Work Force Skills and Mission Requirements Comparison System

As a result of the Agency's downsizing effort, the constant evolution and advance of technology, and the changing mission of V group, V7 was tasked with evaluating, maintaining, and enhancing the technical health of the V organization. In turn, I was tasked with developing a metric for evaluating how well our technical skills match our mission requirements. The following article is the result of that effort. However, because of the complexity of the database required to implement this system and the complexity of managing it, this system was not put into place, but the discussion of it may serve as a guideline for future efforts in this area.

As the Agency continues to downsize and as we continue to attempt to become more efficient and to do more with less, it becomes desirable and even necessary to compare the skills of the work force to those skills required to accomplish our mission's tasks. When the work force skills are compared to our current mission requirements, current deficiencies and weaknesses will be made apparent. When compared to future anticipated mission requirements, those areas which will require the development of skills for our future mission will become evident. The Work Force Skills and Mission Requirements Comparison System was designed to enable the easy and accurate comparison of work force skills and mission requirements. It was designed to be simple to use, produce understandable, repeatable, reliable results, and be unbiased, that is, not easily influenced by data tweaking.

1. DATABASE REQUIRED

To compare employee skills with mission job requirements, a database of common skill attributes is required. This database consists of two parts, employee profiles and mission job position profiles. Both the employee profiles and the job position profiles use exactly the same set of skill attributes as parameters. Examples of some skill attributes are COMSEC equipment design, VHDL functional model design and simulation, higher order language programming, machine language programming, software architecture design, key management techniques, technical contract management, and network protocols. The proposed list of fifty skill attributes is provided in Appendix 1, along with a brief definition of each attribute.

Employee Profiles: An employee skill profile must be prepared for each employee. The employee and his immediate supervisor together prepare a profile for the employee. The profile is a one-page chart displaying the degree of employee's skill on the ordinate for each skill attribute on the abscissa. The same profile form, that is, the same list of attributes, is used for every employee. Skill proficiency is rated from zero to five with the following definitions.

Zero: The employee has no knowledge, ability, or skill in the specific attribute and no interest in pursuing this skill.

One: The employee has some slight knowledge, ability, or skill in the specific attribute, or a sincere desire to develop skill in this attribute.

Two: The employee has elementary knowledge, ability, skill, and experience in the specific attribute.

Three: The employee has substantial knowledge, ability, skill, and experience in the specific attribute.

Four: The employee has sufficient knowledge, ability, skill, experience, and expertise in the specific attribute to perform the function without supervision and to instruct and guide others in performing the function.

Five: The employee is a genuine expert in the attribute and has sufficient knowledge, ability, skill, experience, and expertise to act as a consultant to capable others who are performing the function.

Job Position Profiles: A job position profile must be prepared for each specific job position. The program manager prepares a job position profile for each job position in his project. (Internal in-house NSA employee jobs and jobs being performed by contractor personnel at NSA, but does not include jobs performed on contract at the contractor's facility.) If two individuals are performing exactly the same job, two profiles must be prepared. The profile is a one-page chart displaying the degree of skill required by the specific job position on the ordinate for each skill attribute on the abscissa. The same profile form, that is, the same list of attributes, is used for every job position, and exactly the same list of attributes is used for the job positions as was used for the employee profiles. Skill required to perform the job position is rated from zero to five with the following definitions:

Zero: The skill attribute is not required for the job position.

One: The job position requires only a very small amount of knowledge, ability, or skill in the specific attribute.

Two: The job position requires some knowledge, ability, or skill in the specific attribute.

Three: The job position requires substantial knowledge, ability, skill, and experience in the specific attribute.

Four: The job position requires thorough knowledge, ability, skill, experience, and expertise in the specific attribute. The employee must be able to perform the function without supervision and to instruct and guide others in performing the function.

Five: The job position requires that the employee be a genuine expert in the attribute and has sufficient knowledge, ability, skill, experience, and expertise to act as a consultant to capable others who are performing the function.

An example of a skill profile, either an employee skill profile or a job position requirements profile is shown in figure 1.

2. DATABASE MAINTENANCE

The list of attributes will be updated yearly during October, and the updated list of attributes will be provided to each employee, supervisor, and program manager no later than 1 November. Each supervisor will be responsible for preparing a new profile for each of his employees, and each program manager will be responsible for preparing a new job position profile for each job position in his project, using the updated attributes. The updated profiles will be due to the work force skills and mission requirements comparison system control authority no later than 1 December. The work force skills and mission requirements comparison system control authority will be responsible for updating the databases in the computer and having the system up and running no later than 1 January.

3. FUNCTIONS PERFORMED

The work force skills and mission requirements comparison system was designed to perform each of the following functions.

a. Compare the skills of each employee against the requirements of one specific job position and rank employees from one through n based on how well their skills match the requirements of the job position.

b. Compare the skills of one single employee against the requirements of all the jobs and rank the jobs from one through n based on how well the requirements of each job position match the employee's skills.

c. Sum the skills of a group, or all employees, to get an employee group composite skill profile.

d. Sum the skill requirements of a group, or all jobs, to get a group mission composite skill need profile.

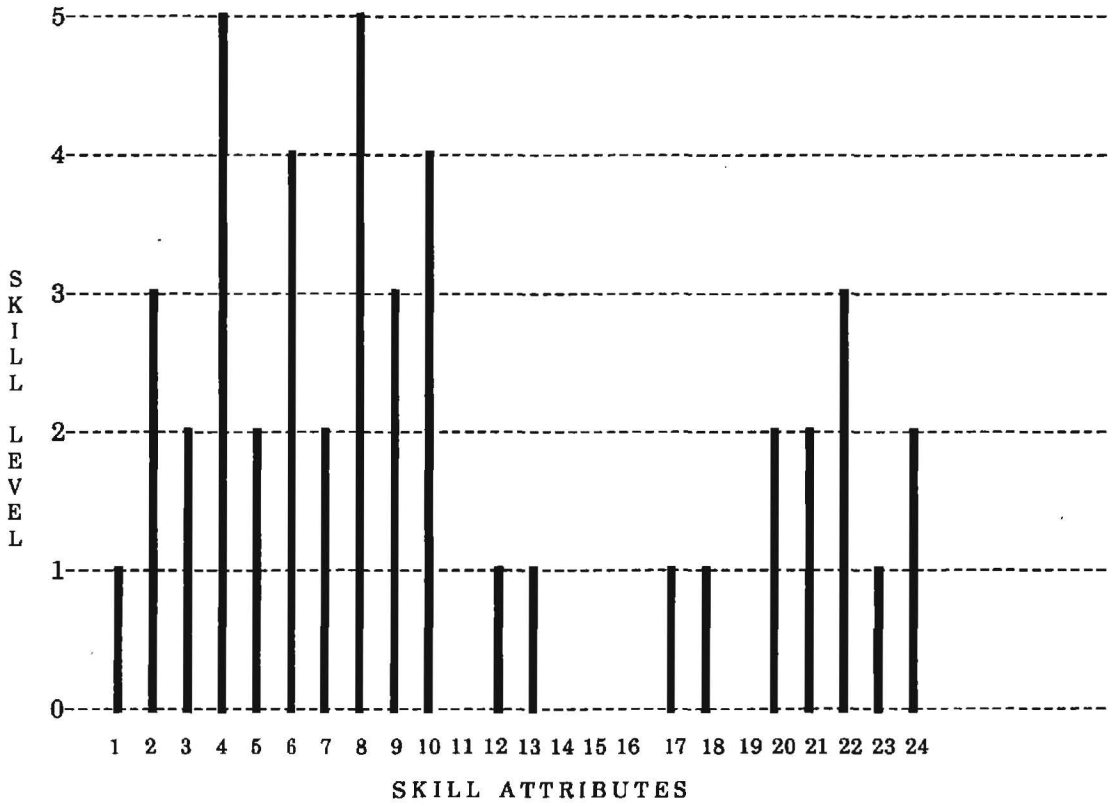


Fig. 1. Example of employee skill profile or job position requirements profile

e. Compare the skills of the employee group composite skill profile against the group mission composite skill need profile to see how well the skills of the organization relate to the mission requirements.

f. Prepare a future group mission skill need profile composite based on anticipated future mission needs and compare the employee group composite skill mix profile against this future group mission composite skill need profile to see how well the skills of the organization relate to future mission requirements.

4. HOST COMPUTER SYSTEM CAPABILITIES REQUIRED

A host computer system, such as the V-EDA network or the Virtual Campus, is required to contain the database of employee profiles and job position profiles, and to permit access to users to manipulate the databases. A control authority must be made responsible for loading the database of profiles and the yearly update to this database. The users will be prohibited from modifying the database. The users will be able to manipulate the database to perform the comparisons and computations listed above. This program will be menu driven. The required menu items will include these options:

a. Display the skill attribute profile for a selected employee.

b. Display the skill requirements profile for a selected job position.

c. Compare the skills of a selected employee against the requirements of a selected job position and display a combined profile showing both the employee's skills and the job position requirements.

d. Compare the skills of each employee against the requirements of one specific job position and rank employees from one through n based on how well their skills match the requirements of the job position. Display a selected number of employee names from the top of the list or the entire list. Display a combined profile showing both the skills of an employee selected from this list and the job position requirements.

e. Compare the skills of a selected employee against the requirements of all the jobs and rank the jobs from one through n based on how well the requirements of each job position match the employee's skills. Display a selected number of job position names from the top of the list, or the entire list. Display a combined profile showing both the requirements of a job position selected from this list and the employee's skills.

f. Sum the skills of a selected number of employees (or all the employees) to get an employee group composite skill profile. Display this composite profile and the names of the employees which comprise it.

g. Sum the skill requirements of a selected number of job positions (or all the job positions) to get a job position group composite skill need profile. Display this composite profile and the names of the job positions which comprise it.

h. Compare the skills of the employee group composite skill profile against the group job position composite skill need profile to see how well the skills of the employees relate to the project requirements. Display a combined profile showing both the skills of the employee group composite skill mix profile and the group job position composite skill need profile.

i. Prepare a future group mission skill need profile composite based on anticipated future mission needs and compare the employee group composite skill profile against this future group mission composite skill need profile to see how well the skills of the organization relate to future mission requirements. Display a combined profile showing both the skills of the employee group composite skill profile and the future group mission job position composite skill need profile.

j. A submenu containing various correlation functions to be used in comparing the employee skills to the job position requirements.

(1) Correlation function number one, which is recommended for finding which employees best match the job position requirements.

(2) Correlation function number two, which is recommended for finding which job best matches the skills of the employee.

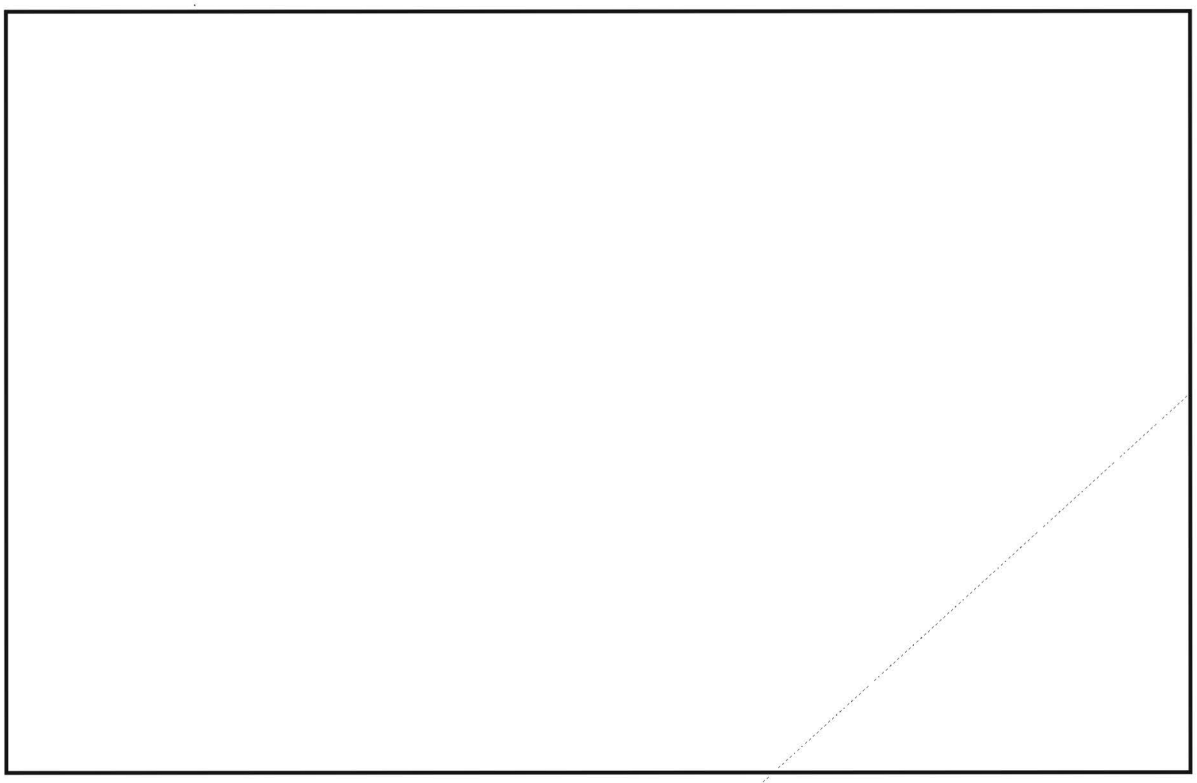
k. Other menu items as appropriate.

5. LIMITATIONS OF WORK FORCE SKILLS AND MISSION REQUIREMENTS COMPARISON SYSTEM

The proposed work force skills and mission requirements comparison system fails to address the optimization of the best mix of personnel for a project, for example, three engineers rather than two engineers and one computer scientist. It also fails to optimize the selection of a person for task number two given the selection of an individual for task number one. This comparison system relies entirely on the program manager's definition of the skills required for a particular job position. This comparison addresses only the degree of skill required for a particular position and does not address the number of man-hours of that skill required.

6. CONCLUSION

The proposed work force skills and mission requirements comparison system can be a useful tool to match both employees to jobs and jobs to employees when used with prudent judgment by managers and program managers. In addition, it will provide some insight into where our skills lie, where they are strong, weak, inadequate, and obsolete. Employees should find the comparison system useful in comparing their own skills to those required by our mission and in identifying where their skills should be strengthened.



STATUTORILY EXEMPT

Appendix 1

List of Attributes for Work Force Skills and Mission Requirements

1. COMSEC Equipment Design
2. Hardware Architecture Design
3. Digital Logic Design
4. Cryptographic Algorithm Design
5. Key Management Techniques
6. Benign Fill Techniques
7. Firefly Techniques
8. Mayfly Techniques
9. RDD-100 Design and Documentation Techniques
10. VHDL Schematic Capture
11. VHDL Behavioral Model Design and Simulation
12. VHDL Functional Model Design and Simulation
13. VHDL Test Vector Generation and Simulation
14. LSIC Chip Layout, Back Annotation and Simulation
15. Computer-aided Design (CAD) Database Management
16. Printed Wiring Board Design and Layout
17. Electrical and Electronic Interfaces
18. Computer-to-Hardware Interfaces
19. Breadboard Design, Fabrication and Test
20. Hardware Technology Awareness
21. Software Technology Awareness
22. Digital Signal Processor (DSP) Applications
23. Micro Processor (MP) Applications
24. Gate Array and Programmable Logic Applications
25. PCMCIA Card Applications
26. Fiber Optic Applications
27. Software Architecture Design
28. Higher Order Language (HOL) Programming
29. Machine Language Programming
30. Database Applications

31. Computer Architecture Design
32. Local Area Network (LAN) and Wide Area Network (WAN) Design
33. Network Protocols (SMTP, TCP/IP, OSI etc.)
34. Telecommunications Protocols
35. Certified Network Engineering
36. Operating System Expertise
37. Security Software Expertise
38. NSA Business Process (25-5, etc.)
39. ISSO Mission and Function, Policies and Direction Awareness
40. Technical Contract Management
41. Authoritative Posture and Ability to Direct Contractors
42. Decision Making
43. Technical Personnel Management
44. Program Management
45. Briefing Skills
46 Writing Skills
47. Technical Documentation
48. Security Profiles
49. Security Risk Plane Analysis
50. Certification and Accreditation

Attribute Definitions

1. COMSEC Equipment Design: The skills required to design and build a COMSEC equipment such as a KG-84 Link Encryptor. This is a broad category and includes system architecture, circuit design, LSIC design, layout and fabrication, printed wiring board design, Tempest, quadrant, maintainability, reliability, etc.

2. Hardware Architecture Design: The skills required to design an INFOSEC System at the highest level of hardware, to include LSIC versus microprocessor tradeoffs, hardware component selection, bus architecture, serial versus parallel processing, etc.

3. Digital Logic Design: The skills required to design digital logic electronic circuits to perform specified functions. This includes clock generation and distribution, timing considerations, fan-out , speed, power, circuit partitioning, interconnect, etc.

4. Cryptographic Algorithm Design: The mathematical and electronic skills required to understand and design cryptographic functions such as key generators.

5. Key Management Techniques: The mathematical and electronic skills required to understand and design key management systems including generation, distribution and storage.

6. Benign Fill Techniques: The mathematical and electronic skills required to understand the concepts, purpose, design, and implementation of systems to perform benign fill.

7. Firefly Techniques: The mathematical and electronic skills required to implement the functions required to perform the various Firefly functions.

8. Mayfly Techniques: The mathematical and electronic skills required to implement the functions required to perform the various Mayfly functions.

9. RDD-100 Design and Documentation Techniques: The computer, data management and electronic design skills required to effectively utilize RDD-100 design and documentation procedures.

10. VHDL Schematic Capture: The computer skills and digital logic expertise required to load digital logic circuitry from paper schematics into a VHDL database.

11. VHDL Behavioral Model Design and Simulation: The computer skills and VHDL design knowledge required to design, implement, simulate, and test VHDL behavioral models of a complex digital logic circuit.

12. VHDL Functional Model Design and Simulation: The computer skills and VHDL design knowledge required to design, implement, simulate and test VHDL functional models of a complex digital logic circuit.

13. VHDL Test Vector Generation and Simulation: The computer skills and VHDL design knowledge required to design and write test vectors for simulating a complex digital logic circuit. This includes running the test vectors on a complex circuit design, calculating the fault grade and minimizing the number of test vectors required to obtain the required fault grade.

14. LSIC Chip Layout, Back Annotation and Simulation: The computer skills required to lay out a large-scale integrated circuit implementation of a complex electronic circuit. After layout, the database representing the LSIC circuitry is modified by the actual physical parameters of the layout and the simulations rerun.

15. Computer-aided Design (CAD) Database Management: The computer skills required to set up and manage a CAD database to hold the various parts of a large scale integrated circuit electronic design, including test vectors and the control of that database to allow access to many different engineers working simultaneously on the various portions of the design.

16. Printed Wiring Board Design and Layout: The computer and engineering skills required to design, and layout multilayer printed wiring boards.

17. Electrical and Electronic Interfaces: Knowledge of the military, government and industry standard electrical and electronic interfaces, and how to design appropriate circuitry to bridge between the various interfaces.

18. Computer-to-Hardware Interfaces: Knowledge of the input and output characteristics of the various computer architectures and of electronic equipment and the ability to design, build and interface between these devices.

19. Breadboard Design, Fabrication and Test: The ability to design and build proof of principal breadboards to include gate arrays, microprocessors, personal computers, electronic equipment, and other components.

20. Hardware Technology Awareness: An awareness of the state-of-the-art of hardware technology, what is the present industry standard, and what devices, tools, and techniques are on the horizon.

21. Software Technology Awareness: An awareness of the state-of-the-art of software technology, what is the present industry standard, and what devices, tools and techniques are on the horizon.

22. Digital Signal Processor (DSP) Applications: The ability to design complex functions with Digital Signal Processors, program these devices, and interface them to electronic hardware and other computers.

23. Micro Processor (MP) Applications: The ability to design complex functions using Microprocessors, program these devices, and interface them to electronic hardware and other computers.

24. Gate Array and Programmable Logic Applications: The ability to design complex functions using gate arrays and programmable logic devices, program these devices, and interface them to electronic hardware and other computers.

25. PCMCIA Card Applications: Knowledge of the function and application of Personal Computer Memory Card Interface Association (PCMCIA) cards. The ability to design functions using these cards and to interface these functions with computers in various applications.

26. Fiber Optic Applications: Knowledge and skill in applying fiber optic technology to INFOSEC applications, computer networks, and communications circuits.

27. Software Architecture Design: The knowledge and ability to design software systems at the highest level and to make intelligent trade-offs between the various architectures to optimize the system being designed.

28. Higher Order Language (HOL) Programming: Knowledge and skill in programming higher order languages such as C, C++ and other languages.

29. Machine Language Programming: The ability to write specialized programs using machine and assembly language to include writing macros for use with programs written in higher order languages.

30. Database Applications: The ability to write programs for and manage databases to include access privileges, data entry, data manipulation, auditing, etc.

31. Computer Architecture Design: The knowledge and skill required to design computers, to include a thorough understanding of the various computer architectures, including shared resources and parallel processing. The ability to use this knowledge to design systems which must interface with computers and computer networks.

32. Local Area Network (LAN) and Wide Area Network (WAN) Design: The knowledge and ability required to design, operate and manage both local and wide area networks, to include interfacing INFOSEC equipment and functions onto or with these networks.

33. Network Protocols (SMTP, TCP/IP, ISO-7, OSI etc.): Knowledge and expertise in working with Network Protocols, such as Simple Mail Transfer Protocol (SMTP), Transmission Control Protocol and Internet Protocol (TCP/IP), International Standards Organization Seven Layer Protocol (ISO-7) and Open System Interconnection Protocol (OSI).

34. Telecommunications Protocols: Knowledge and expertise in working with Communications Systems protocols such as ATT's telephone line, trunk, and switching protocols, cable television, and mobile telephone protocols.

35. Certified Network Engineering: Knowledge and expertise in network engineering principles to include formal education and certification as a Certified Network Engineer.

36. Operating System Expertise: The knowledge and expertise required to work with computer operating systems, to the extent that these operating systems can be thoroughly evaluated and modified for specific unique applications.

37. Security Software Expertise: Knowledge and expertise in the design and writing of software code to enable the writing of secure software code and the evaluation of software developed on contract for security strengths and weaknesses.

38. NSA Business Process (25-5, etc.): The knowledge and experience required to enter into contracts for the development and production of INFOSEC equipment and systems, and to do so legally in minimum time.

39. ISSO Mission and Function, Policies and Direction Awareness: Knowledge and awareness of the goals and mission of V group, the ISSO, and NSA to promote the success of NSA's programs and mission.

40. Technical Contract Management: The technical knowledge and expertise required to manage a complex INFOSEC development program to include all of the expertise required in all the technical disciplines required by the development effort, such as COMSEC, cryptographic algorithms, key management, computers, networks, etc.

41. Authoritative Posture and Ability to Direct Contractors: The knowledge, expertise, and experience required to project a positive, authoritative image when working with contractors and the ability to guide and direct contractors to insure the success of the program.

42. Decision Making: The knowledge, expertise and experience required to make intelligent decisions based on the technical impact, while taking into account the programmatic issues such as cost, schedule and political effect.

43. Technical Personnel Management: The ability to manage technical personnel, to inspire individual enthusiasm and performance and to foster group cooperation and synergism.

44. Program Management: The ability to manage a program, to define and monitor the critical schedule path, to identify and minimize the technical risk, to identify alternative solutions, and manage the entire effort to assure a timely success.

45. Briefing Skills: The ability to prepare and deliver briefings to audiences of various technical interest and ability. To determine the significant items of interest for diverse groups and to present technically complex functions and issues in a clear and concise manner.

46 Writing Skills: the ability to write in plain English and to convey complex thoughts simply and concisely.

47. Technical Documentation: The ability to manage technical documentation in all of the various media: computer files, magnetic tape, floppy discs, and hard copy (paper). The expertise and experience required to determine what documentation is required on a development or production program and where and how it is to be used and stored for future reference.

48. Security Profiles: Knowledge of the function and purpose of security profiles to insure their proper use on an INFOSEC development or producton program and to assist users of INFOSEC products in obtaining the information required for certification, accreditation, and the proper use of INFOSEC equipment.

49. Security Risk Plane Analysis: Knowledge, expertise and experience in the risk plane analysis process to include understanding the strengths and weaknesses of this analysis.

50. Certification and Accreditation: Knowledge, expertise, and experience in the certification and accreditation process to include being able to provide the data and information required by those doing the analysis, and to be capable of doing the analysis.

Appendix 2

Correlation Functions for Work Force Skills and Mission Requirements Comparison System

For each pair of profiles, an employee skill profile and a job position profile, it is possible to compare how well the employee's skills meet the job position requirements, or how well the job position requirements match the employee's skills. The difference between these two comparisons is subtle but significant. The first case compares employees against a job position requirement to find those employees who best meet the requirements of the job position. When comparing an employee's skills against a job position requirement and the employee's skill in a specified attribute is greater than that required by the job, the employee's skill excess is of no significant value in meeting the requirements of the job. Case two compares a single employee's skills against several job position requirements to find the job position best suited to utilize all of that employee's skills. In this case, if the employee's skills far exceed the requirements of the job position, that job position would not efficiently utilize the employee's skills; that is, the employee would be overqualified for the job, and this would not represent a good match between the employee and the job.

1. Correlation Function Number 1: This correlation function is optimal for finding which employees meet the job position requirements. It is recommended for use when trying to find suitable employees for filling a specific job position.

a. For each skill attribute, compare the employee's skill level to the skill level required by the job position. If the employee's skill is greater than that required by the job position, set the employee's skill level number equal to that required by the job. If the employee's skill level is less than that required by the job position, maintain the employee's skill level number as is.

b. Sum up the (modified) skill level numbers for each of the employee's skill attributes.

c. Sum up the skill level number for each of the job position skill attributes.

d. Divide the sum of the employee's (modified) skill attributes by the sum of the job position skill attributes. This number (times 100 percent) states how well the employee's skills meet the job position requirements.

The greater the number, the better the employee's skills meet the requirement of the job position. A score of 100 percent implies that the employee meets all of the requirements of the job position, but it does not address the fact that the employee may be overqualified for the job. (For example, this calculation may show that the employee's skills meet 84.6 percent of the job position skill requirements.)

2. Correlation Function Number 2: This correlation function is optimal for comparing the efficiency of utilization of the employee's skills. It is recommended for use when trying to find which job best suits the skills of the employee.

a. For each skill attribute, compare the employee's skill level to the skill level required by the job position. Sum the set of smaller values and divide this by the sum of the set of larger values. For each attribute, compare the employee's skill number to the job position requirement skill number. Let *Ni* equal the smaller of the two numbers, and *Di* equal the larger of the two numbers, where *i* is the number of the attribute.

b. Sum up the *Ni*'s for all the skill attributes.

c. Sum up the *Di*'s for all the skill attributes.

d. Divide the sum of the *Ni*'s by the sum of the *Di*'s. This number (times 100 percent) states how efficiently the employee's skills and the job position requirements match.

The greater the number, the better the employee's skills and the requirements of the job position match. A score of 100 percent implies both that the employee meets all of the skills required of the job position and that the employee has no skills in excess of those required. Therefore, this employee would not be overqualified for the job. (For example, this calculation may show that the correlation between the employee skills and the job position requirements is 62.8 percent.)

The values obtained using correlation function number two will generally be smaller than those obtained when using correlation function number one, because an employee usually has many skills and more skills than required by any one specific job position. When comparing one employee to another, the same correlation function should be used. Comparing correlation function number one against correlation function number two for the same employee gives an indication of both how well the employee meets the job position requirements and how well the employee's skills are being utilized.

Appendix 3

Simplified Example for
Work Force Skills and Mission Requirements Comparison System

The following simplified example illustrates the procedure, calculations and results for comparing the skill level of a single employee with the requirements of a single job position.

For this example we will use ten undefined attributes, numbered from one to ten. The employee's skill profile and the job position requirements profile, as well as the Modified Employee Skill, and the *Ni*'s and *Di*'s are shown in the following table.

Skill Attribute Number	Job Position Requirement	Employee Skill	Modified Employee Skill	*Ni*	*Di*
1	1	1	1	1	1
2	1	3	1	1	3
3	3	2	2	2	3
4	2	5	2	2	5
5	1	2	1	1	2
6	4	4	4	4	4
7	1	2	1	1	2
8	3	5	3	3	5
9	5	3	3	3	5
10	5	4	4	4	5
Sum:	26	31	22	22	35

In this example the employee's skills total, 31, is greater than the job position requirements total, 26. Nevertheless, the employee's skills in attributes numbers 3, 9, and 10 are less than those required by the job.

1. We use correlation function number 1 to see how well the employee's skills satisfy the job requirements.

The modified employee skills are set equal to the lesser of the employee's actual skill or the job position requirements. For example, in skill attribute number 8 the job position requirement is 3 and the employee skill is 5. Therefore, we set the modified employee skill number equal to 3 since the employee satisfies the attribute requirement for this job position, and any employee skill greater than that required by the job is of no importance.

> Correlation Function One (CF1) = Sum of Modified Employee Skill ÷ Sum of Job Position Requirements.

CF1 = 22 ÷ 26 = 84.6 percent. Therefore, the employee's skills satisfy 84.6 percent of the job position requirements.

2. We use correlation function two to see how well the employees's skills and the job position requirements match.

The *Ni* number represent the lesser of the job position requirement and the employee skill for each attribute. For example, in skill attribute number 10 the job position requirement is 5 and the employee skill is 4. Therefore $N_{10} = 4$. Similarly the *Di* number represents the larger of the job position requirement and the employee skill for each attribute. For skill attribute number 10, $D_{10} = 5$.

Ni = lesser of (Job position requirement and employee skill)
Di = greater of (Job position requirement and employee skill)

Correlation Function Two (CF2) = Sum of *Ni*'s ÷ Sum of *Di*'s

CF2 = 22 ÷ 35 = 62.8 percent. Therefore, the employee's skills and the job position requirements match with a score of 62.8 percent.

CF1 equal to 84.6 percent shows that the employee meets a large portion of the job position requirements. Since CF2 equal to 62.8 percent is less than CF1, the employee has skills in excess of those required for the job position, and some of his skills are not required by the job. This result is to be expected, for it is highly unlikely that all of a person's skills would be totally utilized in any given job position.