	1	1	4	2	0	0	3	0	0	6	0	0	2	0	0	5	5	0	0	0	8
9	71	1	0	0	0	2	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	3
9	100	1	0	0	0	3	1	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	4
9	104	1	0	0	0	2	1	0	1	0	1	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	3
12	86	1	0	2	0	0	1	0	1	0	3	0	0	0	0	0	2	0	0	0	0	1	1	0	0	1	0	3
12	110	1	0	2	0	0	0	0	0	1	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	1	0	3
18	84	1	2	0	0	2	1	0	0	0	0	1	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	5
18	99	1	0	0	0	1	1	0	0	0	0	1	0	1	0	0	2	0	0	0	0	2	0	0	0	0	0	2
18	114	1	0	0	0	2	1	0	0	0	0	1	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	3
19	84	3	0	0	0	0	1	0	0	0	0	0	0	2	2	0	6	0	0	0	0	3	0	5	0	2	0	3
19	114	1	0	0	0	0	0	0	0	0	0	0	0	1	1	0	2	2	5	2	0	2	0	2	0	1	0	1
20	71	3	1	0	0	6	5	0	0	4	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	0	0	10
21	73	3	0	0	0	1	2	1	3	4	0	0	0	0	0	0	2	0	0	0	0	0	5	0	0	0	0	4
23	131	0	1	2	0	1	0	0	0	0	0	0	0	0	0	0	1	2	5	0	0	2	0	1	0	0	0	4
24	79	1	0	2	0	3	1	0	1	3	3	2	0	2	0	0	2	0	0	0	0	2	1	1	0	0	0	6
24	103	3	0	5	1	6	2	0	3	4	5	5	0	3	1	0	6	0	0	0	4	3	2	2	0	0	0	15
35	86	1	0	1	0	3	2	0	0	3	3	0	0	1	0	0	2	0	0	0	0	0	2	2	0	0	0	5
35	116	1	0	0	0	3	0	0	1	0	0	0	1	2	0	0	2	0	0	0	0	0	2	2	0	0	0	4
36	83	1	0	0	0	3	1	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	3
36	86	1	0	1	0	2	1	0	0	3	3	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	4
36	116	1	0	0	0	3	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4
38	70	0	0	2	1	3	2	0	0	3	3	0	0	2	0	0	2	0	0	0	2	2	0	0	0	0	0	6
38	81	1	2	0	1	1	1	0	0	1	0	1	0	2	0	1	1	2	5	0	0	2	0	1	0	0	0	5
41	87	0	0	5	5	1	5	0	0	4	5	2	0	1	1	0	1	0	0	0	0	3	0	2	0	0	0	11
41	94	0	0	2	2	1	2	0	0	3	3	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0	5
43	79	1	3	0	0	3	2	0	1	1	0	0	0	2	0	0	2	0	0	0	0	2	0	0	0	0	0	9
43	87	3	0	0	5	1	2	0	0	2	5	0	0	0	0	0	6	0	0	0	0	3	0	0	0	0	0	7
45	105	2	0	0	0	3	1	0	3	4	0	5	0	1	1	0	6	0	0	0	0	3	5	0	0	0	0	5
48	77	1	0	0	0	2	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0	3

Beta Subject H

Session	Task	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	Score
48	87	1	0	2	2	2	2	0	0	3	3	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0		7
48	91	0	0	0	0	2	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	2	0	0	0	0	0		2
60	86	0	2	1	0	2	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0		5
60	100	1	2	0	0	2	1	0	1	3	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0	0	0		5
60	104	1	3	2	0	2	0	0	1	3	3	0	0	2	0	0	1	0	0	0	0	2	1	1	0	0	0		8
60	131	1	3	0	0	2	0	0	0	1	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	0	0		6
60	132	0	2	0	0	2	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	0		4
61	126	3	0	5	0	1	1	0	0	4	0	0	0	1	1	0	6	0	0	0	0	3	0	1	0	0	0		9
62	72	2	3	2	0	1	0	0	1	2	5	0	1	0	0	0	6	0	0	0	0	3	0	0	0	0	0		8
63	66	1	0	5	0	3	5	0	0	4	5	0	0	0	1	0	6	0	0	0	0	2	5	0	0	0	0		9
63	100	1	0	0	0	1	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	0	0		2
63	121	1	0	0	0	1	0	0	0	1	0	0	0	0	0	0	2	2	4	0	0	2	0	1	0	0	0		2
64	87	0	1	2	2	3	1	0	0	3	3	0	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0		8
65	86	1	0	1	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0		3
65	116	1	0	0	0	1	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0		2
65	130	1	0	0	0	3	1	0	0	3	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	1	0		4
66	95	0	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	0		1
66	123	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	0		1
66	124	1	0	0	0	1	2	0	0	1	0	1	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2		2
66	125	1	0	1	0	1	1	0	0	3	3	2	0	0	0	0	2	0	0	0	0	2	0	0	1	0	0		3
67	119	3	0	5	0	1	2	0	0	4	0	2	0	2	2	0	6	0	0	0	0	3	0	5	0	2	0		9
68	121	0	4	0	0	6	2	2	1	2	0	0	0	2	2	0	6	2	0	0	0	3	0	0	0	0	0		10
69	121	1	2	0	0	1	1	0	0	0	1	0	0	2	0	0	2	2	0	0	0	2	1	2	0	0	0		4
71	122	1	2	1	0	1	1	0	0	1	0	0	0	0	0	0	1	2	5	0	0	2	1	0	0	0	0		5
71	123	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0		1

Scenario	Task	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating	BT Rating	LF Rating	HE Rating
1	86	7	2	3	0	3	2	1	1	1
2	103	17	9	5	1	2	3	3	2	1
4	114	2	1	3	0	2	1	1	1	1
4	119	1	2	6	0	3	1	1	2	1
7	68	6	6	4	0	1	2	2	2	1
7	119	13	11	10	0	3	3	3	3	1
9	71	1	1	2	0	1	1	1	1	1
9	100	2	1	2	0	2	1	1	1	1
9	104	3	1	2	0	1	1	1	1	1
12	86	5	2	2	1	1	2	1	1	1
12	110	1	2	2	1	1	1	1	1	1
18	84	2	2	2	0	2	1	1	1	1
18	99	2	3	2	0	1	1	1	1	1
18	114	2	2	2	0	1	1	1	1	1
19	84	1	10	8	2	1	1	3	3	1
19	114	0	13	4	1	1	1	3	2	1
20	71	9	6	0	0	3	3	2	1	1
21	73	10	2	5	0	2	3	1	2	1
23	131	0	8	3	0	2	1	3	1	1
24	79	10	4	4	0	2	3	2	2	1
24	103	19	14	7	0	3	3	3	2	1
35	86	8	3	4	0	2	3	1	2	1
35	116	2	4	4	0	2	1	2	2	1
36	83	1	1	2	0	1	1	1	1	1
36	86	7	1	2	0	2	3	1	1	1
36	116	1	2	2	0	2	1	1	1	1
38	70	8	6	2	0	2	3	2	1	1
38	81	3	11	3	0	2	1	3	1	1
41	87	16	3	5	0	3	3	1	2	1
41	94	9	0	2	0	2	3	1	1	1
43	79	9	6	3	0	3	3	2	1	1
43	87	4	4	2	0	2	2	2	1	1
45	105	13	8	8	0	2	3	3	3	1
48	77	3	1	2	0	1	1	1	1	1

Scenario	Task	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating	BT Rating	LF Rating	HE Rating
48	87	8	1	2	0	2	3	1	1	1
48	91	0	2	2	0	1	1	1	1	1
60	86	2	0	2	0	2	1	1	1	1
60	100	5	1	1	0	2	2	1	1	1
60	104	7	3	4	0	3	2	1	2	1
60	131	1	2	2	0	2	1	1	1	1
60	132	1	0	2	0	2	1	1	1	1
61	126	5	8	4	0	3	2	3	2	1
62	72	9	6	3	0	3	3	2	1	1
63	66	14	7	8	0	3	3	2	3	1
63	100	2	2	4	0	1	1	1	2	1
63	121	1	8	3	0	1	1	3	1	1
64	87	7	2	1	0	3	2	1	1	1
65	86	1	1	2	0	1	1	1	1	1
65	116	3	0	2	0	1	1	1	1	1
65	130	4	1	2	1	2	2	1	1	1
66	95	1	0	2	0	1	1	1	1	1
66	123	1	1	2	0	1	1	1	1	1
66	124	4	0	2	2	1	2	1	1	1
66	125	9	3	3	0	1	3	1	1	1
67	119	8	10	8	2	3	3	3	3	1
68	121	7	12	3	0	3	2	3	1	1
69	121	2	6	5	0	2	1	2	2	1
71	122	2	8	3	0	2	1	3	1	1
71	123	1	0	1	0	1	1	1	1	1

Beta Subject I

Session	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	86	3	0	0	1	0	0	0	3	4	5	2	0	0	4	0	6	0	0	0	0	3	0	0	0	0	0	4
2	103	1	0	5	2	1	0	0	3	4	5	2	0	1	0	1	6	0	0	0	2	3	2	0	0	0	0	9
4	114	1	2	0	1	1	2	0	1	0	0	0	0	0	0	0	1	0	0	0	0	1	0	2	0	2	2	5
4	119	3	3	0	2	0	5	2	0	1	5	0	0	0	0	0	2	0	0	0	0	3	0	2	0	3	3	8
7	68	0	1	2	2	0	2	0	0	3	3	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	5
7	119	0	1	5	5	0	5	0	0	4	5	0	0	0	0	0	0	0	0	0	0	0	5	5	0	1	1	10
9	71	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
9	100	0	0	0	0	0	1	0	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9	104	0	0	2	2	0	2	0	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	4
12	86	1	1	2	0	2	1	0	1	3	3	2	0	0	0	0	2	0	0	0	0	2	2	2	0	2	2	6
12	110	1	1	2	0	2	1	0	1	3	3	1	0	0	0	0	2	0	0	0	0	2	2	2	0	2	2	6
18	89	0	0	0	1	2	1	0	0	1	0	0	0	2	0	3	2	0	0	0	0	2	2	2	0	0	0	3
18	99	0	0	0	1	1	0	0	0	3	3	0	0	2	0	3	2	0	0	0	0	2	2	2	0	0	0	2
18	114	0	0	0	0	1	1	1	0	1	0	0	0	0	0	0	1	0	0	0	0	2	2	2	0	0	0	1
19	84	0	0	0	0	0	0	0	0	4	5	0	0	1	0	0	6	0	0	0	0	2	5	5	0	3	3	0
19	99	0	0	0	0	0	0	0	0	3	3	0	0	0	0	0	2	0	0	0	0	1	2	1	0	2	2	0
20	71	3	0	0	5	6	5	0	0	4	1	5	0	0	0	0	6	0	0	0	0	0	0	0	0	2	3	14
21	73	3	0	0	0	0	1	2	0	4	0	0	0	0	0	0	6	0	0	0	0	0	0	0	0	3	3	3
23	131	0	0	0	0	0	0	0	0	0	0	0	0	2	0	1	0	0	6	0	0	0	2	2	0	2	2	0
24	79	1	0	1	0	1	2	0	1	3	3	1	0	1	0	1	2	0	0	0	0	2	2	2	0	1	0	3
24	103	2	0	2	1	1	5	2	3	4	5	2	0	2	4	2	6	0	0	0	0	3	5	5	0	2	1	6
35	86	0	0	2	0	2	1	0	1	3	3	1	0	1	1	0	2	0	0	0	0	2	2	2	0	1	2	4
35	116	0	0	2	0	2	1	0	1	3	3	1	0	1	1	0	2	0	0	0	0	2	2	2	0	1	2	4
36	83	1	0	0	0	3	0	0	1	3	3	2	0	0	0	0	2	0	0	0	1	1	0	0	0	1	1	4
36	86	1	1	2	0	2	0	0	1	3	3	2	0	0	0	0	2	0	0	0	1	1	0	0	0	1	1	6
36	116	0	0	0	0	3	0	0	1	3	3	2	0	0	0	0	2	0	0	0	1	1	0	0	0	1	1	3
38	70	0	0	0	2	2	2	0	1	1	3	2	0	0	0	1	2	3	0	0	2	2	0	0	0	0	0	4
38	81	0	0	2	2	0	0	0	0	1	1	2	0	1	0	0	0	3	0	0	0	2	0	0	0	0	0	4
41	87	2	0	5	5	0	1	0	0	4	5	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	12
41	94	0	0	1	2	0	0	0	0	3	3	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
43	79	1	1	2	0	0	2	0	1	3	3	2	1	1	1	0	2	0	0	0	0	2	2	0	0	0	0	4
43	87	1	0	0	2	0	2	0	0	3	3	2	1	1	1	0	2	0	0	0	0	2	2	0	0	0	0	3
45	105	0	0	5	5	0	0	0	3	0	0	5	0	0	0	6	0	0	0	0	0	3	0	0	0	0	2	10
48	77	0	0	0	0	1	1	0	0	3	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0	1	1

Scenario	Time	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	SN	Score
48	87	0	0	0	2	1	2	0	0	3	3	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	3
48	91	1	0	2	0	1	0	0	0	0	0	0	0	1	3	0	2	0	0	0	1	2	0	0	0	0	2	4
60	86	1	1	2	0	1	2	0	1	3	3	1	0	0	0	0	2	0	0	0	0	2	1	1	0	1	1	5
60	100	1	3	2	2	0	2	0	1	3	3	0	0	2	0	0	2	0	0	0	0	2	1	1	0	1	1	8
60	104	1	0	2	1	1	2	0	1	3	3	0	0	0	1	0	2	0	0	0	0	2	1	1	0	1	1	5
60	131	1	1	2	0	0	2	0	1	3	3	0	0	0	0	0	2	0	0	0	0	2	1	1	0	1	1	4
60	132	1	1	2	0	1	0	0	1	3	3	0	0	0	0	0	2	0	0	0	0	2	1	1	0	1	1	5
61	126	3	1	5	2	3	2	0	0	4	5	0	0	2	1	1	6	0	0	0	0	3	0	0	0	0	0	14
62	72	3	0	5	0	6	1	0	3	4	5	0	0	1	0	0	6	0	0	0	0	3	0	0	0	2	2	14
63	66	0	0	1	0	0	5	0	0	4	5	0	0	0	0	0	0	0	0	0	0	3	0	0	0	0	0	1
63	100	0	0	0	0	1	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
63	121	0	0	0	0	2	0	0	0	0	0	0	0	0	1	1	0	0	4	0	0	0	0	0	0	0	0	2
64	87	0	0	2	2	2	0	0	0	3	1	2	0	2	3	3	1	3	0	0	0	2	0	0	0	0	0	6
65	86	1	0	2	0	2	1	0	1	3	3	1	0	2	1	0	2	0	0	0	0	2	1	1	0	1	0	5
65	116	1	0	2	0	2	1	0	1	3	3	1	0	2	1	0	2	0	0	0	0	2	1	0	0	1	0	5
65	130	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	2	2	0	2	2	3
66	95	0	0	0	0	2	0	0	0	1	1	0	0	1	0	0	2	0	0	1	0	0	0	0	0	0	0	0
66	123	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	1	2	2
66	124	0	0	0	0	0	1	0	0	3	3	0	0	0	0	0	2	0	0	0	0	0	0	0	0	1	1	4
66	125	0	2	0	0	2	0	0	1	3	3	0	0	0	0	0	2	0	0	2	0	2	0	0	0	1	2	1
67	119	3	0	5	5	3	5	0	1	4	5	2	0	0	0	0	2	0	0	0	0	3	5	5	0	0	0	16
68		1	4	0	1	3	5	1	0	0	1	2	0	1	0	0	2	2	0	0	0	3	5	1	0	3	1	9
69	121	1	3	0	2	3	0	0	1	3	3	2	0	0	0	3	0	3	0	0	0	0	2	2	0	0	0	9
71	122	0	1	0	0	0	0	1	0	1	0	0	0	1	0	0	0	2	5	0	0	2	0	0	0	0	0	1
71	123	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Scenario	Time	HW Score	BT Score	LF Score	HE Score	SN Rating	HW Rating	BT Rating	LF Rating	HE Rating
1	86	14	10	3	0	2	3	3	1	1
2	103	14	10	5	0	3	3	3	2	1
4	114	3	1	3	4	2	1	1	1	2
4	119	13	2	5	6	3	3	1	2	2
7	68	8	0	4	0	2	3	1	2	1
7	119	14	0	10	2	3	3	1	3	1
9	71	1	0	0	0	1	1	1	1	1
9	100	8	0	0	0	1	3	1	1	1
9	104	9	0	0	0	2	3	1	1	1
12	86	10	2	6	4	2	3	1	2	2
12	110	9	2	6	4	2	3	1	2	2
18	89	2	7	6	0	1	1	2	2	1
18	99	6	7	6	0	1	2	2	2	1
18	114	3	1	6	0	1	1	1	2	1
19	84	9	7	12	6	1	3	2	3	2
19	99	6	2	4	4	1	2	1	2	2
20	71	15	6	0	5	3	3	2	1	2
21	73	7	6	0	0	1	2	2	1	1
23	131	0	9	4	4	1	1	3	2	2
24	79	10	4	6	1	1	3	2	2	1
24	103	21	14	13	3	2	3	3	3	1
35	86	9	4	6	3	2	3	2	2	1
35	116	9	4	6	3	2	3	2	2	1
36	83	9	3	1	2	2	3	1	1	1
36	86	9	3	1	2	2	3	1	1	1
36	116	9	3	1	2	1	3	1	1	1
38	70	9	8	2	0	2	3	3	1	1
38	81	4	4	2	0	2	2	2	1	1
41	87	12	1	0	0	3	3	1	1	1
41	94	7	0	0	0	1	2	1	1	1
43	79	12	4	4	0	2	3	2	2	1
43	87	11	4	4	0	1	3	2	2	1
45	105	8	6	3	2	3	3	2	1	1
48	77	4	1	1	1	1	2	1	1	1

Scenario	Task	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating	BT Rating	LF Rating	HE Rating
48	87	8	0	1	1	1	3	1	1	1
48	91	0	7	2	2	2	1	2	1	1
60	86	10	2	4	2	2	3	1	2	1
60	100	9	4	4	2	3	3	2	2	1
60	104	9	3	4	2	2	3	1	2	1
60	131	9	2	4	2	2	3	1	2	1
60	132	7	2	4	2	2	2	1	2	1
61	126	11	10	3	0	3	3	3	1	1
62	72	13	7	3	4	3	3	2	1	2
63	66	14	0	3	0	1	3	1	1	1
63	100	3	0	1	0	1	1	1	1	1
63	121	0	6	0	0	1	1	2	1	1
64	87	6	12	2	0	2	2	3	1	1
65	86	9	5	4	1	2	3	2	2	1
65	116	9	5	3	1	2	3	2	1	1
65	130	0	2	6	4	1	1	1	2	2
66	95	7	2	0	2	1	2	1	1	1
66	123	2	4	0	0	1	1	2	1	1
66	124	7	4	2	3	2	2	2	1	1
66	125	1	2	2	3	1	1	1	1	1
67	119	17	2	13	0	3	3	1	3	1
68		9	5	9	3	3	3	2	3	1
69	121	9	6	4	0	3	3	2	2	1
71	122	2	8	2	0	1	1	3	1	1
71	123	0	0	0	0	1	1	1	1	1

Beta Subject J

Scenario	Task	1A	1B	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	SNScore
1	86	3	1	5	0	6	5	0	3	4	5	0	0	0	0	0	6	0	0	0	0	3	0	0	0	0	15
2	103	3	1	5	0	6	5	2	3	4	5	1	0	0	0	0	6	0	0	0	0	3	0	0	0	2	15
4	114	0	3	1	0	2	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	1	0	1	6
4	119	2	4	0	0	6	5	1	0	2	0	0	0	0	0	0	6	0	0	0	0	3	0	1	0	3	12
7	68	1	1	2	1	3	2	1	1	3	3	1	0	0	0	0	2	0	0	0	0	1	2	2	0	1	8
7	119	3	3	5	5	6	5	1	3	4	5	2	0	0	0	0	6	0	0	0	0	2	5	5	0	2	22
9	71	1	1	0	0	3	2	0	0	0	0	0	0	2	3	0	0	0	0	0	0	2	2	0	0	0	5
9	100	1	1	0	0	3	2	0	1	0	0	0	0	0	3	0	0	0	0	0	0	2	2	0	0	0	5
9	104	1	1	2	0	3	2	0	0	3	3	0	0	2	3	0	2	0	0	0	0	2	2	0	0	0	7
12	86	1	2	2	2	3	2	0	1	3	3	0	0	1	1	0	2	0	0	0	0	2	2	2	0	2	10
12	110	1	3	2	0	3	2	0	0	3	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	2	9
18	84	1	0	2	0	3	2	1	1	3	0	0	0	0	0	0	2	0	0	0	0	2	2	0	0	0	6
18	99	1	0	2	0	3	2	1	0	3	3	0	0	0	0	0	2	0	0	0	0	2	2	0	0	0	6
18	114	1	0	0	0	3	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	4
19	84	3	0	1	2	6	5	1	0	0	0	0	0	1	1	4	6	0	0	0	0	0	0	5	0	0	12
19	99	1	0	2	2	3	2	1	0	3	3	0	0	2	3	3	2	3	4	3	0	0	0	2	0	0	8
20	71	3	0	0	0	6	5	1	0	4	0	0	0	0	0	0	6	0	0	0	0	0	2	0	0	0	9
21	73	1	0	0	0	6	5	2	0	0	0	0	0	0	0	0	6	0	0	0	0	0	5	0	0	0	7
23	131	1	0	0	0	31	0	0	0	0	0	0	0	2	0	0	1	0	0	0	0	0	0	1	0	0	4
24	79	1	1	2	0	3	2	0	1	3	0	2	0	2	3	3	2	0	0	0	0	2	2	2	0	0	7
24	103	3	1	5	0	6	5	2	3	4	1	5	0	3	4	4	6	0	0	0	0	3	5	5	0	0	15
35	86	1	0	0	0	3	2	0	1	3	1	0	0	0	0	3	0	0	0	0	0	2	2	2	0	0	4
35	116	1	2	0	0	3	2	0	1	0	0	0	0	2	3	0	2	0	0	0	0	2	2	2	0	0	6
36	83	1	0	0	0	3	2	0	1	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	4
36	86	1	2	1	0	3	2	0	0	1	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	0	7
36	116	1	0	0	0	3	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	4
38	70	1	0	2	0	3	1	0	1	1	0	0	1	0	0	0	2	0	0	0	2	1	0	0	0	0	6
38	81	1	3	2	2	3	2	0	0	0	3	0	1	2	3	3	0	2	0	0	0	2	0	0	0	0	11
41	87	3	1	5	5	6	5	0	0	4	5	1	0	0	0	0	6	0	0	0	0	3	0	0	0	0	20
41	94	1	3	2	2	3	2	0	0	3	3	2	0	0	0	0	2	0	0	0	0	2	0	0	0	0	11
43	79	1	0	2	0	3	2	0	1	3	3	0	1	1	1	0	2	0	0	0	0	2	2	0	0	0	6
43	87	3	0	5	5	6	5	1	1	4	5	2	2	1	2	0	6	0	0	0	0	3	5	0	0	0	19
45	105	3	1	2	1	6	5	0	0	4	0	0	0	1	0	0	6	0	0	0	0	3	5	0	0	0	13
48	77	1	0	0	0	2	2	0	1	3	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	2	3

Scan no	Task	HA	TR	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	SI Score
48	87	1	0	2	2	3	2	0	0	3	3	0	0	0	0	0	2	0	0	0	0	2	2	0	0	2	2	8
48	91	1	3	0	0	3	1	0	0	0	0	2	0	0	0	0	2	3	0	0	0	1	2	0	0	2	2	7
60	86	1	3	1	0	3	2	0	1	3	3	2	0	1	3	0	2	0	0	0	0	2	2	2	0	0	0	8
60	100	1	3	0	0	3	2	0	1	3	0	0	0	1	3	0	2	0	0	0	0	2	2	2	0	0	0	7
60	104	1	3	1	0	3	2	0	1	3	3	2	0	2	3	0	2	0	0	0	0	2	2	2	0	0	0	9
60	131	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
60	132	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
61	126	3	4	5	2	6	5	0	3	4	1	0	0	0	0	0	6	4	7	0	0	2	5	0	0	0	0	20
62	72	3	4	5	0	6	5	0	3	4	5	0	0	1	1	1	6	3	4	0	0	2	0	2	0	0	0	18
63	66	3	1	5	2	6	5	0	3	4	5	0	0	0	0	0	6	0	0	0	0	3	0	0	0	0	0	17
63	100	1	0	0	0	3	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	0	0	0	4
63	121	1	0	1	0	2	2	0	0	0	0	1	0	2	3	3	2	3	0	0	0	0	0	1	0	0	0	4
64	87	1	3	2	2	1	2	0	0	3	3	0	0	2	3	3	2	3	0	2	0	1	0	0	0	0	0	9
65	86	1	1	0	0	2	2	0	0	3	0	0	0	0	0	0	2	0	0	0	0	0	1	0	0	1	2	4
65	116	1	2	0	0	2	2	0	0	0	0	0	0	0	0	0	2	0	0	0	0	2	0	0	1	0	0	5
65	130	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	2	0	0	0	2	2	2
66	95	0	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	2	2	3
66	123	1	1	0	0	2	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	1	1	0	0	0	0	4
66	124	1	1	0	0	3	2	1	0	3	0	2	0	1	1	0	2	0	0	0	0	1	1	1	0	0	0	5
66	125	1	0	0	0	2	2	0	0	1	1	1	0	0	0	0	2	0	0	0	0	2	1	0	1	0	0	3
67	119	3	3	5	5	6	5	2	3	4	5	5	2	2	4	1	6	0	0	0	0	3	5	5	0	3	3	22
68	121	3	4	5	1	6	5	2	0	4	0	5	0	0	4	0	6	0	0	0	0	3	5	1	0	3	3	19
69	121	1	3	1	0	3	2	0	1	0	0	0	0	1	1	0	2	0	0	0	0	2	2	1	0	0	0	8
71	122	1	2	1	0	2	2	1	0	1	0	1	0	0	0	0	2	2	4	0	0	2	0	0	0	0	0	6
71	123	1	0	0	0	1	2	1	0	0	0	0	0	0	0	0	2	0	0	0	0	0	0	0	0	0	0	2

Scenario	Task	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating	BT Rating	LF Rating	HE Rating
1	86	17	6	3	0	3	3	2	1	1
2	103	20	6	3	4	3	3	2	1	2
4	114	3	2	1	2	2	1	1	1	1
4	119	8	6	4	6	3	3	2	2	2
7	68	11	2	5	1	3	3	1	2	1
7	119	20	6	12	3	3	3	2	3	2
9	71	2	5	4	0	2	1	2	2	1
9	100	3	3	5	0	2	1	1	2	1
9	104	8	7	4	0	2	3	2	2	1
12	86	9	4	6	4	3	3	2	2	2
12	110	5	2	4	4	3	2	1	2	2
18	84	7	2	4	1	2	2	1	2	1
18	99	9	2	4	1	2	3	1	2	1
18	114	2	2	2	1	2	1	1	1	1
19	84	6	12	5	0	3	2	3	2	1
19	99	9	20	2	0	3	3	3	1	1
20	71	10	6	2	0	3	3	2	1	1
21	73	7	6	5	0	2	2	2	2	1
23	131	1	3	1	0	2	1	1	1	1
24	79	8	10	6	0	2	3	3	2	1
24	103	20	17	13	0	3	3	3	3	1
35	86	7	3	6	0	2	2	1	2	1
35	116	3	7	6	0	2	1	2	2	1
36	83	3	2	2	2	2	1	1	1	1
36	86	3	1	2	2	2	1	1	1	1
36	116	2	2	2	2	2	1	1	1	1
38	70	4	4	1	0	2	2	2	1	1
38	81	6	10	2	0	3	2	3	1	1
41	87	15	6	3	0	3	3	2	1	1
41	94	10	2	2	0	3	3	1	1	1
43	79	10	4	4	0	2	3	2	2	1
43	87	19	10	8	0	3	3	3	3	1
45	105	9	7	8	0	3	3	2	3	1
48	77	5	2	2	4	1	2	1	1	2

Scenario	Task	HWA Score	BT Score	LF Score	HE Score	SN Rating	HWA Rating	BT Rating	LF Rating	HE Rating
48	87	8	2	4	4	3	3	1	2	2
48	91	3	5	3	4	2	1	2	1	2
60	86	11	6	6	0	3	3	2	2	1
60	100	6	6	6	0	2	2	2	2	1
60	104	11	7	6	0	3	3	2	2	1
60	131	.	.	.	.	.	.	.	.	.
60	132	.	.	.	.	.	.	.	.	.
61	126	13	17	7	0	3	3	3	2	1
62	72	17	16	4	0	3	3	3	2	1
63	66	17	6	3	0	3	3	2	1	1
63	100	2	2	2	0	2	1	1	1	1
63	121	3	13	1	0	2	1	3	1	1
64	87	8	15	1	0	3	3	3	1	1
65	86	5	2	1	3	2	2	1	1	1
65	116	2	2	3	0	2	1	1	1	1
65	130	0	1	2	4	1	1	1	1	2
66	95	0	0	3	4	1	1	1	1	2
66	123	3	2	3	0	2	1	1	1	1
66	124	8	4	3	0	2	3	2	1	1
66	125	5	2	4	0	1	2	1	2	1
67	119	26	13	13	6	3	3	3	3	2
68	121	16	10	9	6	3	3	3	3	2
69	121	3	4	5	0	3	1	2	2	1
71	122	5	8	2	0	2	2	3	1	1
71	123	3	2	0	0	1	1	1	1	1

APPENDIX F

Alpha and Beta Test Checklist and Scoring Summaries
(Draft 1, Draft 2 and Draft 3)

This page intentionally left blank

Appendix F

DRAFT 1

Appendix F

This page intentionally left blank

Appendix F

USAF Maintenance Tool

Level I - Ergonomics Assessment for Maintenance and Inspection Work Areas

Part I - Work Content (Description of Tasks Performed)

For this section, work with the employee to obtain a basic description of the types of tasks that make up the job being evaluated. Using the Maintenance and Inspection Work Content (description of tasks performed list), write in the tasks that the employee performs and indicate the approximate task frequency. If the employee mentions a task which is not currently included on the task list, write the additional task and work frequency.

- **Routine:**
  - **> 50 % (High):** The total percentage the job spent performing the task is greater than 50%.
  - **10-50 % (Moderate):** The total percentage of the job spent performing the task is between 10 and 50%.
- **< 10 % (Low):** The total percentage of the job spent performing the task is less than 10%.
- **Non-routine:** The task is not performed during the normal course of work or is performed under special circumstances.

Analyst _____

Scenario # _____

Job: _____

Start time: _____

WORK CONTENT MATRIX

Task	Lifting / Exertion occur in Task	Task Frequency (Check one)			
				Routine	
		Non-Routine	(Low) < 10%	(Moderate) 10-50%.	(High) > 50%
1.	O	O	O	O	O
2.	O	O	O	O	O
3.	O	O	O	O	O
4.	O	O	O	O	O
5.	O	O	O	O	O
6.	O	O	O	O	O

Critical tasks include:
- Routine tasks
- Tasks involving lifting or exertion

Performance Measures

How is your performance measured? _____

_____

Part I - Work Content (Description of Tasks Performed) (Cont'd)

Maintenance and Inspection Task Key List

66. abrading
68. bolting/screwing
70. chipping
71. cleaning by hand
72. cleaning with high pressure equipment
73. coating/immersing
76. crimping
77. cutting/shearing
79. drilling
80. driving (vehicles)
81. excavating
83. flame cutting/arc cutting
84. folding/fitting
85. glueing/laminating
86. grinding/buffing/polishing
87. hammering
88. lifting
90. lubricating
91. machining
92. masoning
93. melting
94. molding
97. nailing
98. opening/closing heavy doors
100. painting/spray painting
101. paving
102. pumping (by hand)
103. riveting/bucking
104. sanding
105. sawing
107. sewing
108. soldering/brazing
110. stripping/depainting by hand
111. stripping/depainting mechanically
113. turning valves
114. tying/twisting/wrapping
116. welding
118. wiring
119. wrenching/ratcheting

(Write in others)

121. _____
122. _____

Part II - Checklist, Shoulder / Neck

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occassional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

	Job Factor	Task Name: Task Frequency Low	Moderate	High	Task Name: Task Frequency Low	Moderate	High	Task Name: Task Frequency Low	Moderate	High	Comments
	1. **Repeated reaching or arms held continuously away from body while unsupported**										
	• *Arm 30-90° away from body (below shoulder level)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	• *Arm >90° away from body (above shoulder level)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	2. **Arm forces exceeding 10 lbs.** *(e.g. roughly equivalent to lifting a gallon of milk)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	3. **High speed, sudden shoulder movements** *(e.g., opening a stuck door, pulling and yanking on a stuck component to remove it)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	4. **Holding/carrying materials** *exceeding 25 lbs. for more than three steps*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	5. **Head/neck bent or twisted** *(e.g., craning neck looking into tight spaces)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	Task Scores = (column total)										

Part II - Checklist, Hands/Wrists/Arms

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occassional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

	Job Factor	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Comments
	6. **Bent wrists or repeated wrist movements or repeated forearm rotation** *(e.g., turning a screwdriver, alynn wrench)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	7. **Repeated manipulations with fingers** *(e.g., repetitive computer keying tasks, removing small screws, electrical wiring tasks)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	8. **Hyperextension of finger/thumb, repeated single finger activation** *(e.g., using pliers with a wide handle span or single finger triggers on power tools)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	9. **Constant holding forces:** *fingertip pressure: > 2 lb. (e.g., holding a pair of fingernail clippers closed)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	

Part II - Checklist, Hands/Wrists/Arms (Cont'd)

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occassional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

	Job Factor	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Comments
	10. Repeated grip forces: • *fingertip force: > 8 lb. (e.g., squeezing a large binder clip)* • *full hand force:> 25 lb. (e.g.,roughly equivalent to squeezing a stapler)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	11. High speed hand/wrist /arm movements *(e.g., yank components with fingers, using the hand as a hammer) or impact or torque to the hand (e.g., operating a nail gun)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	12. Exposure to hard edges *(e.g., tool handle or work area presses into fingers or palm of hands)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	13. Vibration to the hand/ arm *(e.g., using powered tools and equipment)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	14. Hands and fingers exposed to cold temperatures *(e.g., working outside in winter environment, cold exhaust air from tool blows on hand/wrist)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)										

Part II - Checklist, Back/Torso

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occassional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

	Job Factor	Task Name: Task Frequency Low	Moderate	High	Task Name: Task Frequency Low	Moderate	High	Task Name: Task Frequency Low	Moderate	High	Comments
	15. **Repeated or continuous forward bending** (>20°) *while standing*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	16. **Twisting and/or lateral bending** *(any observable amount)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	17. **High speed, sudden movements w/ lower back**	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	18. **While seated, poor lower back posture** *(e.g., no back rest, lower back support)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	19. **Whole body vibration** *felt through standing or seated surface*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	20. **Lifting Forces**										
	• *> 50 lb. while upright w/ load close to body or* • *>10 lb. while bending or reaching*	F S O N 2 1 1 0	F S O N 3 2 1 0	F S O N 5 4 3 0	F S O N 2 1 1 0	F S O N 3 2 1 0	F S O N 5 4 3 0	F S O N 2 1 1 0	F S O N 3 2 1 0	F S O N 5 4 3 0	
	• *> 70 lb. while upright w/ load close to body or* • *> 40 lb. while bending or reaching*	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	
	21. **Pushing or pulling** *(initial force >50 lb.) forces (e.g. force needed to push/pull a full two-drawer file cabinet accross a carpeted floor)*	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	
	Task Scores = (column total)										

Part II - Checklist, Legs/Feet

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occassional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

	Job Factor	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Comments
	22. **Static effort in legs** *(e.g. standing or walking on hard floor surfaces)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	23. **Exposure to hard edges on legs and feet** *(e.g. standing on bars or rails on a ladder leaning against a hard edge)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	24. **Awkward leg postures** *(e.g. kneeling, squatting or crawling / knee hyperextension)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	25. **Slippery, uneven, or unstable walking or working surface causes slipping** *(high speed movements)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	26. **Constantly apply pressure with one or both feet** *(e.g., using foot pedal while standing)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	Task Scores = (column total)										

Part II - Checklist, Head/Eyes

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occassional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

	Job Factor	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Task Name: Task Frequency Low	Task Name: Task Frequency Moderate	Task Name: Task Frequency High	Comments
	27. **Difficult to see/light levels too low /too high.** *(e.g., see detail)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	28. **Intensive visual tasks, staring at work objects for long periods** *(e.g., inspection, troubleshooting)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	29. **Displays and controls are difficult to understand and use**	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)										

Part III - Environmental

Environmental Factors

	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
30. Restricted space					
32. Windy conditions					
33. Extreme temperatures heat / cold					
34. Noise or distractions					
35. Air quality concerns					

Environmental Score = ____

Environmental Rating	Low	Med	High
Environmental Score	0-3	4-7	8+

Part IV - Employee Suggestion

Ask the employee for any suggestions for corrective actions that they may have.

Stop time:_____

Elapsed time:_____

ERGONOMIC SUMMARY REPORT

Technician_____ **Date**_____

1. Job Description: Please write out job description.

2. Scoring Summary: Transfer scores from individual scoring sheets.

Body Region	Task Scores					Priority Score by Body Region	Priority Rating by Body Region
	Task Name:	**Task Name:**	**Task Name:**	**Task Name:**		**Add across row and divide by # of tasks for average**	High: 8+ Med: 4-7 Low: 0-3
Shoulder/Neck					=		High Med Low
Hand/Wrist/Arm					=		High Med Low
Back/Torso					=		High Med Low
Legs/Feet					=		High Med Low
Head/Eyes					=		High Med Low

Select the highest body region score for each task then circle below for High, Med, Low	Highest Score	Highest Score	Highest Score	Highest Score
High: 8+ Med: 4-7 Low: 0-3	High Med Low	High Med Low	High Med Low	High Med Low

Environmental Rating
High Med Low

DRAFT 2

Appendix F

This page intentionally left blank

Appendix F

Part I - Work Content (Description of Tasks Performed)

For this section, work with the employee to obtain a basic description of the types of tasks that make up the job being evaluated. Use the Maintenance and Inspection Task Key List as a reference. If the employee mentions tasks which are not included on the Task Key List, write-in the additional tasks.

For each task performed, determine the approximate task frequency using the following proportions of job time:

- **Routine:**
  - **> 50 % (High):** The total percentage the job spent performing the task is greater than 50%.
  - **10-50 % (Moderate):** The total percentage of the job spent performing the task is between 10 and 50%.
- **< 10 % (Low):** The total percentage of the job spent performing the task is less than 10%.
- **Non-routine:** The task is not performed during the normal course of work or is performed under special circumstances.

Analyst _____

Scenario # _____

Job: _____

Start time: _____

For each task, check the most appropriate circle in the Work Content Matrix below.
If lifting or high force exertions occur in the task, indicate by checking the appropriate circle.

WORK CONTENT MATRIX

Task	Lifting / Exertion Occur in Tas	Task Frequency (Check one)			
				Routine	
		Non-Routine	(Low) 0-9%	(Moderate) 10-50%.	(High) 51-100%
1.	○	○	○	○	○
2.	○	○	○	○	○
3.	○	○	○	○	○
4.	○	○	○	○	○
5.	○	○	○	○	○
6.	○	○	○	○	○

▒ = Critical tasks are indicated by the shaded boxes in the Work Content Matrix. Critical tasks are tasks which occur greater than 10% of the job time or which involve lifting or high forces.

ONLY COMPLETE THE CHECKLIST FOR CRITICAL TASKS.

Performance Measures

How is your performance measured? _____

Part I - Work Content (Description of Tasks Performed) (Cont.)

Maintenance and Inspection Task Key List

66. abrading
68. bolting/screwing
70. chipping
71. cleaning by hand
72. cleaning with high pressure equipment
73. coating/immersing
76. crimping
77. cutting/shearing
79. drilling
80. driving (vehicles)
81. excavating
83. flame cutting/arc cutting
84. folding/fitting
85. glueing/laminating
86. grinding/buffing/polishing
87. hammering
88. lifting
90. lubricating
91. machining
92. masoning
93. melting
94. molding
97. nailing
98. opening/closing heavy doors
100. painting/spray painting
101. paving
102. pumping (by hand)
103. riveting/bucking
104. sanding
105. sawing
107. sewing
108. soldering/brazing
110. stripping/depainting by hand
111. stripping/depainting mechanically
113. turning valves
114. tying/twisting/wrapping
116. welding
118. wiring
119. wrenching/ratcheting

(Write in others)

121. _____
122. _____

Part II - Checklist, Shoulder / Neck

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name:			Task Name:			Task Name:			Comments
		Task Frequency			Task Frequency			Task Frequency			
		Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	
	1. **Repeated reaching or arms held continuously away from body while unsupported**										
	• *Arm 30-90° away from body (below shoulder level)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	• *Arm >90° away from body (above shoulder level)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	2. **Arm forces exceeding 10 lbs.** *(e.g. roughly equivalent to lifting a gallon of milk)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	3. **High speed, sudden shoulder movements** *(e.g., opening a stuck door, pulling and yanking on a stuck component to remove it)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	4. **Holding/carrying materials** *exceeding 25 lbs. for more than three steps*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	5. **Head/neck bent or twisted** *(e.g., craning neck looking into tight spaces)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	Task Scores = (column total)										

Part II - Checklist, Hands/Wrists/Arms

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name:			Task Name:			Task Name:			Comments
		Task Frequency			Task Frequency			Task Frequency			
		Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	
	6. **Bent wrists or repeated wrist movements or repeated forearm rotation** *(e.g., turning a screwdriver, alynn wrench)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	7. **Repeated manipulations with fingers** *(e.g., repetitive computer keying tasks, removing small screws, electrical wiring tasks)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	8. **Hyperextension of finger/thumb, repeated single finger activation** *(e.g., using pliers with a wide handle span or single finger triggers on power tools)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	9. **Constant holding forces:** *for > 10 sec at a time* *fingertip pressure: > 2 lb. (e.g., holding a pair of fingernail clippers closed)* *full hand pressure: > 5 lb. (e.g., holding a half-gallon of milk or a tool that weighs more than 5 lb.)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	

Transfer these column totals to the next page.

Part II - Checklist, Hands/Wrists/Arms (Cont'd)

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name:			Task Name:			Task Name:			Comments
		Task Frequency			Task Frequency			Task Frequency			
		Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	
	10. **Repeated grip forces:** • *fingertip force: > 8 lb. (e.g., squeezing a large binder clip)* • *full hand force:> 25 lb. (e.g.,roughly equivalent to squeezing a stapler)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	11. **High speed hand/wrist /arm movements** *(e.g., yank components with fingers, using the hand as a hammer)* **or Impact/ torque to the hand** *(e.g., using a nail gun, hammer)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	12. **Exposure to hard edges** *(e.g., tool handle or work area presses into fingers or palm of hands)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	13. **Vibration to the hand/ arm** *(e.g., using powered tools and equipment)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	14. **Hands and fingers exposed to cold temperatures** *(e.g., working outside in winter environment, cold exhaust air from tool blows on hand/wrist)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)										

Part II - Checklist, Back/Torso

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name:			Task Name:			Task Name:			Comments
		Task Frequency			Task Frequency			Task Frequency			
		Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	
	15. **While standing, repeated or continuous forward bending (>20°)**	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	16. **Twisting and/or lateral bending**	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	17. **High speed, sudden movements w/ lower back**	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
	18. **While seated, poor lower back posture or leaning forward** *(e.g., no back rest, no lower back support, no support for feet)*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	19. **Whole body vibration** *felt through floor surface*	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	F S O N 2 1 0 0	F S O N 5 3 1 0	F S O N 8 4 2 0	
	20. **Lifting forces**										
	• *> 50 lb. while upright w/ load close to body or* • *>10 lb. while bending or reaching*	F S O N 2 1 1 0	F S O N 3 2 1 0	F S O N 5 4 3 0	F S O N 2 1 1 0	F S O N 3 2 1 0	F S O N 5 4 3 0	F S O N 2 1 1 0	F S O N 3 2 1 0	F S O N 5 4 3 0	
	• *> 70 lb. while upright w/ load close to body or* • *> 40 lb. while bending or reaching*	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	
	21. **Pushing or pulling** *(initial force >50 lb.) forces (e.g. force needed to push/pull a full two-drawer file cabinet accross a carpeted floor)*	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	F S O N 4 2 2 0	F S O N 6 4 2 0	F S O N 8 6 4 0	
	Task Scores = (column total)										

Part II - Checklist, Legs/Feet

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

Job Factor	Task Name:			Task Name:			Task Name:			Comments
	Task Frequency			Task Frequency			Task Frequency			
	Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	
22. **Static effort in legs** *(e.g. standing or walking on hard floor surfaces, feet dangling while sitting)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
23. **Exposure to hard edges on legs and feet** *(e.g., standing on rungs of a ladder, leaning against a hard edge, hard front edge of chair)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
24. **Awkward leg postures** *(e.g. kneeling, squatting, crawling, or knee hyperextension)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 5 3 1 0	
25. **Constantly apply pressure with one or both feet** *(e.g., using foot pedal while standing)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
Task Scores = (column total)										

Part II - Checklist, Head/Eyes

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name:			Task Name:			Task Name:			Comments
		Task Frequency			Task Frequency			Task Frequency			
		Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	Low 0-9%	Moderate 10-50%	High 51-100%	
	26. **Difficult to see/light levels too low /too high.** *(e.g., see detail)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	27. **Intensive visual tasks, staring at work objects for long periods** *(e.g., inspection,troubleshooting)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	28. **Displays and controls are difficult to understand and use**	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)										

Part III - Environmental

Environmental Factors

	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
29. Restricted space	0	0	0	1	4
30. Windy conditions	0	0	0	1	4
31. Extreme temperatures heat / cold	0	0	0	1	4
32. Noise or distractions	0	0	0	1	4
33. Air quality concerns	0	0	0	1	4

Environmental Score = ____

Environmental Rating	Low	Med	High
Environmental Score	0-3	4-7	8+

Part IV - Employee Suggestion

Ask the employee for any suggestions for corrective actions that they may have.

Stop time:_____

Elapsed time:_____

ERGONOMIC SUMMARY REPORT:

Start Time_____

Technician _____ Scenario number_____

Date_____ Scenario name_____

1. **Job Description:** Please write out job description.

2. **Scoring Summary**:Transfer scores from individual scoring sheets.

Body Region	Task Scores					Priority Score by Body Region	Priority Rating by Body Region
	Task Name:	Task Name:	Task Name:	Task Name:		Add across row and divide by # of tasks for average	High: 8+ Med: 4-7 Low: 0-3
Shoulder/Neck					=		High Med Low
Hand/Wrist/Arm					=		High Med Low
Back/Torso					=		High Med Low
Legs/Feet					=		High Med Low
Head/Eves					=		High Med Low

Select the highest body region score for each task then circle below for High, Med, Low	Highest Score	Highest Score	Highest Score	Highest Score
High: 8+ Med: 4-7 Low: 0-3	High Med Low	High Med Low	High Med Low	High Med Low

Environmental Rating
High Med Low

First Priority Task

Select the highest task score.
Write the task name.

Task Name_____

Select the two highest body region scores within the task.

First Highest Body Region	Second Highest Body Region
Score _____	Score_____
Body Region_____	Body Region_____

Second Priority Task

Select the next highest task score.
Write the task name.

Task Name_____

Select the two highest body region scores within the task.

First Highest Body Region	Second Highest Body Region
Score _____	Score_____
Body Region_____	Body Region_____

Overall

Highest Priority Score by Body Region	Priority Rating
Score:_____	**High**
Body Region:_____	**Med**
	Low

DRAFT 3

Appendix F

This page intentionally left blank

Appendix F

Part I - Work Content (Description of Tasks Performed)

For this section, work with the employee to obtain a basic description of the types of tasks that make up the job being evaluated. Use the Maintenance and Inspection Task Key List (on the next page) as a reference. If the employee mentions tasks which are not included on the Task Key List, write-in the additional tasks.

For each task performed, determine the approximate task frequency using the following proportions of job time:

- **> 50 % (High):** The total percentage of work time spent performing the task is greater than 50%.
- **10-50 % (Moderate):** The total percentage of work time spent performing the task is between 10 and 50%.
- **< 10 % (Low):** The total percentage of work time spent performing the task is less than 10%.

Analyst _____

Scenario # _____

Job: _____

Start time: _____

For each task, check the most appropriate circle in the Work Content Matrix below.
If lifting or high force exertions occur in the task, indicate by checking the appropriate circle.

WORK CONTENT MATRIX

Task	Lifting / Exertion Occur in Task	Task Frequency (Check one)		
		(Low) 0-9%	(Moderate) 10-50%.	(High) 51-100%
1.	○	○	○	○
2.	○	○	○	○
3.	○	○	○	○
4.	○	○	○	○
5.	○	○	○	○
6.	○	○	○	○

■ = Critical tasks are indicated by the shaded boxes in the Work Content Matrix. Critical tasks are tasks which occur greater than 10% of the job time or which involve lifting or high forces.

ONLY COMPLETE THE CHECKLIST FOR CRITICAL TASKS.
LOW FREQUENCY TASKS WITH LIFTING OR EXERTION ARE SCORED AS MODERATE FREQUENCY.

Performance Measures

How is your performance measured? _____

Part I - Work Content (Description of Tasks Performed) (Cont.)

Maintenance and Inspection Task Key List

66. abrading
68. bolting/screwing
70. chipping
71. cleaning by hand
72. cleaning with high pressure equipment
73. coating/immersing
76. crimping
77. cutting/shearing
79. drilling
80. driving (vehicles)
81. excavating
83. flame cutting/arc cutting
84. folding/fitting
85. gluing/laminating
86. grinding/buffing/polishing
87. hammering
88. lifting
90. lubricating
91. machining
92. masoning
93. melting
94. molding
95. monitoring
97. nailing
98. opening/closing heavy doors
100. painting/spray painting
101. paving
102. pumping (by hand)
103. riveting/bucking
104. sanding
105. sawing
107. sewing
108. soldering/brazing
110. stripping/depainting by hand
111. stripping/depainting mechanically
113. turning valves
114. tying/twisting/wrapping
116. welding
118. wiring
119. wrenching/ratcheting
121. assembly/disassembly internal component
122. assembly repair bench work
123. computer work
124. masking
125. mediablasting glove box
126. mediablasting-whole body
127. prying
128. solvent cleaning
129. visual inspection-machine aided
130. visual inspection-non machine aided

(Write in others)

131. _____
132. _____

Part II - Checklist, Shoulder / Neck

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

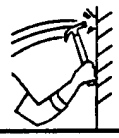
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

Job Factor	Task Name:		Task Name:		Task Name:		Comments
	Task Frequency		Task Frequency		Task Frequency		
	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	
1. **Reaching** *repeated reaching or arms held continuously away from body while unsupported*							
 *Below shoulder level (arm 30-90° away from body)*	F S O N 1 1 0 0	F S O N 3 2 1 0	F S O N 1 1 0 0	F S O N 3 2 1 0	F S O N 1 1 0 0	F S O N 3 2 1 0	
 *Above shoulder level (arm > 90° away from body)*	F S O N 3 2 1 0	F S O N 4 3 1 0	F S O N 3 2 1 0	F S O N 4 3 1 0	F S O N 3 2 1 0	F S O N 4 3 1 0	
  2. **Arm forces:** **Repeated arm forces** exceeding 10 lbs. *(e.g. roughly equivalent to lifting a gallon of milk) or* **Holding/carrying materials** *exceeding 25 lbs. for more than three steps*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
 3. **High speed, sudden shoulder movements** *(e.g., opening a stuck door, pulling and yanking on a stuck component to remove it)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
 4. **Head/neck bent, tilted, or twisted** (>10°) *(e.g., craning neck looking into tight spaces)*	F S O N 3 2 1 0	F S O N 6 3 1 0	F S O N 3 2 1 0	F S O N 6 3 1 0	F S O N 3 2 1 0	F S O N 6 3 1 0	
Task Scores = (column total)							

Part II - Checklist, Hands/Wrists/Arms

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

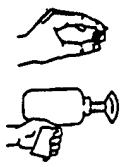
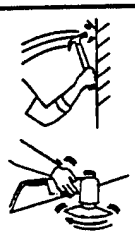
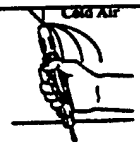
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name: Task Frequency Moderate 10-50%	Task Name: Task Frequency High 51-100%	Task Name: Task Frequency Moderate 10-50%	Task Name: Task Frequency High 51-100%	Task Name: Task Frequency Moderate 10-50%	Task Name: Task Frequency High 51-100%	Comments
	5. **Bent wrists/repeated wrist movements** (>10° in any direction) **or repeated forearm rotation** *(e.g., turning a screw driver, Allen wrench)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	6. **Repeated manipulations with fingers** *(e.g., repetitive computer keying tasks, removing small screws, electrical wiring tasks)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 1 0 0 0	F S O N 2 1 0 0	
	7. **Hyperextension of finger/thumb** *(e.g., using pliers with a wide handle span)* **or repeated single finger activation** *(e.g., single finger triggers on power tools)*	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 1 0 0 0	F S O N 3 1 0 0	F S O N 1 0 0 0	F S O N 3 1 0 0	
	8. **Hand/grip forces** *fingertip force: > 2 lb. (e.g., 2 lb. is roughly equal to holding fingernail clippers closed full hand force: > 8 lb. (e.g., 8 lb. is roughly equal to holding a 8 lb. tool or holding a gallon of milk)*	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	
	9. **High speed hand/wrist /arm movements** *(e.g., yank components with fingers, using the hand as a hammer)* ***OR*** **Vibration, impact, or torque to the hand** *(e.g., using a nail gun or other power tools and equipment)*	F S O N 3 1 0 0	F S O N 5 2 1 0	F S O N 3 1 0 0	F S O N 5 2 1 0	F S O N 3 1 0 0	F S O N 5 2 1 0	
	10. **Exposure to hard edges** *(e.g., tool handle or work area presses into fingers or palm of hands)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	11. **Hands and fingers exposed to cold temperatures** *(e.g., working outside in winter environment, cold exhaust air from tool blows on hand/wrist)*	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 1 0 0 0	F S O N 2 1 0 0	F S O N 1 0 0 0	F S O N 2 1 0 0	
	Task Scores = (column total)							

Part II - Checklist, Back/Torso

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

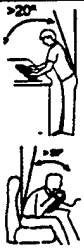
Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

Job Factor	Task Name:		Task Name:		Task Name:		Comments
	Task Frequency		Task Frequency		Task Frequency		
	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	
 12. **Repeated forward or sideways bending movements** (>20°) (e.g. lifting from floor level)	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
 13. **Twisting of the lower back** (e.g. rushing while lifting, pulling, open a stuck door)	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	
 14. **High speed, sudden movements** *with the back*	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	F S O N 3 1 0 0	F S O N 4 2 1 0	
 15. **Static, awkward back postures** *(for >10 sec at a time)* ***While standing,*** *continuous leaning forward or to the side* (>20°) **or** ***While seated,*** *continuous leaning forward* (>20°) *or poor lower back posture (e.g., poor lower back support, no support for feet)*	F S O N 2 1 0 0	F S O N 6 2 1 0	F S O N 2 1 0 0	F S O N 6 2 1 0	F S O N 2 1 0 0	F S O N 6 2 1 0	
16. **Lifting forces**							
 • *50-70 lb. while upright w/ load close to body or*	F S O N 3 2 2 0	F S O N 4 3 2 0	F S O N 3 2 2 0	F S O N 4 3 2 0	F S O N 3 2 2 0	F S O N 4 3 2 0	
 • *10-40 lb. while bending or reaching*							
 • *> 70 lb. while upright w/ load close to body or*	F S O N 6 5 4 0	F S O N 7 6 4 0	F S O N 6 5 4 0	F S O N 7 6 4 0	F S O N 6 5 4 0	F S O N 7 6 4 0	
 • *> 40 lb. while bending or reaching*							
 17. **Pushing or pulling** *(initial force > 50 lb.) (e.g. pushing/pulling a full two-drawer file cabinet across a carpeted floor)*	F S O N 3 2 1 0	F S O N 4 3 2 0	F S O N 3 2 1 0	F S O N 4 3 2 0	F S O N 3 2 1 0	F S O N 4 3 2 0	
 18. **Whole body vibration** *felt through floor surface (e.g. operating heavy machinery)*	F S O N 2 1 0 0	F S O N 4 2 1 0	F S O N 2 1 0 0	F S O N 4 2 1 0	F S O N 2 1 0 0	F S O N 4 2 1 0	
Task Scores = (column total)							

Part II - Checklist, Legs/Feet

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name:		Task Name:		Task Name:		Comments
		Task Frequency		Task Frequency		Task Frequency		
		Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	
	19. **Fixed position, standing** *static effort in legs (e.g. standing on hard floor surfaces)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	20. **Exposure to hard edges on legs, knees, and feet** *(e.g., kneeling on a hard surface standing on rungs of a ladder, leaning against a hard edge, exposure to hard front edge of seat)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	21. **Awkward leg postures** *(e.g. kneeling, squatting, crawling, or knee hyperextension)*	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	F S O N 2 1 0 0	F S O N 5 2 1 0	
	22. **Standing foot pedal** *(e.g., using foot pedal while standing)*	F S O N 1 0 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 3 2 1 0	F S O N 1 0 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)							

Part II - Checklist, Head/Eyes

Job Factors

For each Job Factor, select the appropriate Job Factor frequency score using the following guidelines:

Frequently (F): Job Factor occurs for greater than 50% of the task

Sometimes (S): Job Factor occurs for 10-50% of the task

Occasional (O): Job Factor occurs for less than 10% of the task

Never (N): Job Factor does not occur or does not apply

Critical Tasks

	Job Factor	Task Name:		Task Name:		Task Name:		Comments
		Task Frequency		Task Frequency		Task Frequency		
		Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	Moderate 10-50%	High 51-100%	
	23. **Difficult to see/light levels too low /too high.** *(e.g., see detail)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	24. **Intensive visual tasks, staring at work objects for long periods** *(e.g., inspection, troubleshooting)*	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	F S O N 2 1 0 0	F S O N 3 2 1 0	
	Task Scores = (column total)							

Part III - Environmental

Environmental Factors	Strongly Disagree 1	Disagree 2	Neutral 3	Agree 4	Strongly Agree 5
25. Restricted space	0	0	0	1	4
26. Windy conditions	0	0	0	1	4
27. Extreme temperatures heat / cold	0	0	0	1	4
28. Noise or distractions	0	0	0	1	4
29. Air quality concerns	0	0	0	1	4
30. Displays/controls are difficult to understand	0	0	0	1	4

Environmental Score = ____

Environmental Rating	Low	Med	High
Environmental Score	0-3	4-7	8+

Part IV - Employee Suggestion

Ask the employee for any suggestions for corrective actions that they may have.

Stop time:_____

Elapsed time:_____

ERGONOMIC SUMMARY REPORT:

Start Time_____

Technician _____ **Scenario number**_____

Date _____ **Scenario name**_____

1. Job Description: Please write out job description.

2. Scoring Summary: Transfer scores from individual scoring sheets.

Body Region	Task Scores					Priority Score by Body Region	Priority Rating by Body Region
	Task Name:	**Task Name:**	**Task Name:**	**Task Name:**		**Add across row and divide by # of tasks for average**	High: 8+ Med: 4-7 Low: 0-3
Shoulder/Neck					=		High Med Low
Hand/Wrist/Arm					=		High Med Low
Back/Torso					=		High Med Low
Legs/Feet					=		High Med Low
Head/Eyes					=		High Med Low

Select the highest body region score for each task then circle below for High, Med, Low	Highest Score	Highest Score	Highest Score	Highest Score
High: 8+ Med: 4-7 Low: 0-3	High Med Low	High Med Low	High Med Low	High Med Low

Environmental Rating
High Med Low

First Priority Task

Select the highest task score.
Write the task name.

Task Name_____

Select the two highest body region scores within the task.

First Highest Body Region	**Second Highest Body Region**
Score _____	Score_____
Body Region_____	Body Region_____

Second Priority Task

Select the next highest task score.
Write the task name.

Task Name_____

Select the two highest body region scores within the task.

First Highest Body Region	**Second Highest Body Region**
Score _____	Score_____
Body Region_____	Body Region_____

Overall

Highest Priority Score by Body Region	Priority Rating
Score:_____	**High**
Body Region:_____	**Med**
	Low

Customer
POC and Phone: _____

Customer
Office Symbol: _____

Date:_____

Division: OEMO

TECHNICAL REPORT SATISFACTION SURVEY
(AF PREMIER Program Level I Ergonomics Assessment Guide-Maintenance/Inspection)

This survey is used to help us improve our service to you. Your answers will be held in confidence and will significantly impact how we allocate resources to meet your needs. Upon completion of your review, please mail or fax (DSN 240-2288/Comm 210-536-2288) this form to our Quality Assurance office (OEPQ). Thank you very much!

GRADING SCALE: EXTREMELY DISSATISFIED 1 | DISSATISFIED 2 | SLIGHTLY DISSATISFIED 3 | SLIGHTLY SATISFIED 4 | SATISFIED 5 | EXTREMELY SATISFIED 6 | N/A

FORMAT: Is the report understandable and well organized?	1	2	3	4	5	6	N/A
CONTENT: Does it provide you with necessary program implementation guidelines or data collection tools?	1	2	3	4	5	6	N/A
USEFULNESS: Did you use this product and, if so, was it easy to use?	1	2	3	4	5	6	N/A
QUALITY: Are you satisfied with the quality of this product?	1	2	3	4	5	6	N/A
SUPPORT: Are you satisfied with the support we have provided on this product?	1	2	3	4	5	6	N/A
OVERALL: Overall, how would you rate this product?	1	2	3	4	5	6	N/A

Comments/Suggestions: Did you find any errors or omissions? Will you continue to use this product? Are there any specifics of this product you would like to discuss? Are there other services you would like provided in the future? (Use back of page if more space is required.)

----------(fold)----------

OFFICIAL BUSINESS

Return to:

Armstrong Laboratory / OEPQ
2402 E Drive
Brooks AFB, TX 78235-5114