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EVALUATION PROCESS REPORT FOR NEXT GENERATION COMPUTER RESOURCES OPERATING SYSTEMS INTERFACE BASELINE SELECTION

BY NEXT GENERATION COMPUTER RESOURCES (NGCR)
OPERATING SYSTEMS STANDARDS WORKING GROUP (OSSWG)

STEVEN L. HOWELL, EDITOR
UNDERWATER SYSTEMS DEPARTMENT

7 MAY 1990

NAVAL SURFACE WARFARE CENTER

Dahlgren, Virginia 22448-5000 • Silver Spring, Maryland 20903-5000

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FOREWORD

The work reported here was conducted over a period of a little more than one year by a joint team of Navy, other government, industry, and academic experts in the field of computer operating systems. Only a few of the Navy participants were actually funded to directly participate in this process.

The report was funded under NUSC Job Order Number A45146, Next Generation Computer Resources. The sponsoring activity is Space and Naval Warfare Systems Command, through the work of the Operating Systems Standards Working Group (OSSWG). The OSSWG management structure is as follows:

NGCR Program Manager, Mr. H. Mendenhall, SPAWAR 324
NGCR OSSWG Co-Chairman, CDR R. Barbour, SPAWAR 324
NGCR OSSWG Co-Chairman, Ms. T. Oberndorf, NADC
Approach Subgroup Chairman, Mr. T. Conrad, NUSC
Requirements Subgroup Chairman, Mr. R. Bergman, NOSC
Available Technology Subgroup Chairman, Mr. J. Oblinger, NUSC

Although the report is the result of work performed by the entire membership of the OSSWG, the following OSSWG members actively performed the evaluation of the final seven candidates:

CDR Richard Barbour	SPAWAR 324
Richard Bergman	NOSC
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Dr. Thomas Drake	Clemson University
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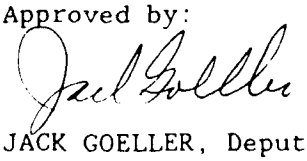
LT Karl Fairbanks	NWC
Gary Fisher	NIST
Lester Fraim	Honeywell
Dr. Karen Gordon	IDA
Dr. Mars Gralia	JHU/APL
Daniel Green	NAVSWC
Raymond Gretlein	Dynamics Research
Joseph Gwinn	Raytheon

Barbara Haleen	Unisys
James Hall	NIST
Neil Henderson	Litton Data Systems
Gail Holmes	NUSC
Steven Howell	NAVSWC
John Johnson	NAC
Daniel Juttelstad	NUSC
Kari Kruempel	Unisys
Dr. James Leathrum	Clemson University
Warren Loper	Texas Instruments
Dr. Douglass Locke	IBM
Warren Loper	NOSC
Michael Morgan	Pacific International Center for High Technology Research (PICHTR)
Dr. John F. Nixon	General Electric Co. Advanced Technology Laboratories
Patricia Oberndorf	NADC
James Oblinger	NUSC
Frank Prindle	NADC
John Reed	DEC
Carl Reinert	Computer Based Systems
Helmut Roth	NAVSWC
Dr. Timothy Saponas	Intel
John Shea	NOS
Del Swanson	Unisys
Maria Voreh	NRL
Patrick Watson	IBM

We would like to thank Carl Schmiedekamp (NADC) for his help with the data collection and analysis.

We would especially like to take this opportunity to thank the United States industry and academia for the staunch support of and participation in this working group and would like to strongly encourage their continued support and involvement.

Approved by:



JACK GOELLER, Deputy Head
Underwater Systems Department

CONTENTS

CONTENTS (Cont.)

ILLUSTRATIONS

CHAPTER 1

INTRODUCTION

The Operating Systems Standards Working Group (OSSWG) evaluation process defined within this document provides the techniques and methods by which the OSSWG will recommend a baseline operating system interface specification to the Next Generation Computer Resources (NGCR) program office. This document describes the process, the inputs into the process in the form of criteria, baseline candidates, evaluators, and weights, as well as the outputs of the process. A taxonomy which describes the relationships and organization of the criteria is presented as well as the procedure by which the candidate baselines are to be evaluated.

1.1 BACKGROUND

The U.S. Navy has embarked on a new computing resources standardization effort called the Next Generation Computer Resources (NGCR). This program is designed to fulfill the Navy's need for standard computing resources while allowing it to take advantage of commercial products and investments and to field new technological advances more quickly and effectively. The program revolves around the selection of standards in 10 interface areas. One of these is an operating systems interface standard. The general requirements for this interface standard are that it be Ada-oriented, real-time, distributed/networked, multi-level secure, reliable, and realizable on heterogeneous processors. The effort to establish such an interface standard was initiated at the start of 1989 and will draw on industry expertise. An initial operating system interface standard is expected in 1993 and the final standard is expected to be usable in the procurement of Navy systems in fiscal year 1996.

The Navy's current computer standardization approach is having difficulty remaining competitive in an environment where rapidly changing technologies permit more efficient and effective solutions to the range of Navy computing system requirements. Thus, the objective of the NGCR program is to restructure the Navy's approach to the acquisition of standard computer resources so as to take better advantage of commercial advances and investments. It is expected that this new approach will result in reduced production costs (through large quantity buys), reduced operation and maintenance costs, avoidance of replication of Navy RDT&E costs (for separate projects to develop similar computers), and more effective system integration.

The proposed new approach is an open systems approach based on the establishment of interface standards The application of these standards will

change the Navy's approach from one of buying standard computers to one of procuring computer resources which satisfy the interfaces defined by the standards. These standards will be applied to procurements at the project level rather than a Navy-wide procurement level.

These interface standards will be based, to the greatest extent possible, on existing standards. In cases where existing industry standards do not meet Navy mission-critical needs, the approach is to enhance the existing standards jointly with industry, thus assuring the most widely accepted set of commercially-based interface standards possible.

An operating system interface standard is a key element in the success of NGCR. The function of the operating system is to control operation of all the computing system hardware and software elements in a coordinated, uniform manner that is consistent with the needs of embedded and real-time applications. The operating system capabilities include system initialization, fault tolerance and recovery, global resource allocation, and interprocess communication. The operating system will have components in each processing element. The operating system interface standard is not a design of the operating system components comprising each processing system but is, in part, a specification of an application program interface common to all computing elements. This provides the basis for system-wide dynamic task and resource allocation. Global dynamic task and resource allocation is the basis for system-wide fault tolerance and recovery in heterogeneous processing systems. The operating system provides the ability to achieve multi-level security at the system level. Conformance to other Navy directives requires that the operating system be Ada-oriented.

Other ongoing NGCR standardization efforts are in the backplane and local area network (SAFENET I and SAFENET II) areas. Each of these efforts has a technically oriented working group comprised of industry, academia, and government experts.

The OSSWG, the operating system effort's technical working group, has been tasked to evolve an interface standard for operating systems. This document defines the process by which the OSSWG will make a recommendation of a baseline interface specification to the NGCR program office. This baseline specification will be derived from one or more existing operating system implementations, specifications, or standards.

The OSSWG is organized into three subgroups: Available Technologies, Approach, and Requirements. The Available Technologies Subgroup is responsible for maintaining an extensive knowledge of current operating system technologies. The Approach Subgroup is responsible for defining the evaluation process. In addition, it is also responsible for defining the programmatic evaluation criteria, the Representative Application Domains (RADs), and the OSSWG Reference Model. The Requirements Subgroup is responsible for determining and delineating Navy requirements for operating systems. Two co-chairs, Patricia Oberndorf and CDR Rick Barbour, lead the OSSWG.

1.2 ORGANIZATION

This document is organized into 5 chapters. Chapter 2 defines the approach by which the process was developed; Chapter 3 defines the components of the evaluation process and the interrelationships among components; Chapter 4 defines the process of evaluating operating systems specifications against the criteria; and Chapter 5 describes the types of conclusions and results that are expected from the evaluation. The forms to perform the evaluation process are included in Appendix A.

CHAPTER 2

DEVELOPMENT OF EVALUATION PROCESS

The evaluation process objective is to allow the OSSWG to analyze the current state of operating system technology in order to make recommendations of a baseline interface specification to the NGCR program office. The OSSWG will need to justify its recommendation; therefore, this evaluation process must not only determine the 'best' candidate interface specification(s), but also describe the relative strengths and weaknesses of each of the possible candidates. This is accomplished by organizing the criteria into a hierarchical taxonomy which allows analysis of results at either a high gross level or at a low detailed level. The result of the process will be a series of values related to the relative merits of the candidate interface specification when compared against key attributes. The key attributes are service classes (operating system's functions), programmatic issues, and representative application domains.

Additionally, the process attempts to be as objective as possible, demonstrating neither bias toward a particular candidate baseline nor a Navy application domain. For instance, a small number of biased evaluators scoring a candidate unusually high/low does not skew the results of the process. Wherever possible, to encourage objectivity, the process quantifies the relative differences between candidates.

Figure 2-1 describes the inputs and the outputs of the evaluation process. The inputs are: the criteria which are the basis for the evaluation, the candidate baseline specifications; and the evaluators of the candidates. The output of the process, the results, will be a recommendation for candidate baseline(s) along with extensive information to justify the recommendation. A detailed description of the process is presented in Section 4.1.

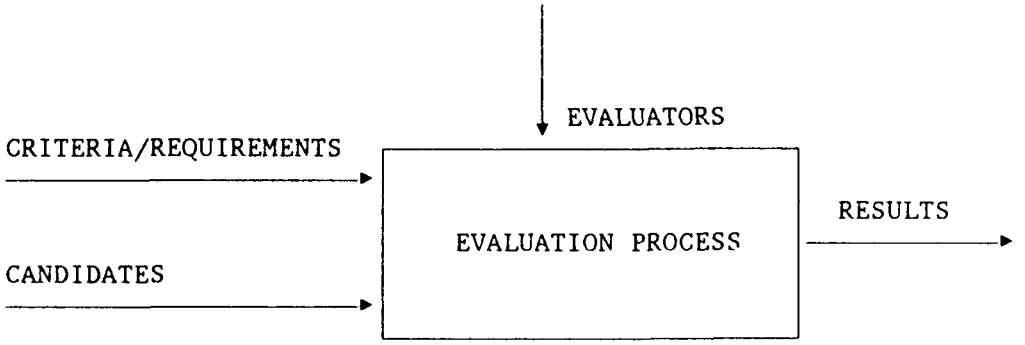


FIGURE 2-1. EVALUATION PROCESS OVERVIEW

The requirements for the interface have been developed by personnel from industry, academia, the Navy as well as other government/DoD agencies. The requirements have been derived by an extensive analysis of current and future Navy's systems needs. Inputs from Navy contractors, various Navy program offices, Navy systems documentation, and Navy laboratory personnel were collected to generate pertinent requirements. The requirements have been arranged into two categories: Navy functional requirements and NGCR program requirements. The Navy functional requirements define technical needs of the operating system services and were developed by the Requirements Subgroup of the OSSWG. The NGCR program requirements define criteria related to the environment in which the NGCR operating system standard is being developed and used. NGCR program requirements were developed by the Approach Subgroup of the OSSWG. An example of a functional requirement is: the types of process schedulers that must be supported. An example of an NGCR program requirement is: the need for nonproprietary interface specifications. The Navy functional requirements are listed in the OSSWG Requirements Document and the NGCR program requirements are listed in Section 3.2.

An evaluation criterion is the atomic unit against which the various candidates are evaluated, producing raw scores. Each evaluation criterion is either one Navy functional and/or NGCR program requirement, with an associated metric used to evaluate candidate interface specifications. The evaluation criteria is applied to the candidate interface specifications which are derived from existing operating systems implementations, designs or standards from which formalized interfaces can be extracted.

Each requirement and evaluation criterion is defined by six associated descriptors: (1) category (criteria number); (2) requirement/criteria name; (3) definition; (4) evaluation criteria metric; (5) rationale; and (6) reference/bibliography. This format correlates extremely well with the format which the Requirements Subgroup of OSSWG used to generate Navy functional requirements. The evaluation criteria have been derived from the requirements. The two categories for requirements/criteria are either Navy functional or NGCR program. Section 3.3 describes the relationship between these criteria and requirements.

The ultimate NGCR operating system interface standard is intended to adequately meet the requirements of a large number of Navy applications. Therefore, the evaluation process attempts to appraise the candidate baselines against the full breadth of Navy operating system applications. The current breadth of applications under consideration is described in the Reference Model documentation under domain areas. Since the breadth of application domains in the Navy is immense, satisfactorily representing Navy applications was a major concern in the development of the evaluation process. It was considered impossible to evaluate all possible candidate interface specifications against the criteria as they relate to each of the application domains. Various alternatives were considered including defining one most important set of interfaces and services (a kernel), and defining a large number of representative applications such as the cross product of application domains which occur in the NGCR OSSWG Reference Model. It was determined that the best option was to describe a small number of application types, called the Representative Application Domains (RADs), which require particular system

service and interface sets and are truly representative of operating systems needs of applications in the Navy. This set will satisfy the requirements of a wide range of application domains. The description of the RADs is included in Section 3.5.

CHAPTER 3

EVALUATION COMPONENT DEFINITION

This chapter describes the various components which make up the evaluation process including the requirements, criteria, service classes, programmatic issues and the RADs. Section 3.1 and 3.2 reference and/or list the requirements for the standard; Section 3.3 lists the evaluation criteria; Section 3.4 describes service classes and programmatic issues including information on how they relate to the criteria; and Section 3.5 defines the RADs.

Figure 3-1 shows how the low level requirements of the system are aggregated through the process into a selection of the baseline. There exists a process or mapping between each two adjacent levels. The mapping between the requirements and criteria is a direct one to one mapping, while the mapping from criteria to services classes, programmatic issues, and RADs is a many to one mapping.

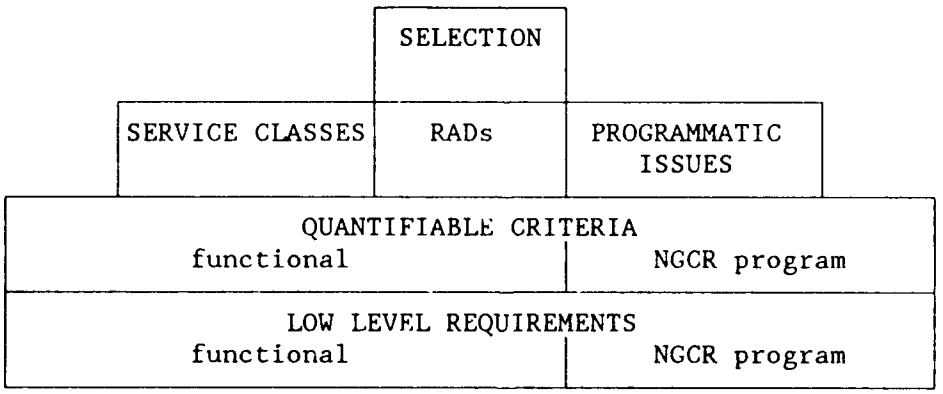


FIGURE 3-1. COMPONENT RELATIONSHIP

3.1 NAVY FUNCTIONAL REQUIREMENTS

The functional requirements used in the evaluation can be found in the Requirements Document, Version 2.0.

3.2 NGCR PROGRAM REQUIREMENTS

The following is the set of NGCR program requirements. The category of all requirements in this section can be described as programmatic.

3.2.1 Public Domain Interfaces

3.2.1.1 Definition. The baseline specification must be in the public domain and should not be proprietary.

3.2.1.2 Evaluation Criteria.

10--currently in the public domain

5--proprietary, but written agreement to become nonproprietary if selected

0--proprietary

3.2.1.3 Rationale. The standard derived from the baseline specifications should not allow one company or group of companies to be the sole supplier of products which conform to the standard. This open approach will foster competition between commercial vendors.

3.2.1.4 Reference/Bibliography. NGCR OSSWG Charter, Operational Requirement for Next Generation Computer (pg 1).

3.2.2 Navy Influence

3.2.2.1 Definition. This is the extent to which the Navy community is able to influence modification and adaptation of the baseline specification.

3.2.2.2 Evaluation Criteria.

10--extensive influence with voting power

5--some influence, with voting power.

0--no influence

3.2.2.3 Rationale. If the Navy cannot influence the baseline specification, the baseline may diverge from the Navy needs. If this occurs it could have one of two effects. One, if the Navy stays with the baseline, the Navy would have a standard which does not fit the Navy's needs. Two, if the Navy proposes a new baseline, major cost and schedule problems would occur in the NGCR operating system effort. Therefore, it benefits the Navy to have a major influence on modifications to the baseline specification.

3.2.2.4 Reference/Bibliography

3.2.3 Maturity/Confidence

3.2.3.1 Definition. The baseline specification should be mature with high confidence so that the baseline specification can be implemented on various hardware configurations.

3.2.3.2 Evaluation Criteria.

10--implemented and used over time by a wide user base

5--implementations have just become available

0--no implementations available

3.2.3.3 Rationale. The Navy needs to use a standard that has been verified as usable. It would also be beneficial to the government if implementations have existed for sometime.

3.2.3.4 Reference/Bibliography.

3.2.4 Documentation

3.2.4.1 Definition. The baseline specification must be well documented.

3.2.4.2 Evaluation Criteria.

10--excellent, well maintained documentation available

5--documentation inadequate for operating system implementor and/or user, or not reflective of current baseline

0--no documentation exists

3.2.4.3 Rationale. This will alleviate problems associated with transitioning the baseline specification to a standard and problems associated with ambiguous interfaces.

3.2.4.4 Reference/Bibliography.

3.2.5 Commercial Acceptance (Listed as Nonfunctional on Evaluation Form)

3.2.5.1 Definition. The baseline specification should have wide commercial acceptance or show great promise to have such acceptance.

3.2.5.2 Evaluation Criteria.

10--accepted by a wide portion of the commercial community

5--partial acceptance from a portion of commercial community exists or is likely

0--not accepted and not likely to be accepted

3.2.5.3 Rationale. A wide market acceptance will encourage implementations of the standard to be implemented without Navy funding.

3.2.5.4 Reference/Bibliography. Operational Requirement for Next Generation Computer (pg 1), NGCR OSSWG Charter.

3.2.6 Timeframe

3.2.6.1 Definition. The baseline specification should be ready and available, in an unified form, within the timeframe of the OSSWG standardization effort without Navy funding.

3.2.6.2 Evaluation Criteria.

10--available now

5--not available now, but can probably be available by 1993

0--cannot be made available by 1993

3.2.6.3 Rationale. This will reduce risk to the NGCR program while increasing the likelihood of commercial acceptance. The initial standard is scheduled to be in place by January 1993.

3.2.6.4 Reference/Bibliography. Operational Requirements for Next Generation Computer (pg 1)

3.2.7 User Influence (Listed as System/Standard Goal on Evaluation Form)

3.2.7.1 Definition. The goal of the development of the baseline specification should have been to meet user's needs.

3.2.7.2 Evaluation Criteria.

10--Developed as industry standard with wide user input

5--moderate user influence

0--pure research with no user influence

3.2.7.3 Rationale. The NGCR operating system interface specification is being developed to meet Navy operating system user needs. A baseline developed with the same motivation as NGCR is more likely to be applicable to this program.

3.2.7.4 Reference/Bibliography.

3.2.8 Economics/Cost

3.2.8.1 Definition. Implementing the operating systems which conform to the baseline specification should be achievable by vendors from an economic viewpoint.

3.2.8.2 Evaluation Criteria.

10--low cost to implement will result in implementations by many vendors

5--moderate cost to implement will result in some Navy unique implementations

0--extreme cost to implement will result in predominately Navy implementations

3.2.8.3 Rationale. A baseline specification which is expensive to implement will be expensive to the Navy. It will likely have very few implementations and will not gain broad commercial acceptance. The Operational Requirement Document states that existing software environments have limited productivity.

3.2.8.4 Reference/Bibliography. Operational Requirement for Next Generation Computer (pg 1).

3.3. EVALUATION CRITERIA

There is a one to one mapping between criteria and requirements; therefore each requirement referenced in 3.1 and listed in 3.2 will be used as the evaluation criteria.

3.4 SERVICE CLASSES AND PROGRAMMATIC ISSUES

This section describes services classes and programmatic issues. Included in the description is an explanation of how the various service class and programmatic issues are related to the criteria of 3.3.

3.4.1 Service Classes

The service classes for the evaluation are listed in the Requirements Document. A detailed explanation of each service class is given in the OSSWG Reference Model. The service classes used in the evaluation are:

1. General Requirements
2. Architecture-Dependent Services
3. Capability and Security Services
4. Data Interchange Services
5. Event and Error Management Services
6. File Services
7. Generalized I/O Services
8. Network and Communications Services
9. Process Management Services
10. Project Support Environment Interaction Services
11. Reliability, Adaptability, and Maintainability
12. Resource Management Services
13. Synchronization and Scheduling Services
14. System Initialization and Reinitialization Services
15. Time Services
16. Ada Language Support Services

3.4.2 Programmatic Issues

There is a one to one mapping between NGCR program requirements and programmatic issues.

3.5 REPRESENTATIVE APPLICATION DOMAIN SET

The RADs define characteristic application types which provide coverage for a wide range of Navy applications. Each application in the set is described by its relative inclusion/exclusion of key attributes described in the Reference Model. The representative applications are defined in the following sections.

For each RAD, weights are attached to service classes allowing certain service classes to be worth more than others, depending on how they relate to the representative application domain. Service classes have as many weights as representative applications, with each application's weight corresponding to the relative importance of that service class to that application requirement. A more detailed description of the weighting process is included in Chapter 4. Appendix B includes the service class and the class' weight for each application domain.

3.5.1 Application Domain Ruby

This application domain frequently features on-line transaction processing, off-the-shelf software products, networking to PC's, workstations, other host environments, and background processing. This application domain is characterized by strong requirements for data management, data reformatting, file services, generalized I/O, and resource management. By contrast, specific requirements for operating system support for languages and an interface to the project support environments are low. This domain includes shore-based logistics systems, for example. In extant technology, implementations of these systems typically involve wide area networks of multiple heterogeneous processors linked through gateways and the like.

3.5.2 Application Domain Opal

This application domain consists of special purpose dedicated processors, high data rates, and computationally intensive cyclic processing. This application domain is characterized by strong requirements for event and error management, generalized I/O and times services. By contrast, specific requirements for operating system support for data management, file system, and man-machine interfaces are minimal. In extant technology, implementations of these systems typically involve one or more specialized processors such as might be found in signal processing applications.

3.5.3 Application Domain Amethyst

This application domain consists of message switching, store and forward, message processing encryption, and error detection and recovery. This application domain is characterized by strong requirements for security, fault-tolerance, nuclear survivability, event and error management, networking and communications, scheduling and synchronization, and time management. By contrast, specific requirements for operating system support for project support environments are low. In extant technology, implementations of these systems involve processors on a given platform that must interface with networks that are widely distributed or with intra-platform networks. For example, this would include processors interfacing with global command, control and/or intelligence systems.

3.5.4 Application Domain Garnet

This application domain consists of autonomous embedded processors with a wide spectrum of data rates and duty cycles. Overall, this application domain does not put high demands on the operating system. This application domain is characterized by strong requirements for language support, reliability and availability. By contrast, specific requirements for operating system support for security, data management, file services, man-machine interfaces, and network and file communications are low. This application domain is exemplified by single processors embedded in, for example, missile warheads, torpedoes, and shipboard guns.

3.5.5 Application Domain Topaz

This application domain is characterized by high computational needs, interface to multiple sensors, and/or controls, and support of interactive displays. Overall, this application domain puts high demands on the operating system. This application domain has strong requirements for operating system support for languages, data management, data reformatting, man-machine interfaces, and reliability and availability. These applications include major subsystems of shipboard systems such as navigation systems, ship control systems or command systems. In extant technology, such applications typically include heterogeneous processors directly communicating on a near-continuous basis. One processor is typically a high-speed graphics processor.

3.5.6 Application Domain Emerald

This application domain consists of mission critical systems which are characterized by nuclear safety, command significance, and large ramifications of system failure. This application domain has strong requirements for operating system support for security, reliability and availability. By contrast, specific requirements for operating system support for files services are low. In extant technology these applications are frequently embodied in single processors exercising centralized control over other processors and/or devices. The application includes, for example, processors that control the enabling, targeting, and firing of strategic weapons. These systems typically include requirements for access control and man-machine interface management.

3.5.7 Application Domain Diamond

This application domain consists of networked dedicated processors connected to multiple sensors, controls, and displays. This application domain is characterized by strong requirements for operating systems support for languages, hardware architecture dependencies, event and error management, reliability and availability, scheduling and synchronization, and time services. By contrast, specific requirements for operating system support for data management and file services are low. This application domain typically includes multiple heterogeneous processors with particularized, dedicated functions. These processors are linked for cooperative interaction as might be found, for example, in avionics applications.

3.5.8 Application Domain Sapphire

This application domain consists of many cooperating subsystems that carry out mission critical functionality. Overall, this application domain puts high demands on the operating system. This application domain is characterized by strong requirements for operating system support for languages, security, networking and communication, process management, project support environment, reliability and maintainability, and time services. By

contrast, specific requirements for operating system support for file services are low. This application domain typically includes multiple platform-local networks of large numbers of heterogeneous processors. Examples include large tactical combat systems such as might be found aboard major surface ships and submarines.

CHAPTER 4

EVALUATION PROCESS APPLICATION

Figure 4-1 describes the overall evaluation process. The inputs to the evaluation process are the criteria which are the basis for the evaluation, the candidate baseline specifications, and the evaluators of the candidates. The output of the process, the results, will be a recommendation for candidate baseline(s) along with extensive information to justify the recommendation. The total number of possible baseline candidates is reduced by an informal pre-screening process by the Available Technology Subgroup. The product of this early screening process is the baseline candidates. The baseline candidates along with the relevant requirements and criteria developed by the OSSWG are input into the scoring process. In the scoring process, the functional and programmatic criteria are used to evaluate each of the baseline candidates. In addition to a raw score, the evaluators may also enter their confidence level (rated low, medium, or high) and rationales/comments.

The outputs from the scoring process are the raw scores. These raw scores are then refined and the number of scores reduced by the use of a filtering process. The raw scores are reduced from three to two dimensions. The three dimensions of raw scores are the baseline candidate, criterion, and evaluator. In contrast, the filtered scores, called Criterion Scores, have two dimensions: baseline candidate and criterion. A full description of the filtering process is given in Section 4.1.4.

The scores are then further processed by weighting the importance of a Criterion Score to a particular service class for most service classes. The results of applying these weights is a value for each candidate interface specification against each service class or programmatic issue. These values are the processed scores that are used in the analysis.

The final set of processed scores is derived by applying weights to the service class scores. These representative application weights describe the relative importance of particular service classes to particular representative applications. The result of the employment of these weights to the scores is a set of values which will show how well the various candidate interface specifications satisfy the requirements of representative Navy applications.

Various meetings, approximately six weeks apart, are held by the OSSWG during the evaluation process. During the evaluation process the following meetings will occur (listed in time order): Process Preparation Meeting(s), Baseline Candidates Introduction Meeting, Detailed Candidate Evaluation Meeting, and Process Results Meeting(s).

The remaining portion of this chapter describes in more detail the steps in the evaluation process.

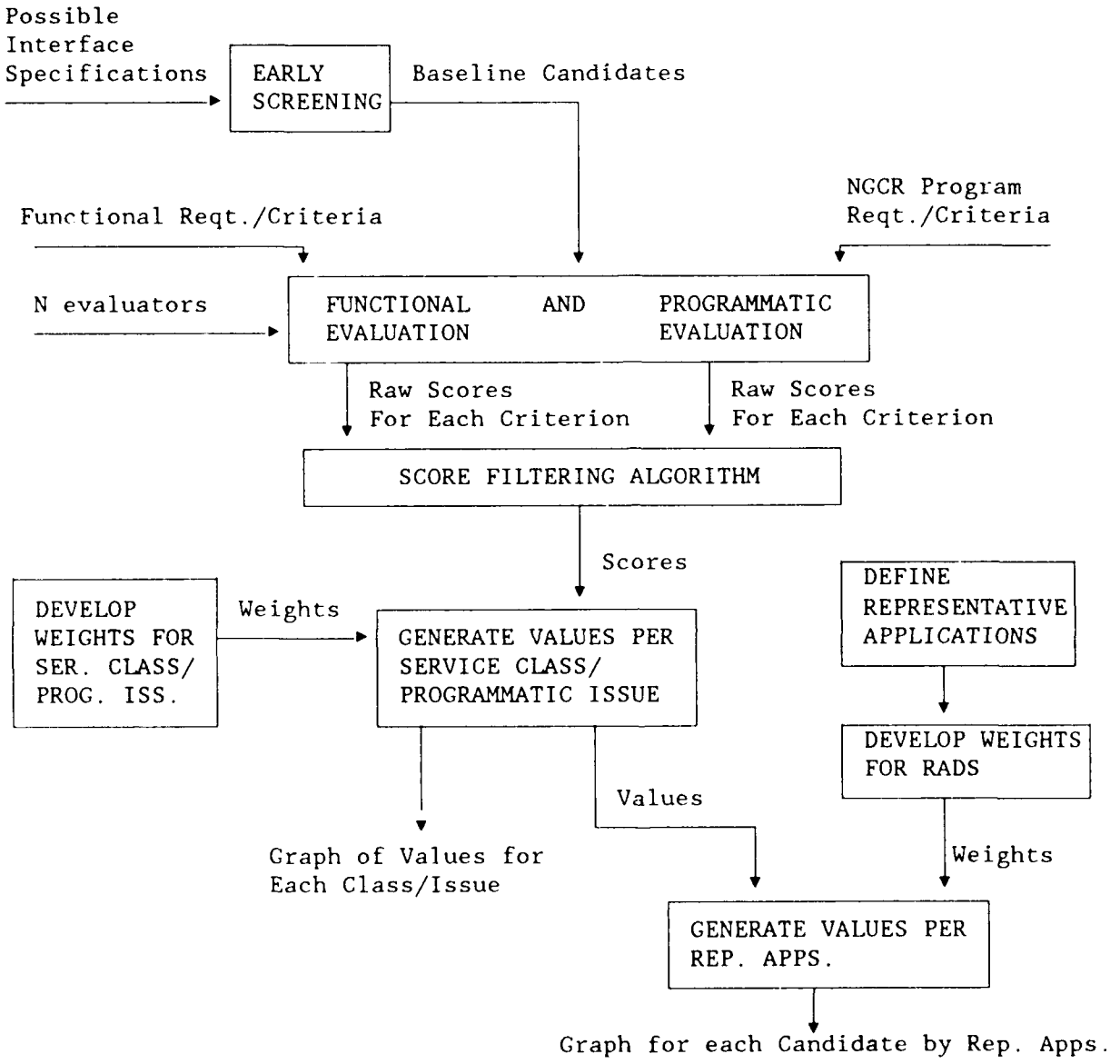


FIGURE 4-1. EVALUATION PROCESS

4.1 SCORING STEPS

4.1.1 Early Screening Process

The Early Screening Process is the mechanism by which the total number of possible baseline candidates is reduced by an informal pre-screening process by the Available Technology Subgroup of the OSSWG. This reduces the number of possible operating system specifications to the number of candidate interface specifications which are truly viable. This is done by informally applying two methods described in this section and eliminating obviously inadequate candidates. By the Baseline Candidates Introduction Meeting, the baseline candidates are selected and a brief description of each candidate is presented.

The two methods used to perform the early screening process are the decision option paper method (DOP method) and the positive-negative method (PN method). The first method is based on a comparison of operating system capabilities against DOP technology area requirements. For the DOP method six critical criterion area were defined: (1) support of real-time, (2) distributed, (3) fault tolerance, (4) security, (5) Ada language, and (6) heterogeneous processors. This scoring system is a set of marks consisting of ("+" provides some support, "-" provides no support, "?" insufficient information, or "blank" no support but can easily be added).

In the PN method two sets of criteria are defined, one for selecting candidates from the original list which should be included on the candidate list, and the other for determining operating systems which were unlikely to be usable as a primary operating system interface standard.

A matrix using the two methods is developed from the results of the two methods. The matrix illustrates where the two methods tend to support each other. In instances where the results appear to conflict, attempts are made to review the individual results and adjust if appropriate, or in most cases to provide an explanation.

4.1.2 Weighting

The scores are weighted in respect to their relative importance to the key attributes of the process. There are two sets of weights. The first set of weights, Weight Set 1, describes the relative importance of a Criterion Score to a particular service class. The results of applying these weights is a value for each candidate interface specification against each applicable service class. The second set of weights, Weight Set 2, describes the relative importance of service classes and their scores to representative applications. The result of the employment, the second set of weights to the scores, is a set of values which shows how well the various candidate interface specifications satisfy the requirements of representative Navy applications.

For Weight Set 1, it was determined that since the criteria of service class 1 (General) are not necessarily related to each other, no weights should be generated for this service class. Additionally, for programmatic criteria, it was decided that the NGCR program office would be the best organization to determine the relative importance of criteria within this class.

Weight Set 1 is developed by the OSSWG committee at the Baseline Candidates Introduction Meeting. The weights for Weight Set 1 are generated by full OSSWG membership. Members submit their set of raw weights on a form similar to the evaluation form for each of the steps in the process that requires weights. The submission is collected by the co-chairs. The filtering process described in Section 4.1.4 is applied to the candidate weight assignments. The final weighting decisions are made by the OSSWG co-chairs and Weight Set 1 is not disclosed to the OSSWG general membership until after the scoring process of criteria against the viable candidates is complete.

Weight Set 2 is developed during Process Preparation Meetings by the Approach Subgroup of OSSWG and is set by the Baseline Candidates Introduction Meeting.

By the beginning of the scoring process, both weight sets are fixed.

4.1.3 Scoring Process

The scoring process involves qualified evaluators rating each baseline candidate against various criteria. Each qualified evaluator signs up for the criterion areas (service classes and/or programmatic issues) which the member feels qualified to evaluate. Given the limited amount of time and effort a member is able to dedicate to the evaluation, he/she should restrict the number of criterion areas that he/she evaluates. The co-chairs adjust the assignment so that a sufficient number (at least seven) of evaluators score each criterion.

The evaluators are required to score all candidate baselines against a particular criterion and further, are required to evaluate all criterion within a service classes/programmatic issues they are evaluating. The filtering process will discard scores of an evaluator for a service class when the evaluator did not provide all necessary scores.

A trial run of the scoring process, after the Baseline Candidates Introduction Meeting, is performed to finalize the scoring process. This gives the chance for the evaluation process to be tested and modified, if needed.

The qualified evaluators receive the evaluation package after the trial scoring process is complete, but before the Detailed Candidate Evaluation Meeting. This package includes documentation of each of the candidate baselines, this document, the criteria with supporting requirements, the reference model, sample scoring form, and scoring instructions. An advocate for each baseline candidate will make a presentation to the evaluators at the Detailed Candidate Evaluation Meeting. During the remainder of the Detailed Candidate Evaluation Meeting and during the next three weeks the evaluators will have an opportunity to score each of the candidate baselines against each of the criterion. The evaluators have two options for transmitting their scores to NADC, where the raw score processing occurs. The deadline for the evaluator to send scores is set. The deadline for sending a hardcopy listing of scores is one week earlier than the deadline for scores transmitted over DDN (or the automated evaluation form). This is due to the logistics problems in handling hardcopy scores (entry and verification process). This deadline can be modified at the co-chairs discretion.

By five working days before the beginning of the Process Results Meeting all scoring is given the OSSWG co-chairs. The raw scores are filtered by the methods described in Section 4.1.4. The results are tabulated by the process described in Section 4.4 The results of the processing of the raw scores into the various processed scores are presented to the OSSWG at the Process Results Meeting(s).

4.1.4 Raw Score/Weight Filtering Process

A filtering process is applied to various scores for many reasons: elimination of scoring anomalies, to account for the variable number of raw scores/weights for each attribute, and to generate an overall score for a key attribute. Filters are applied to the raw criterion scores to generate the Criterion Score for each criterion and to the raw weights to develop the Service Class Weights and Representative Application Domain Weights.

4.1.4.1 Criterion Filtering Process. This section describes the filtering process to determine the Criterion Score from the raw scores for each criterion and candidate baseline. The scoring of each criterion for each candidate baseline is performed by evaluators who are qualified through the process described in Section 4.2.1. The number of raw scores per criterion/candidate baseline must be at least seven. First, the filtering process discards scores of an evaluator of a particular criterion if the evaluator did not score the criterion on all baseline candidates. The mean of the remaining scores for each criterion/candidate baseline pair is the Criterion Score for the pair.

4.1.4.2 Service Class Weight Filtering Process. This section describes the filtering process to determine the weights on the services classes used to generate scores for each criterion. The raw weights are generated by the OSSWG membership. The number of raw weight inputs per criterion must be at least seven. The process to filter these weights to arrive at the one filtered weight is the mean of the weights.

4.1.4.3 RAD Weight Filtering Process. This section describes the filtering process to determine the weights on the services classes used to generate scores for each RAD. The raw weights for the RAD scoring process are generated by the Approac' Subgroup of the OSSWG. The number of raw weight inputs per service class, RAD pair must be at least seven. The process to filter these weights to arrive at the one filtered weight is the mean of the weights.

4.2 THE EVALUATORS

This section describes the qualification of evaluators as well as the responsibilities of each evaluator. The qualification process is the procedure by which evaluators are selected and committed to the candidate scoring.

4.2.1 Evaluator Qualification

Organizations outside the Navy which have sent representatives to attend at least two OSSWG meetings by the Baseline Candidates Introduction Meeting are permitted to qualify organizational personnel to the candidate scoring. If such an organization has sent two or more representatives to two or more meetings then the organization will be permitted to qualify two evaluators for the candidate scoring; otherwise, it will be permitted to qualify one evaluator. Organizations within the Navy are not limited in the number of representatives they qualify. An organization is defined as a corporate division, company or college. Final determination of separate organizational units will be made by the OSSWG co-chairs.

4.2.2 Evaluator Responsibilities

This process calls for a large time and effort commitment by each evaluator. This fact is communicated to all evaluators qualified. Evaluators should be of the highest technical expertise in the area of operating systems. The qualification process allows a company to substitute more experienced technical personnel for the personnel regularly attending OSSWG meetings. This encourages qualified marketers or managerial personnel to substitute highest technical personnel for themselves.

Each evaluator qualified by an organization is required to send a letter of intent to participate in the process to one of the OSSWG's co-chairs by a set duration (approximately one week) after the Baseline Candidates Introduction Meeting and before the evaluation packages are sent.

The evaluator is responsible for attending the Detailed Candidate Evaluation Meeting, if at all possible. The evaluator is also responsible for returning all evaluation forms, completed, by the timetable described in Section 4.1.3.

4.3 EVALUATOR GUIDELINES

The following section describes the guidelines and procedures by which the weight and score developer generates the scores. Rules of evidence are addressed along with a description relative to scoring/weighting and the process of filling out the scoring forms.

4.3.1 Weighting Guidelines

All weights are on a zero to ten scale with zero being the lowest possible score and ten being the highest. Due to the mathematical process of combining weights and scoring, the ratio of weights relative to each other is the important factor when comparing weights for a particular final score. In other words, an attribute with the weight of two is twice as important as another with a weight of one, just as an attribute with the weight of ten is twice as important as an attribute with the weight of five.

To arrive at the weights, which describe the relative worth of scores in the process, the weighter determines how important the attribute to be weighted is to the characteristic to be described by the outcome of the weighted score. The zero score means there is no relationship between the attribute and the characteristic. A score of five means there is a moderate relationship, and a score of ten means there is a critical/essential relationship.

4.3.2 Scoring Guidelines

All scores are on a zero to ten scale with zero being the lowest possible score and ten being the highest. The description evaluation metric for the zero, five and ten score is included with each criterion. The evaluator should score each baseline candidate against each criterion separately, judging strictly on how well the baseline candidate meets the criterion and scoring given the evaluation metric.

Unless overwise specified in the criteria, the evaluator rates the candidate's current interface capabilities against the criteria.

4.3.2.1 Using Evaluation Forms. Each qualified evaluator receives an evaluator identification number. This evaluator identification number is entered into each of the evaluator's evaluation forms. Evaluator identification numbers are used to keep the evaluator scores anonymous, but allows accountability for all scoring forms. The OSSWG co-chairs will know each evaluator's identification number to ensure no duplication or erroneous identification numbers.

The scores are entered by each qualified evaluator into the evaluation forms. Each form is used to evaluate a particular candidate baseline against the criteria associated with particular service classes. The evaluator must enter into each form his/her evaluator identification number. In addition, each candidate baseline has an identification code which the evaluator must

also enter. For each criterion the evaluators enter their raw score, from zero to ten as described in Section 4.3.2., on the form. Optionally, the evaluators enter their confidence in the raw score accuracy, either high, medium or low. If a confidence level is not entered, it is assumed to be medium. Comments and rationale concerning their score including its rationale or reference to information used to arrived at the score is solicited, but is not mandatory. Appendix A is the template for the evaluation forms.

4.3.2.2 Rules of Evidence. This section describes the information that an evaluator can use to arrive at the raw criteria score and confidence level. The evaluators are given a packet of information from the OSSWG to perform the evaluation. This documentation along with the briefing given at the Detailed Candidate Evaluation Meeting provides the major source of information.

If an evaluator is aware of additional information which is documentable, then the evaluator can use this information in the scoring of the criteria. However, the evaluator must specify in the rationale section of the evaluation form the additional source of information. Sources of information that should be avoided include informal conversations, whether they be with marketeers or technical personnel.

4.4 SCORE PROCESSING

This section describes the method by which the raw scores for each candidate baseline specification are processed in order to arrive at the processed scores.

The processing of the scores is as automated as possible. The programs to perform data reduction through the filtering and applying weights are implemented on a computer. Additionally, evaluation forms sent via DDN are automatically read by a computer, allowing it to automatically find erroneous or missing data.

For each candidate baseline specification, the final score for each criterion, the Criterion Score, is arrived at by the filtering method described in Section 4.1.4. The filtering process not only reduces the effect of bias and/or numeric aberrations but also reduces the dimensions of the scoring values from three to two by eliminating the evaluator dimension.

The Service Class Score for each candidate baseline specification and service class is determined by multiplying the Criterion Scores for the candidate baseline specification by the respective weight for the service class. The Programmatic Issue Score for each candidate baseline specification and programmatic issue is determined by multiplying the Criterion Score by the respective weight for the programmatic issue. The Representative Application Score for a particular application and candidate baseline specification is defined as the summation of multiplying each representative application's weight for each service class by the corresponding Service Class Score of the candidate baseline specification.

The mathematical representation of scores for each baseline candidate follows:

S_{ij} -> is the raw score for criterion i from evaluator j

S_i -> is the Criterion Score for criterion i

$S_i = f_A (S_{ij})$ where f_A is the mean of raw scores for criterion i

W_{ik} -> is the weight for score S_i for service class/programmatic issue k

C_k -> is the set of criterion which belong to service class/programmatic issue k

S_k -> is the normalized Criterion Score for service class/programmatic issue k

$$S_k = \sum_{i \in C_k} \left(S_i W_{ik} \Big/ \sum_{j \in C_k} (W_{jk}) \right)$$ for each service class/programmatic issue k

W_{km} -> is the weight on service class k for representative application m

A_m -> is the set of service classes which belong to representative application m

R_m -> is the Representative Application Score for domain m

$$R_m = \sum_{k \in A_m} W_{km} S_k$$

Weights are arrived at through a filtering process so that:

$W_{ij} = f_W (w_{ijk})$ where f_W function is the mean for evaluator i, for attributes j and k.

The main results of the evaluation that is used in the analysis and recommendation are the Representative Application Score (R_m), and Service Class and Programmatic Scores (S_k).

CHAPTER 5

RESULTS AND CONCLUSIONS

The result of the process above is three sets of weighted scores for each candidate baseline specification. These sets of scores are organized into a set of graphs to better illustrate the relationship between the candidate baseline specifications from the three views of the evaluation process. The scores and graphs are documented in the Evaluation Results Report.

The results of the process are analyzed to formulate and justify a recommendation to the NGCR Program office as to which specification(s), if any, the OSSWG should use as a baseline for its standardization process. Discussions concerning which recommendations the OSSWG should make to the program office is discussed at an OSSWG once the scoring is complete. This recommendation is arrived at by discussing the three sets of values with the OSSWG membership. The final decision on recommendations is made by the OSSWG co-chairs. The final recommendation is documented in the Recommendation Report. Other issues and lessons learned are included in the After Action Report.

BIBLIOGRAPHY

After Action Report for Next Generation Computer Resources Operating Systems Interface Baseline Selection Process, Version 1.0, 7 May 1990.

Evaluation Results Report for Next Generation Computer Resources Operating Systems Interface Baseline Selection, Version 1.0, 7 May 1990.

Next Generation Computer Resources Development Options Paper: COMSPAWARSYSCOM LTR 324/253, 30 Oct 1987.

Next Generation Computer Resources Operating Systems Standards Working Group Charter, 16 Mar 1988 (approved at 1st meeting with industry).

Next Generation Computer Resources Operating Systems Standards Working Group Reference Model, Version 1.03, 6 Dec 1989.

Next Generation Computer Resources Operating Systems Standards Working Group Requirements Document, Version 2.0, 21 Dec 1989.

Operational Requirement For Next Generation Computer: CNO Transmittal 098r/8u55086, 8 Aug 1988.

Recommendation Report for Next Generation Computer Resources Operating Systems Interface Baseline Standard, 7 May 1990.

Tentative Operational Requirement for Next Generation Computer, CNO Ltr 098r5u353846, 31 Dec 1985.

APPENDIX A

EVALUATOR TEMPLATE FORM

```
*                    OSSWG OS Interfaces Evaluation
*
*                    Process Management Interface
*Service Class:9
*Evaluator Name:
*Evaluator ID:
*Candidate ID:


*9.1  Create Process
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
*(text: don't start line with '*' or exceed 100 characters per line):


*Comments
*(text; don't start line with '*' or exceed 100 characters per line):


*9.2  Terminate Process
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
*(text; don't start line with '*' or exceed 100 characters per line):


*Comments
*(text; don't start line with '*' or exceed 100 characters per line):


*9.3  Start Process
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
*(text; don't start line with '*' or exceed 100 characters per line):


*Comments
*(text; don't start line with '*' or exceed 100 characters per line):
```

***9.4 Stop Process**
*Score (0 - 10):
*Confidence Level (H/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

***9.5 Suspend Process**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

***9.6 Resume Process**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

***9.7 Delay Process**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

***9.8 Interprocess Communication**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

***9.9 Examine Process Attributes**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

***9.10 Modify Process Attributes**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

***9.11 Examine Process Status**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

***9.12 Process Identification**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

(text; don't start line with '' or exceed 100 characters per line):

***9.13 Save/Restart Process**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

***9.14 Program Management Function**
*Score (0 - 10):
*Confidence Level (H/M/L):
*Rationale/References
(text; don't start line with '' or exceed 100 characters per line):

*Comments
(text; don't start line with '' or exceed 100 characters per line):

*General Comments
(text; don't start line with '' or exceed 100 characters per line):

End of evaluation form (Do not delete this line!)

APPENDIX B

WEIGHT SET 2

	RUBY	OPAL	AMETHYST	GARNET	TOPAZ	EMERALD	DIAMOND	SAPPHIRE
ARCHITECTURE DEPENDENT SERVICES	3.2	5.3	4.2	5.8	6.0	7.2	7.8	6.0
CAPABILITY & SECURITY SERVICES	5.8	2.3	9.0	3.2	4.8	9.3	4.3	7.6
DATA INTERCHANGE SERVICES	6.4	5.5	7.7	4.3	7.7	4.8	5.5	6.2
EVENT & ERROR MANAGEMENT SERVICES	5.4	7.3	7.5	7.5	6.2	7.2	8.5	7.2
FILE INTERFACE SERVICES	9.2	0.5	4.7	0.3	4.2	1.7	1.7	3.4
GENERALIZED I/O SERVICES	5.0	5.5	4.5	6.7	6.3	5.3	6.5	6.0
LANGUAGE SUPPORT SERVICES	2.4	4.5	6.8	8.2	8.8	8.7	8.3	8.8
NETWORK & COMMUNICATION SER.	3.8	5.2	9.5	2.8	6.2	5.3	6.0	8.8
PROCESS MANAGEMENT SERVICES	4.0	4.5	5.5	3.7	5.3	5.2	6.3	8.2
PSE SERVICES	3.0	3.7	4.2	4.7	6.2	7.3	6.5	7.6
R-A-M	3.4	6.0	7.5	8.5	8.2	9.2	8.7	8.2

Appendix B: WEIGHTS TWO, RAD WEIGHTS (Cont.)

	RUBY	OPAL	AMETHYST	GARNET	TOPAZ	EMERALD	DIAMOND	SAPPHIRE
RESOURCE MANAGEMENT SERVICES	6.0	3.0	5.5	4.0	4.3	5.0	5.3	6.8
SYNCHRONIZATION & SCHEDULING SER..	5.4	5.5	7.0	4.3	4.8	5.2	8.3	7.8
SYSTEM INIT. & REINIT. SER.	4.6	3.5	5.0	4.3	6.3	5.2	5.5	4.6
TIME SERVICES	3.8	7.2	7.8	7.0	6.7	6.8	7.7	8.4
ADA SUPPORT	2.4	4.5	6.8	8.2	8.8	8.7	8.3	8.8

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