Pilot Test Results:
Testing Subject Matter Expert Methodology for Collecting Occupational Information for O*NET™

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Introduction

One of the data sources being investigated to support the continuing enhancement of O*NET data is subject matter experts (SMEs). The primary method for collecting O*NET occupational information is the use of job incumbents from business establishments and/or association memberships (United States Department of Labor, 1999). However, other SMEs may serve as the source of data for a small percentage of occupations where the job incumbent approach is problematic. Subject matter experts offer a viable option in occupations where the number of incumbents is small, when the occupation is new or emerging and does not have industry employment data, or those whose incumbents are in remote locations that are difficult to access. In these situations, use of industry occupational data to sample and locate potential job incumbent respondents is inefficient. By enlisting the help of professional associations or other professional groups, a set of experts representing a particular occupation can be identified and asked to participate in the O*NET data collection. By working with these professional groups it will be easier to identify SMEs and foster their cooperation, thus enabling a more targeted approach for data collection.

Data collected from SMEs offers multiple advantages and can serve as a valuable supplement to the current O*NET data collection effort using incumbents. The SME approach can facilitate data collection for occupations that are particularly hard to collect data on through the incumbent approach. Additionally, the SME approach affords a viable option for voluntary data collection opportunities by using targeted sampling. For example, when professional, trade, or industry organizations approach O*NET to participate in data collection, the SME data collection methodology could be implemented. The opportunity to sample within lists of SMEs allows

O*NET to maintain some control over the representativeness of its data. Finally, the SME

approach is potentially an efficient approach to collecting data because it typically requires a

smaller sample size to complete the data for an occupation and saves resources required in

surveying job incumbents in difficult-to-locate occupations in a national sample.

In the following sections we will describe a joint effort with the Environmental Career Center

(ECC) to gather data for an O*NET occupation using subject matter experts. The method and

results are presented, and descriptive statistics for the items are presented in the attached

Apendices.

The Environmental Career Center

The O*NET Project was approached by the Environmental Career Center (ECC) to participate in

a small pilot study in which SMEs provided data for an occupation included in O*NET. ECC

provides assistance to organizations in the environmental sector by identifying and tracking

industry trends, education and training opportunities/needs, career opportunities, and candidate

capabilities. ECC also serves as a clearinghouse for information related to environmental jobs.

Based on their organizational responsibilities, ECC has access to the environmental industry

sector, one of the sectors in which O*NET is collecting occupational data. ECC wants to ensure

that environmental jobs are accurately represented in the O*NET database. By so doing, the

environmental sector will be able to take full advantage of the O*NET database for a variety of

human resources/career exploration functions. Therefore, ECC sponsored a pilot project to work

with the O*NET team to collect SME data for one of its occupations directly linked to O*NET:

Waste Water Treatment Operators.

Method

<u>The Pilot Occupation</u>

ECC has 77 environmental occupations in their database. These occupations were matched with the O*NET data based on a task analysis activity. Occupations that matched an O*NET occupation one-to-one and which were included in the O*NET Pretest Data Collection (Research Triangle Institute, 2000) effort were identified. From this list the project team selected the ECC occupation Waste Water Treatment Operator based on the availability of a broad representative set of experts and a desire on the part of ECC to obtain updated information on the occupation. A Waste Water Treatment Operator (Water and Liquid Waste Treatment Plant and System Operator, O*NET SOC# 51-8031.00) *"operates or controls an entire process or system of machines, often through the use of control boards, to transfer or treat water or liquid waste."* The tasks identified in O*NET OnLine (http://online.onetcenter.org), and included in the task list provided to SMEs to help describe the occupation and for rating, are shown in Table 1.

<u>Sampling.</u> The goal was to identify at least one subject matter expert for the Waste Water Treatment Operator occupation in each state and to receive at least 15 completed sets of questionnaires. Analysis of data gathered in the Pretest determined that 15 respondents were needed to provide reliable information on an occupation (Bender & Koritko, 2000). The Environmental Career Center provided an existing list of experts in waste water treatment from across the country. The list had been compiled by the Advanced Technology Environmental Education Center, the Environmental Hazards Management Institute, Hazardous Materials Training and Research Institute, and the Partnership for Environmental Technology Education so that people seeking advice or information on waste water treatment would have a resource

anywhere in the country. Contacts were found in 39 states. Some states were not represented, while two states had more than one contact. Each of the 43 SMEs identified was assigned a random number and contacted by telephone to request their participation.

Table 1

Tasks for Water and Liquid Waste Treatment Plant and System Operator

1) Operates and adjusts controls on equipment to purify and clarify water, process or dispose of sewage, and generate power.

2) Inspects equipment and monitors operating conditions, meters, and gauges to determine load requirements and detect malfunctions.

3) Adds chemicals, such as ammonia, chlorine, and lime, to disinfect and deodorize water and other liquids.

4) Collects and tests water and sewage samples, using test equipment and color analysis standards.

5) Records operational data, personnel attendance, and meter and gauge readings on specified forms.

6) Cleans and maintains tanks and filter beds, using hand tools and power tools.

7) Maintains, repairs, and lubricates equipment, using hand tools and power tools.

8) Directs and coordinates plant workers engaged in routine operations and maintenance activities.

Procedure. SMEs were contacted according to a pre-determined protocol. First, a telephone call was placed to the SMEs to determine eligibility (five years experience in the field plus one year of supervisory experience). Packets of questionnaires with a pre-addressed Federal Express return envelop were sent out the same day to qualified SMEs. One week later SMEs were contacted by phone to ensure that they received their packets. Three weeks later another follow-up was conducted to ensure that packets were completed and returned.

Questionnaires. Each packet sent to the SMEs included a cover letter (see Appendix A),

instructions for completing the questionnaires (see Appendix A), and the five questionnaires

used for the O*NET pretest data collection (United States Department of Labor, 1999). The

questionnaires covered abilities, generalized work activities, skills, knowledge, education and

training, work styles, and work context. Items were rated for importance and level, with the

exception of the work context scale that asked respondents for importance, level, or frequency

ratings, depending on the item. If a respondent indicated that an item was not important for the

occupation, the instructions stated that the level scale should be skipped. In addition to the

questionnaires, a task list with the eight tasks identified for Waste Water Treatment Operators

and a background questionnaire with demographic questions were included for rating.

In order to make the surveys appropriate for subject matter experts rather than incumbents,

modifications to the survey directions were made. In addition, the reference stem for the items

was changed from "your job" to "the job." Examples of the revisions made to the instructions

and the item stems are presented in Table 2.

Table 2

Examples of Modifications Made to Questionnaires

General Sample	SME Sample
Instructions to respondents:	Instructions to respondents:
You will be asked about a series of different skills and how they relate to your current job – that is, the job you now hold.	You will be asked about a series of different skills and how they relate to incumbents in the job.

Example item stem:	Example item stem:
1. How <u>important</u> is READING COMPREHENSION to the performance of *your current* job?	1. How <u>important</u> is READING COMPREHENSION to the performance of the job?

Results and Analyses

<u>Response rate.</u> Of those selected from the list, 20 (46.5%) were ineligible (no longer with the agency or unable to contact). Of the remaining 23, two individuals declined to participate. Packets were sent to the remaining 21 who agreed to participate. Fifteen of those who agreed to participate returned their surveys (response rate = 71%).

The respondents were primarily employed at state agencies (47%) and colleges or universities (40%). Eleven of the respondents (73%), had direct work experience as Waste Water Treatment Operators, and 7 respondents (47%), had supervised Waste Water Treatment Operators at some time in their work careers, although most had been supervisors ten or more years prior to completing the survey. Thirteen respondents (87%) reported that they taught educational courses on operator duties.

<u>Item descriptive information.</u> The Snapshot, or summary of the most important characteristics, for Waste Water Treatment Operators, is presented in Appendix B, Tables B.1 through B.8. The means and standard deviations for importance and level for all questionnaire items are presented in Tables C.1 through C.6 in Appendix C.

Conclusion

ECC and O*NET conducted a pilot test of subject matter expert methodology for collecting data.

Data was collected from 15 subject matter experts, with a response rate of 71% of the

participating experts. Preliminary review of the data and the survey process indicate that the

SME approach may serve as a viable supplemental method for collecting O*NET data.

References

Bender, R., & Koritko, L., (2000). *Standard error analysis: Reliability and implications for sample size.* Research Triangle Institute, Research Triangle Park, NC: Author.

United States Department of Labor (1999). *Office of Management and Budget Clearance Package Supporting Statement and Data Collection Instruments.* Washington, DC: Author.

Research Triangle Institute, Statistics Research Division (2000). *O*NET pretest report: Results of statistical analysis.* Research Triangle Park, NC: Author.

APPENDIX A

Supplementary Materials Sent to Subject Matter Experts

Cover Letter

June 15, 2000

Dear Ms. Broccoli:

The Environmental Career Center (ECC) and the Occupational Information Network (O*NET) are inviting wastewater treatment experts across the country to help develop ECCO*NET. ECCO*NET is a joint project created in response to changes in the way work is done within the Environmental, Health, and Safety (EH&S) industry. In today's global economy, employers, educators, and government must share a commitment to building and maintaining a skilled U.S. workforce. Our commitment must also include supporting national academic standards to assure that environmental training programs produce graduates that can meet the challenges of changing technologies.

The ECC is a precedent-setting, online employment system for users to identify employment opportunities within the EH&S industry based on their acquired work skills. The system specifically targets the needs of dislocated and incumbent workers, and of employers, and supports the lifelong learning needs of each. O*NET is a national initiative that provides descriptive information important to job performance, such as knowledge, skills, abilities, work styles, for occupations across the economy. ECCO*NET combines these two systems, joining the power of the Internet, EH&S industry resources, and a common language for identifying and organizing data that define the modern world of work. With ECCO*NET, you will be able to:

- Reduce recruitment costs and improve hiring procedures.
- Increase the effectiveness of education and training program expenditures.
- Facilitate career-planning programs for students and also dislocated and incumbent workers.
- Reduce the time spent on task analyses and developing job descriptions.
- Facilitate bench marking against high performance practices, setting skill standards for jobs, updating credential or certificate programs.

Please partner with us to build the ECCO*NET system. By volunteering to serve as a subject matter expert, you will have a voice in defining the characteristics that distinguish the modern American workplace. Enclosed is an overview of the expert rating task and a set of rating materials. Your participation will take approximately three to four hours. If you have questions, please contact Ms. Kara Daly at 603/642-4720 or Mr. David Rivkin at 202/219-7161, ext. 160.

Thank you in advance for your help on this important project. Your participation is an investment in a valuable resource for businesses, schools, and workers nationwide. The potential of ECCO*NET is strengthened by input from experts like yourself.

Sincerely yours,

_____
Ellen Kabat, Director
Advanced Technology Environmental Education Center

_____
Alan John Borner, Executive Director
Environmental Hazards Management Institute

_____
Pat Berntsen, Director
Hazardous Materials Training and Research Institute

_____
Kirk Laflin, Executive Director
Partnership for Environmental Technology Education

_____
Donna Dye, O*NET Project Manager
Office of Policy and Research/US Department of Labor

_____
William R. Osgood, Project Manager
Environmental Career Center

Instructions for Completing the Questionnaires

GENERAL INSTRUCTIONS FOR COMPLETING QUESTIONNAIRES

Thank you for agreeing to serve as an expert for the Environmental Career Center (ECC) and the Occupational Information Network (O*NET) project to improve the occupational information available for Environmental Careers. By serving as an expert for the occupation **Water and Liquid Waste Treatment Plant and System Operator**, you will have a voice in defining the characteristics that distinguish the modern American Workplace. We greatly appreciate your help.

Completing Questionnaires in a Specific Order: To collect updated information on **Water and Liquid Waste Treatment Plant and System Operators**, our team has enclosed seven questionnaire packets for you to complete in a predetermined order:

- Abilities Questionnaire
- Generalized Work Activities Questionnaire
- Skills Questionnaire
- Work Context Questionnaire

- Background Questionnaire
- Knowledge, Education and Training, and Work Styles Questionnaires
- Task Questionnaire

Your questionnaires have been numbered for you to complete them in a particular order. Please complete the questionnaire booklets in the order indicated by the number located on the front page of each booklet.

Each questionnaire booklet contains a **unique set of questions** that will allow you to help this project define the occupational characteristics of **Water and Liquid Waste Treatment Plant and System Operators**.

Following Instructions: Each questionnaire has instructions and examples for completing questions. It is important to read the instructions and examples carefully. **Instructions are different in each booklet.**

Answering Questions: Answer questions based on how Water and Liquid Waste Treatment Plant and System Operators **currently perform their jobs.** Remember, we are trying to provide updated information about the occupation. Base your answers on your experience as a Water and Liquid Waste Treatment Plant and System Operator, a Supervisor of Water and Liquid Waste Treatment Plant and System Operators, and/or a trainer of Water and Liquid Waste Treatment Plant and System Operators. **Please answer all questions.**

Take Your Time: It will probably take you about three hours to complete all seven questionnaires. Take your time. We suggest completing the questionnaires in two sessions. (Complete Booklets One, Two, and Three during your first session, and Booklets Four, Five, Six, and Seven during a second session.) Once you start a questionnaire; however, we would like you to complete that entire booklet.

Do You Have Questions? If you have any questions please contact Kara Daly at (603) 642-4720 or David Rivkin at (202) 219-7161.

MAILING COMPLETED QUESTIONNAIRES

We have enclosed a pre-addressed Federal Express Envelope for you to mail back your completed surveys. If you have any questions please call Kara Daly at (603) 642-4720 or David Rivkin at (202) 219-7161 ext. 160. Thank you again for your help!

COMMENTS AND FEEDBACK

Please use this space to write any comments you have about the questionnaires, the instructions, or any part of this process. Include suggestions you have that you believe would improve the process or the materials.

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APPENDIX B

Snapshot Information for Waste Water Treatment Operators

Table B.1

Snapshot of the Abilities Required for Waste Water Treatment Operator Based on SME Ratings

Item		Means	
No.	Abilities	Importance	Level
2	Written Comprehension	4.07	4.73
7	Problem Sensitivity	3.93	4.27
1	Oral Comprehension	3.87	4.60
13	Number Facility	3.73	4.27
3	Oral Expression	3.73	4.60
8	Deductive Reasoning	3.67	4.07
4	Written Expression	3.53	4.20
23	Manual Dexterity	3.47	4.07
18	Spatial Orientation	3.40	3.60
12	Mathematical Reasoning	3.40	3.67
52	Speech Clarity	3.40	3.60

Table B.2

Snapshot of the Generalized Work Activities Required for Waste Water Treatment Operator Based on SME Ratings

Item		Means	
No.	Generalized Work Activities	Importance	Level
3	Monitoring Processes, Materials, or Surroundings	4.15	4.54
10	Making Decisions and Solving Problems	4.13	4.07
7	Evaluating Information to Determine Compliance with Standards	4.00	4.13
4	Inspecting Equipment, Structures, or Materials	3.92	4.38
1	Getting Information	3.87	4.07
28	Establishing and Maintaining Interpersonal Relationships	3.80	4.27
22	Repairing and Maintaining Mechanical Equipment	3.80	4.64
12	Updating and Using Relevant Knowledge	3.80	4.40
2	Identifying Objects, Actions, and Events	3.80	3.80

| 26 | Communicating with Supervisors, Peers, or Subordinates | 3.80 | 4.20 |

Table B.3

Snapshot of the Knowledge Required for Waste Water Treatment Operator Based on SME Ratings

| Item | | Means | |
No.	Knowledges	Importance	Level
13	Mechanical	3.80	4.53
30	Law and Government	3.53	3.40
14	Mathematics	3.47	3.87
29	Public Safety and Security	3.47	3.86
16	Chemistry	3.33	4.13
17	Biology	3.27	3.79
24	English Language	3.13	3.43
1	Administration and Management	3.00	3.93
9	Computers and Electronics	2.87	3.64
10	Engineering and Technology	2.67	3.57
5	Customer and Personal Service	2.67	3.54
12	Building and Construction	2.67	3.86

Table B.4

Snapshot of the Skills Required for Waste Water Treatment Operator Based on SME Ratings

| Item | | Means | |
No.	Skills	Importance	Level
24	Operations Monitoring	4.53	4.67
27	Troubleshooting	4.40	4.40
25	Operation and Control	4.40	4.47
26	Equipment Maintenance	4.33	4.53
28	Repairing	3.87	4.33
20	Equipment Selection	3.87	4.20
1	Reading Comprehension	3.87	4.20
29	Systems Analysis	3.73	4.07
5	Mathematics	3.73	4.27

31	Judgment and Decision Making	3.73	3.93

Table B.5

Snapshot of the Work Context for Waste Water Treatment Operator Based on SME Ratings

Item No.	Work Context	Means Frequency
1	Face-to-face discussions	4.87
29	Exposure to disease or infection	4.73
3	Telephone conversations	4.67
25	Exposure to contaminants	4.53
43	Wearing common protective or safety equipment	4.47
17	Working outdoors in all weather conditions	4.47
16	Working in a environment that is not environmentally controlled	4.40
31	Exposure to hazardous conditions	4.40
32	Exposure to hazardous equipment	4.33
18	Working outdoors under cover	4.33

Table B.6

Snapshot of the Work Styles for Waste Water Treatment Operator Based on SME Ratings

Item No.	Work Styles	Means Level
49	Dependability	4.33
51	Integrity	4.13
50	Attention to Detail	4.07
43	Cooperation	3.93
54	Analytical Thinking	3.67
48	Adaptability/Flexibility	3.47
46	Self-control	3.40
41	Initiative	3.40
47	Stress Tolerance	3.20
40	Persistence	3.20

Table B.7

Snapshot of the Experience and Training Requirements for Waste Water Treatment Operators Based on SME Ratings

Item No.	Experience and Training	Means Importance
35	Related Work Experience	5.14
37	On-the-job Training	4.47
36	On-site or In-Plant Experience	3.73
38	Apprenticeship	3.40

Table B.8

Means on the Tasks for Waste Water Treatment Operator Based on SME Ratings

Item No.	Tasks	Means Importance	Level
3	Adds chemicals, such as ammonia, chlorine, and lime, to disinfect and deodorize water and other liquids.	4.77	6.00
1	Operates and adjusts controls on equipment to purify and clarify water, process or dispose of sewage, and generate power.	4.69	6.23
4	Collects and tests water and sewage samples, using test equipment and color analysis standards.	4.46	5.38
2	Inspects equipment and monitors operating conditions, meters, and gauges to determine load requirements and detect malfunctions.	4.46	5.92
5	Records operational data, personnel attendance, and meter and gauge readings on specified forms.	4.31	5.69
8	Directs and coordinates plant workers engaged in routine operations and maintenance activities.	4.00	5.09
7	Maintains, repairs, and lubricates equipment, using hand tools and power tools.	4.00	4.00
6	Cleans and maintains tanks and filter beds, using hand tools and power tools.	3.38	3.77

APPENDIX C

Item Descriptive Information

Table C.1
Means and Standard Deviations for the Abilities Questionnaire

Abilities	Importance		Level	
	M	SD	M	SD
1. Oral Comprehension	3.87	.74	4.6	.63
2. Written Comprehension	4.07	.59	4.73	.88
3. Oral Expression	3.73	.88	4.6	.74
4. Written Expression	3.53	.99	4.2	.86
5. Fluency of Ideas	2.27	1.03	3.36	1.21
6. Originality	2.4	1.06	3.42	1.0
7. Problem Sensitivity	3.93	.96	4.27	.96
8. Deductive Reasoning	3.67	.72	4.07	.70
9. Inductive Reasoning	3.13	.92	3.80	.94
10. Information Ordering	3.2	.86	3.4	.63
11. Category Flexibility	2.4	.63	3.5	.65
12. Mathematical Reasoning	3.4	.51	3.67	.72
13. Number Facility	3.73	.80	4.27	.70
14. Memorization	2.80	.94	3.29	.73
15. Speed of Closure	2.6	.91	3.31	.95
16. Flexibility of Closure	2.47	1.13	4.27	.79
17. Perceptual Speed	2.47	.92	3.21	1.05
18. Spatial Orientation	3.4	.83	3.6	1.06
19. Visualization	2.87	.64	4.0	.66
20. Selective Attention	3.33	.62	3.67	.90
21. Time Sharing	3.27	.88	3.93	.70
22. Arm-Hand Steadiness	2.93	.46	3.67	.49
23. Manual Dexterity	3.47	.92	4.07	.88
24. Finger Dexterity	3.07	.80	4.0	.78
25. Control Precision	2.93	.96	4.0	.88
26. Multilimb Coordination	2.87	.99	3.92	.86

27. Response Orientation	2.87	.92	3.71	1.14

Table C.1, continued:

<u>Means and Standard Deviations for the Abilities Questionnaire</u>

	Importance		Level	
Abilities	<u>M</u>	<u>SD</u>	<u>M</u>	<u>SD</u>
28. Rate Control	2.6	.92	3.31	1.25
29. Reaction Time	2.80	.86	3.53	1.25
30. Wrist-Finger Speed	2.4	.83	3.31	.95
31. Speed of Limb Movement	2.27	.96	3.15	1.35
32. Static Strength	2.80	.94	4.27	1.34
33. Explosive Strength	2.0	.85	3.6	.70
34. Dynamic Strength	2.27	.88	3.58	1.0
35. Trunk Strength	2.47	.99	3.83	.94
36. Stamina	2.47	.83	3.39	.96
37. Extent Flexibility	2.27	1.39	4.0	.96
38. Dynamic Flexibility	2.4	.74	3.0	.88
39. Gross Body Coordination	2.47	.92	3.31	.86
40. Gross Body Equilibrium	2.8	.94	3.5	.76
41. Near Vision	3.13	.74	4.0	.66
42. Far Vision	3.0	.76	3.87	.83
43. Visual Color Discrimination	3.27	1.03	4.14	.66
44. Night Vision	2.80	1.01	3.46	.88
45. Peripheral Vision	2.87	.83	3.5	1.09
46. Depth Perception	3.27	.70	3.87	.83
47. Glare Sensitivity	2.20	.68	2.92	.86
48. Hearing Sensitivity	2.93	.80	3.64	.63
49. Auditory Attention	2.53	.74	3.57	.65
50. Sound Localization	2.60	.83	3.57	.76
51. Speech Recognition	2.73	1.22	3.67	.65
52. Speech Clarity	3.4	.74	3.6	.74

Table C.2
Means and Standard Deviations for Items on the Skills Questionnaire

Skills	Importance		Level	
	M	SD	M	SD
1. Reading Comprehension	3.87	.74	4.2	.78
2. Active Listening	3.67	.72	3.93	.59
3. Writing	3.33	.82	3.87	.52
4. Speaking	3.53	.74	4.07	.59
5. Mathematics	3.73	.59	4.27	.59
6. Science	3.4	.74	3.47	.92
7. Critical Thinking	3.47	.92	4.43	.51
8. Active Learning	3.53	.64	4.07	.70
9. Learning Strategies	2.86	.77	3.07	.92
10. Monitoring	3.20	.94	4.0	1.0
11. Social Perceptiveness	2.6	.83	3.5	1.02
12. Coordination	3.27	1.03	4.5	.94
13. Persuasion	2.8	.94	4.07	.48
14. Negotiation	2.8	.78	3.33	1.05
15. Instructing	3.2	1.01	4.14	.77
16. Service Orientation	2.93	1.03	3.29	.83
17. Complex Problem Solving	3.13	.83	3.57	.76
18. Operations Analysis	3.07	.88	3.73	.88
19. Technology Design	2.53	.74	3.29	.91
20. Equipment Selection	3.87	.64	4.20	.56
21. Installation	3.2	.78	3.67	.98
22. Programming	1.4	.63	2.33	1.03
23. Quality Control Analysis	3.53	1.13	4.29	1.14
24. Operations Monitoring	4.53	.83	4.67	1.05
25. Operation and Control	4.4	.63	4.47	.52
26. Equipment Maintenance	4.33	.90	4.53	.92
27. Trouble Shooting	4.40	.63	4.4	1.06
28. Repairing	3.87	.99	4.33	1.05
29. Systems Analysis	3.73	.80	4.07	.46
30. Systems Evaluation	3.53	1.06	4.07	.62
31. Judgment and Decision Making	3.73	.88	3.93	.88
32. Time Management	3.33	.98	3.87	1.19
33. Management of Financial Resources	3.47	.92	4.27	1.03
34. Management of Material Resources	3.60	.74	4.07	.88
35. Management of Personnel Resources	3.2	.94	4.07	1.16

Table C.3

Means and Standard Deviations for Items on the Generalized Work Activities (GWA) Questionnaire

Generalized Work Activities	Importance		Level	
	M	SD	M	SD
1. Getting Information	3.87	.83	4.07	.70
2. Identifying Objects, Actions, & Events	3.8	1.01	3.8	.68
3. Monitoring Processes, Materials, or Surroundings	4.15	.80	4.54	.78
4. Inspecting Equipment, Structures, or Materials	3.92	.76	4.38	.96
5. Estimating the Quantifiable Characteristics of Products, Events, or Information	3.13	.92	3.42	.85
6. Judging the Qualities of Objects, Services, or People	3.27	.96	3.86	.95
7. Evaluating Information to Determine Compliance with Standards	4.0	1.0	4.13	1.25
8. Processing Information	3.6	.99	3.87	1.06
9. Analyzing Data Information	3.6	.83	3.8	1.21
10. Making Decisions and Solving Problems	4.13	.74	4.07	1.10
11. Thinking Creatively	2.67	.72	3.07	1.16
12. Updating and Using Relevant Knowledge	3.8	.68	4.4	.99
13. Developing Objectives and Strategies	2.73	1.22	3.42	1.44
14. Scheduling Work and Activities	3.47	.92	3.93	1.28
15. Organizing, Planning, and Prioritizing Work	3.53	.74	4.53	1.25
16. Performing General Physical Activities	3.47	.83	4.33	.90
17. Handling and Moving Objects	3.4	.99	4.64	1.08
18. Controlling Machines and Processes	3.73	.96	4.29	1.07
19. Working with Computers	3.13	.92	3.29	.83
20. Operating Vehicles, Mechanized Devices, or Equipment	3.4	.91	3.28	.61
21. Drafting, Laying Out, and Specifying Technical Devices, Parts, and Equipment	2.13	.92	3.2	.63
22. Repairing and Maintaining Mechanical Equipment	3.8	1.08	4.64	1.08
23. Repairing and Maintaining Electronic Equipment	3.0	.85	3.5	1.09
24. Documenting/Recording Information	3.73	.96	3.57	.85
25. Interpreting the Meaning of Information for Others	3.0	.66	2.67	.90
26. Communicating with Supervisors, Peers, or Subordinates	3.8	.56	4.2	.78

Table C.3, continued:

Means and Standard Deviations for Items on the Generalized Work Activities (GWA)
Questionnaire

	Importance		Level	
Generalized Work Activities	M	SD	M	SD
27. Communicating with People Outside the Organization	3.67	.82	3.87	1.25
28. Establishing and Maintaining Interpersonal Relationships	3.8	.78	4.27	.88
29. Assisting and Caring for Others	2.33	.82	3.15	1.28
30. Selling or Influencing Others	1.87	.83	2.67	1.12
31. Resolving Conflicts and Negotiating with Others	3.13	1.19	4.0	1.30
32. Performing for or Working Directly with the Public	3.2	1.08	3.77	.83
33. Coordinating the Work Activities of Others	3.07	.88	3.53	1.13
34. Developing and Building Teams	2.8	1.01	3.21	1.05
35. Training and Teaching Others	2.87	1.13	3.31	1.32
36. Guiding, Directing, and Motivating Subordinates	3.13	.99	3.47	1.46
37. Coaching and Developing Others	2.73	.88	3.79	1.25
38. Providing Consultation and Advice to Others	2.93	.96	3.2	1.37
39. Performing Administrative Activities	3.47	.83	3.33	.98
40. Staffing Organizational Units	2.8	1.27	4.27	1.10
41. Monitoring and Controlling Resources	3.33	.82	4.13	1.13

Table C.4

Means and Standard Deviations of Items on the Work Context Questionnaire

Work Context	Importance		Frequency	
	M	SD	M	SD
1. Face to face discussion within teams	--	--	4.87	.35
2. Public speaking	--	--	2.33	.82
3. Telephone conversation	--	--	4.67	.49
4. Electronic mail	--	--	3.40	1.60
5. Written letters and memos	--	--	3.93	.88
6. Contact with others	--	--	4.20	.78
7. Work/contribute to a work group or team	4.0	.76	--	--
8. Dealing with external customers or the public	3.4	1.18	--	--
9. Coordinate or lead others in accomplishing work activities	3.33	.98	--	--
10. Responsibility for health and safety of others	4.27	1.03	--	--
11. Responsibility for work outcomes and results of other workers	3.13	.92	--	--
12. Frequency of conflict situations	--	--	2.60	.63
13. Dealing with unpleasant, angry or discourteous people	--	--	2.60	.63
14. Dealing with violent or physically aggressive people	--	--	1.47	.52
15. Work indoors in an environmentally controlled environment	--	--	3.93	1.16
16. Work in an environment that is not controlled	--	--	4.40	1.30
17. Work outdoors, exposed to weather conditions	--	--	4.47	1.13
18. Work outdoors, under cover	--	--	4.33	1.18
19. Work in an open vehicle or operating equipment	--	--	3.40	1.35
20. Work in a closed vehicle or operate enclosed equipment	--	--	3.93	1.34
21. Physical closeness to other people	3.27	1.10	--	--
22. Distracting and uncomfortable sounds and noise levels	--	--	4.20	.86
23. Very hot (above 90°F) or very cold (under 32°F)	--	--	3.87	1.19
24. Extremely bright or inadequate lighting conditions	--	--	3.53	1.36
25. Exposure to contaminants	--	--	4.53	.92
26. Cramped work spaces requiring getting into awkward positions	--	--	3.33	1.11
27. Whole body vibrations	--	--	2.27	1.03
28. Exposure to radiation	--	--	1.07	.26
29. Exposure to diseases or infection	--	--	4.73	1.03
30. Exposure to high places	--	--	3.67	1.18

Note: Dashes in the table indicate the scale was not relevant for the item.

Table C.4, continued:

Means and Standard Deviations of Items on the Work Context Questionnaire

	Importance		Frequency	
Work Context	M	SD	M	SD
31. Exposure to hazardous conditions	--	--	4.40	1.06
32. Exposure to hazardous equipment	--	--	4.33	1.11
33. Exposure to minor burns, cuts, bites, or stings	--	--	3.67	1.50
34. Sitting	--	--	2.20	.56
35. Standing	--	--	3.67	.82
36. Climbing ladders, scaffolds, poles, etc.	--	--	2.07	.46
37. Walking or running	--	--	2.60	.99
38. Kneeling, crouching, stooping, or crawling	--	--	2.00	.38
39. Keeping or regaining balance	--	--	1.93	.26
40. Using hands to handle, control, or feel objects, tools, or controls	--	--	3.53	1.30
41. Bending or twisting their bodies	--	--	2.27	.80
42. Making repetitive motions	--	--	2.13	.64
43. Wear common protective or safety equipment	--	--	4.47	1.13
44. Wear specialized protective or safety equipment	--	--	2.87	.83
45. How serious a mistake can incumbents make on the job	3.60	1.72	--	--
46. Results of incumbents decisions on other people/financial resources of employer	3.93	.88	--	--
47. Frequency of decisions affecting other people or the employer	--	--	3.87	1.13
48. Freedom to make decisions without supervision	3.73	.96	--	--
49. Automation of the job	2.87	.92	--	--
50. High accuracy required	3.53	.92	--	--
51. Importance of continuous, repetitious physical activities or mental activities	3.07	.88	--	--
52. Freedom to determine tasks, priorities or goals of the job	3.53	.83	--	--
53. Competitiveness of the job	2.33	.72	--	--
54. Frequency of meeting strict deadlines			3.40	1.06
55. Keeping a pace set by machinery or equipment	2.40	1.06	--	--
56. Regularity of work schedule	1.40	.51	--	--
57. Typical work hours in a week	2.27	.46	--	--

Note: Dashes in the table indicate the scale was not relevant for the item.

Table C.5

Means and Standard Deviations of Items on the Knowledge and Work Styles Questionnaires

Items	Importance		Level	
	M	SD	M	SD
Knowledge				
1. Administration and Management	3.00	.93	3.93	.48
2. Clerical	2.47	.74	3.14	1.03
3. Economics and Accounting	2.07	1.03	2.78	.97
4. Sales and Marketing	1.53	.92	3.40	.89
5. Customer and Personal Service	2.67	1.05	3.54	1.13
6. Personnel and Human Resources	2.60	1.12	3.75	.62
7. Production and Processing	2.00	1.07	3.50	.93
8. Food Production	1.27	.46	3.25	.50
9. Computers and Electronics	2.87	.99	3.64	.63
10. Engineering and Technology	2.67	1.05	3.57	.94
11. Design	2.00	1.00	3.30	.95
12. Building and Construction	2.67	.90	3.86	1.10
13. Mechanical	3.80	.94	4.53	.92
14. Mathematics	3.47	.64	3.87	.52
15. Physics	2.60	.74	3.47	.99
16. Chemistry	3.33	.90	4.13	.83
17. Biology	3.27	1.03	3.79	.98
18. Psychology	1.87	.83	3.11	.93
19. Sociology and Anthropology	1.80	.86	3.00	1.07
20. Geography	1.73	.88	3.29	1.25
21. Medicine and Dentistry	1.73	.70	2.33	1.00
22. Therapy and Counseling	1.60	.83	3.17	.75
23. Education and Training	2.33	1.23	3.70	1.25
24. English Language	3.13	.92	3.43	.85
25. Foreign Language	1.20	.41	2.33	1.53
26. Fine Arts	1.07	.26	3.00	0.0
27. History and Archeology	1.20	.41	1.75	.50
28. Philosophy and Theology	1.27	.59	2.75	1.26

Table C.5, continued

Means and Standard Deviations of Items on the Knowledge and Work Styles Questionnaires

| | Importance | | Level | |
Items	M	SD	M	SD
29. Public Safety and Security	3.47	1.25	3.86	1.03
30. Law and Government	3.53	.99	3.40	.91
31. Telecommunications	2.07	.70	2.25	1.06
32. Communications and Media	2.53	.92	3.08	.76
33. Transportation	2.00	.96	3.11	.93
Work Styles				
1. Achievement/Effort	2.87	1.06	--	--
2. Persistence	3.20	.94	--	--
3. Initiative	3.40	.99	--	--
4. Leadership	3.13	.99	--	--
5. Cooperation	3.93	.70	--	--
6. Concern for Others	3.0	1.07	--	--
7. Social Orientation	2.67	.90	--	--
8. Self Control	3.40	.83	--	--
9. Stress Tolerance	3.20	.78	--	--
10. Adaptability/Flexibility	3.47	.74	--	--
11. Dependability	4.33	.82	--	--
12. Attention to Detail	4.07	.88	--	--
13. Integrity	4.13	.99	--	--
14. Independence	3.0	1.20	--	--
15. Innovation	2.87	.99	--	--
16. Analytical Thinking	3.67	.90	--	--

Note: Dashes in the table indicate the scale was not relevant for the item.

Table C.6

<u>Education and Training Required for Waste Water Treatment Operators Based on the Mode of</u>
<u>SME Responses</u>

Education and Training items	
1. Level of Education	Less than a High School Diploma.
2. Related Work Experience	Over 6 months, up to and including 1 year.
3. On-site or In-plant Training	Over 6 months, up to and including 1 year.
4. On-the-Job Training	Over 6 months, up to and including 1 year.
5. Apprenticeship	None.