

# Position Classifications Standard for Operations Research Series, GS-1515

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## SERIES DEFINITION

This series includes professional positions that apply multi-disciplinary and interdisciplinary scientific principles and mathematical methods to study and analyze problems of complex systems to provide advice and insight about the probable effects of alternative courses of action. The work requires the ability to apply quantitative techniques to solve problems or provide alternative solutions for management. Competence in the rigorous methods of scientific inquiry and analysis is more important than knowledge of the subject matter of the problem.

## RELATIONSHIP TO OTHER OCCUPATIONS

Operations research work shares many similarities with other kinds of scientific and analytical work, such as (1) mathematics and mathematical statistics, (2) engineering, (3) budget analysis, (4) management and program analysis, (5) computer science, (6) information technology management, and (7) economics.

1. *Mathematics (including mathematical statistics)*: Mathematics is one of the most useful tools of the operations research analyst. Mathematical models, often computerized, show the relationship of important factors in the operations research project. Models permit testing factors to detect the effects of changing variables. Operations research analysts use mathematical techniques such as calculus, statistics, numerical analysis, probability theory, linear and dynamic programming, design of experiments, queuing theory, and game theory. They are concerned with the entire range of analytical, scientific, and nonscientific areas that affect a particular problem.

2. *Engineering*: Professional engineering involves the application of the principles and practices of engineering. Industrial engineers use these concepts in arriving at engineering conclusions concerning industrial operations, work flow, facilities layout, and system improvement. Other engineers apply knowledge of engineering principles to understand how a system or process is designed, how its parts work together, and how the system's mechanical or physical forces are affected if the system is changed. Engineers use mathematical techniques such as finite element analysis for modeling systems such as machines, bridges, or buildings.

Operations research analysts are concerned with the operation of a total system rather than the engineering aspects of a system or operation. They must learn enough about the system and how it operates to understand cause/effect relationships, to represent the system symbolically, and to examine alternatives for using, operating, or supporting the system. For example, an operations research analyst conducting a cost effectiveness study of a fleet of trucks must know enough about how trucks are designed and built to recognize factors in the manufacturing process that drive costs up or down, and why. Unlike engineers, operations research analysts are not expected to apply a detailed knowledge of engineering principles.

3. *Budget analysis*: Budget analysis work requires a detailed knowledge of the planning, programming, and budgeting system, and knowledge of laws, constraints, and reprogramming rules. Operations research analysts study financial and resource problems using the scientific approach and a variety of mathematical and statistical techniques.

4. *Management and Program Analysis*: Management and program analysts evaluate the effectiveness of government programs or operations, or the productivity and efficiency of management practices. They serve as staff analysts, evaluators and advisors to management on the effectiveness and efficiency of agencies and their components in carrying out assigned programs and functions. Although the work requires analytical skill, it does not require professional knowledge of scientific principles, application of rigorous methods of scientific inquiry, and the use of mathematical methods that are typical of operations research work.

5. *Computer science*: Computer science involves scientific inquiry into computer hardware, software, and information structures. The computer scientist is concerned with problems arising from the use of computers. Operations research analysts use computers as tools to develop, modify, or update models.

6. *Information Technology*: Information technology management specialists apply knowledge of computer hardware, software, or information structures to perform a wide variety of functions to establish or maintain computer systems. The computer system is the focus of their work.

Operations research analysts use higher mathematics and computer programs to solve problems. They may develop and modify computer programs to use as tools in analyses. Analysts identify changes in real-world systems, decide how to mathematically represent them in simulations, and change computer programs accordingly. The primary knowledge applied is of modeling techniques and the subject matter of the simulation. Computer knowledge is secondary.

7. *Economics*: Economists study economic phenomena and analyze and interpret economic data. They prepare special or continuing reports on economic facts and activities. They adapt and use specialized methods for quantifying, measuring, and understanding economic relationships. The field of econometrics involves application of mathematical methods to economic problems. Operations research is less demanding in the requirement to understand economic phenomena and more demanding in the requirement to be able to move from one category of project, e.g., physical, social, or economic, to another.

When the proper series for a position is not clear, the interdisciplinary approach to classification and recruitment described in the [Introduction to the Position Classification Standards](#) should be applied.

## OCCUPATIONAL INFORMATION

Operations research is also called operations research/systems analysis, operations analysis, and systems analysis. Operations research analysts work on issues related to many functions of the Federal government such as research and development, resource and cost analysis, and policy analysis. They study systems, processes or operations and help decision makers find the best courses of action, often within the context of limited resources. Operations research analysts occasionally produce principles, such as Search Theory. More often they adapt methods from other areas of science, such as Chaos Theory. Similarly, professionals in other fields may use the operations research approach to solve problems in their disciplines. Operations research involves developing analytical methods as well as adapting and modifying techniques from other scientific, technical, and analytical disciplines.

Most operations research work involves either (1) methods development and assessment, or (2) problem solving. Operations research analysts who develop problem solving methods are experts on the methods associated with particular class of problems. They may specialize in one or more areas such as queuing theory, optimization methods, simulation, or artificial intelligence. They advise other operations research analysts, scientists, or engineers on techniques best suited for analyzing their problems.

Analysts who work directly on systems, process, or operations problems are experts in the methods of problem solving or, for recurring or long term problems, problem management. An example of a recurring problem is the various strains of influenza that appear each year. An example of a long term problem would be a disease like cancer.

Analysts apply operations research techniques as well as methods borrowed from other fields. They usually deal with a variety of broad issues, subjects, and problems. Each assignment presents a different question. Analysts may work in many subject areas. They acquire knowledge needed for problem solving from subject matter experts and the literature.

Over time analysts may gain considerable knowledge of some specialty fields. For example, an analyst studying alternatives to the use of scarce minerals becomes quite knowledgeable about the minerals. In modeling the world market to examine alternatives, the analyst learns about properties of minerals, their uses, their sources, their availabilities, and possible substitutes for them. The analyst acquires subject matter knowledge by asking questions of experts, reading technical journals, and examining mineral data. After several years, the analyst has acquired substantial knowledge of the subject.

Operations research is an advisory function and a structured approach to problem solving. It is a rigorous process of scientific inquiry and analysis, applied to one-of-a-kind or recurring problems that confront decision makers. It is the systematic examination and development of alternative courses of action to define and clarify available choices and their advantages and disadvantages. A key requirement of an operations research analyst position is the ability to work across disciplinary boundaries and to develop multi-disciplinary solutions to complex problems. For example, an analyst may be asked to evaluate the capability of a specific high performance fighter/bomber for attacking

selected power plants in enemy territory. The analyst defines and quantifies the factors affecting the ability of aircraft to reach the target, destroy it, and survive the mission. The problem may involve issues relating to aeronautical, electrical, electronics, and mechanical engineering, and scientific fields such as physics, mathematics, and economics.

## THE ANALYSIS PROCESS

Three key concepts are important in understanding the analysis process. These concepts are (1) system, (2) relationship, and (3) model.

1. A *System* is a group of interrelated, interacting or interdependent elements forming a complex whole. A process or operation may be a system. In this standard the term system refers to the system, process, operation, or other subject being analyzed.
2. A *Relationship* is a statement about the similarities, differences, or interactions of two or more quantities or measurements called variables. For example, a tall person probably weighs more than a short person. The two measurements of height and weight are related variables. There are other variables related to weight, such as the person's bone structure and body type. A relationship can be established between a person's height and any of these other variables. Much of the work of operations research lies in identifying the proper variables and true relationships for use in solving a particular problem or evaluating alternatives.
3. A *Model* is a useful representation of the relationships that define a system or situation under study. It may be a set of mathematical equations, a computer program, a hand played game, a written scenario, an experiment, or other type of representation ranging from verbal statements to physical objects. Models permit the manipulation of variables to determine how a process, object, or concept would behave in different situations, without the time, risk or expense of actual real world implementation.

The primary purpose of analyses is to provide decision makers with sound, scientific, and quantitative bases for making decisions. These decisions are often made under conditions of uncertainty arising from a lack of current experience and knowledge, conflicts in objectives, the variety of possible alternatives, and/or the failure of current systems to meet their goals.

The analytic process begins with defining problems, usually in the form of A what-if@ questions. In formulating problem statements, analysts examine the objectives and criteria of systems to make sure they are studying the right problems. They determine the context of problems to identify (1) the principal decisions to be made, (2) the relevant variables and true relationships, as well as the irrelevant variables, (3) the alternative choices, (4) the measures of effectiveness, or success, that distinguish among the alternatives, and (5) the constraints.

The analysts develop models of the important factors and their relationships representing selected features of the real world. Models permit experimentation. They augment and extend the evaluation of system performance and reliability beyond the scope of practical testing.

Analyses done with models may be the only means to forecast performance for certain kinds of systems such as the world economy or combat.

The use of models leads to the discovery of cause/effect relationships that may otherwise go unnoticed. Analysts develop or select models with which they can experiment to develop and explore choices or hypotheses. They determine if the models describe the systems under study and test their reality by measuring their sensitivity to various values of appropriate variables. After showing that a model is a fair representation of reality, or that its limitations are acceptable for the current study, the model can be used for analyses.

The main hypotheses are tested and possible courses of action are investigated. The analytical process involves successive integration of analogies, patterns and relationships, and usually involves feedback and further restructuring. For new types of problems, analyses constitute a continuous cycle of formulating problems, selecting the objectives, designing better alternatives, collecting data, building new models, weighing cost against performance, questioning assumptions and data, reexamining objectives, and identifying new alternatives.

Some problems cannot be solved with mathematical models. These problems usually include intangible characteristics that cannot be expressed in quantitative terms. Foremost among such characteristics is the presence of the human element.

The end results of analyses are usually predictions of future events or explanations of past events. Analysts recommend the best alternatives, if they can be found. They present the various alternatives and their tradeoffs and limitations so that managers can make informed choices or take appropriate action.

## TITLES

*Operations Research Analyst* is the title for nonsupervisory positions.

*Supervisory Operations Research Analyst* is the title for positions that meet the criteria for application of the [General Schedule Supervisory Guide](#). @

## EVALUATING POSITIONS

This standard provides grade level guidance for individual analyst and team leader positions. The factors are (1) assignment characteristics and (2) level of responsibility.

### 1. *Assignment characteristics*

This factor deals with the size, scope, and complexity of the assignment; the nature of the functions performed; and the degrees of creativity and judgment involved. Operations research assignments range in difficulty depending upon the:

- (a) Size and scope of the project, and the nature of the system being studied in terms of its complexity and the number, relationships, and subtlety of variables involved;
- (b) Degree to which the issues and problems are known or specified and the relative availability of precedents and guidelines;
- (c) Extent of conceptualization, innovation, creativity and judgement required to structure and pursue the work and to apply methods and techniques;
- (d) Extent of operations research and related knowledge, skill, and ability required to carry out the work;
- (e) Extent of participation in projects and nature of functions performed.

At the lower levels assignments relate primarily to specific procedural steps or tasks which are limited in scope and for which analytical methods and techniques are known. At the higher levels assignments typically involve a complete project or a part of a larger project which in its complexity, breadth, and importance is comparable to a complete project.

### 2. *Level of responsibility*

This factor includes the nature and extent of supervisory control exercised over the work, of personal contacts, of responsibility for project formulation, and the significance of recommendations and advice rendered.

It is measured by the degree to which the analyst or team leader is held accountable for processes such as the formulating and structuring problems, specifying alternatives, and establishing assumptions governing the work. This factor is also measured by the degree to which the analyst is held accountable for the effectiveness of planning, the adequacy of treatment, the accuracy of analysis, the validity of interpretations, and the significance of findings.

Usually, as a project progresses, the work, judgement, and assumptions of an analyst are subject to review by other operations research analysts, subject matter specialists, and supervisory personnel. At the lower levels, this review typically is made by a team member, team leader, or supervisor. At the grade 12 level and above this review typically results from informal coordination among co-workers and from meetings held to assess progress and to make further plans.

## SUPERVISORY POSITIONS

Classify supervisory positions using the [General Schedule Supervisory Guide](#) and this standard.

### OPERATIONS RESEARCH ANALYST, GS-1515-15

Positions at grade 15 may be evaluated by:

- (a) extension of criteria in this standard;
- (b) comparison to other classification standards or guides such as the standard for the [Economist Series, GS-0110](#), or the [Policy Analysis Grade Evaluation Guide](#); and
- (c) application of sound position classification principles.

### OPERATIONS RESEARCH ANALYST, GS-1515-5, 07, AND 09

For specific grade level criteria below grade 11, refer to other classification standards such as the [Economist Series, GS-0110](#), [Electronics Engineering Series, GS-0855](#), [Actuary Series, GS-1510](#), and [Mathematician Series, GS-1520](#).

### OPERATIONS RESEARCH ANALYST, GS-1515-11

#### *Assignment characteristics*

At the grade 11 level, many analysts are continuing to develop their analytical capabilities and to broaden their experience in the assigned subject area.

Assignments at this grade characteristically are segments of a larger project. Grade 11 segments typically involve one of the major phases of a project or several phases of a specific question. Over the course of several assignments, the analyst performs all of the steps in the analytic process with the help of a supervisor or senior analyst. These steps include setting up the problem, conducting background investigation, collecting and reducing data, displaying data for analysis, formulating mathematical expressions, and drawing conclusions.

The requirement for creativity and innovation is limited to the application of standard methods and techniques to describe, treat and evaluate the particular circumstances involved. While the process, operations, or questions are complex to treat, the variables and the relationships to be considered are normally conventional. Grade 11 analysts are expected to examine a variety of methods, techniques, and processes and to recommend those suitable for producing explicit findings and evaluations.



Guidelines and precedents are generally available to cover most of the work, but they are not detailed or explicit. The grade 11 analyst is therefore required to select, interpret, and apply appropriate guidelines to satisfy the objectives of the assignment. In addition, the grade 11 analyst exercises judgement in applying standard professional practices to new situations and in relating new work situations to precedent ones. Situations not covered by precedents or guidelines are referred to the supervisor or team leader, with recommended solutions. In these cases oral explanations and guidance are provided so that the analyst gains further insight and understanding about the work.

### *Level of responsibility*

Grade 11 analysts typically assistance other professionals, who outline the objectives and anticipated results of the assignment, provide guidance on possible approaches to resolve questionable areas, and approve methods to be used. Typically, the goals, constraints, measures of effectiveness, and value criteria which structure and control the overall analysis are established by others. Within this context, the grade 11 analyst is responsible for gathering and analyzing data, identifying relationships among data elements, and recognizing the relative significance of those relationships and their potential impact on the project. Completed work and work in progress are reviewed for technical propriety, validity, and soundness.

Grade 11 analysts plan, organize, and carry out the processes implicit in their assignments and determine the detailed steps to be undertaken in conjunction with operating and subject-matter specialists, or other team members.

Grade 11 analysts are responsible for proposing the operations research methods and approaches to be used, and explaining to the supervisor or team leader the basis for selecting these methods and approaches. They obtain assistance of others, as needed, in carrying out the assignment. For example, they usually need to elicit cooperation of others to obtain data.

At this level, investigations and analyses are expected to result in a specific work product such as: conclusions about or proposals for design of experiments; isolation of representative factors to describe the operation; specification of data collection methods and techniques; construction of parts of analytical and mathematical models for predicting the effects of alternative courses of action; or preparation of reports describing and justifying the results of analytic studies.

Contacts are more widespread than found at lower grades and the grade 11 analyst has greater latitude in making independent technical decisions, gaining cooperation of those contacted, explaining needs or requirements, and resolving problems.

## **GS-11 Operations Research Analyst Illustrations**

### **Illustration #1**

Works as a team member in an organization that conducts operations research investigations of logistics support systems for military weapons and materiel systems. Assignments generally are segments of a larger study and involve one of its major phases. Under the direction of a senior analyst, participates in a variety of projects such as: (1) determining tradeoff relationships between system operating costs and level of performance; (2) determining the optimum test design for development tests to minimize the amount of testing while still providing adequate data for decision making; (3) determining the effect of age on system performance; or (4) evaluating the appropriate mix of support equipment to obtain maximum effectiveness on the battlefield.

### **Illustration # 2**

Assists in the development and implementation of analytical and simulation models used to evaluate the feasibility and effects of new or current compliance strategies for mobile source emissions regulations. Using established analytical techniques, carries out a variety of tasks such as: (1) modeling the cumulative amount of emissions from mobile sources on a local, state, and federal level, (2) participate in modeling the benefit derived from new or proposed programs in the mobile source area, (3) independently analyze the relationship between emissions recorded on short tests and the Federal Test Procedures using regression analysis and associated techniques, (4) modeling and analyzing the effects of various fuels and fuel additives, or (5) independently correlate emission test results from various laboratories operated by the division to assure a high level of quality control. Maintains and modifies manufacturers= assembly line test data base and analysis programs.

### **Illustration #3**

Assists in analyzing target maintenance, maintainability, cost, performance, and related manpower data. Participates in the identification of trends and problem areas and develops recommended corrective actions. Uses existing data elements collected as part of the maintenance program to establish, develop and maintain an accurate and dependable data base of aerial and surface target deficiencies, failures or shortcomings. A typical example is the analysis of failure history of an avionics processor to determine if failure is user or design related. Assists in developing target performance history derived through the statistical and mathematical analysis of data from the appropriate repositories. Compares actual target component reliability with the reliability goal. Examines data bases to identify deficiencies in training, technical manuals, handbooks, and test and ground support equipment. Data analysis results are used to support other studies or identify problems that require immediate attention.

## **OPERATIONS RESEARCH ANALYST, GS-1515-12**

### *Assignment characteristics*

This level differs from the grade 11 level in that the grade 12 operations research analysts perform complete projects independently and are responsible for each step of the analytic process.

Typically, grade 12 analysts conduct complete projects of limited scope in a narrow subject-matter area or serve as team members with responsibility for portions of broadly defined projects.

Grade 12 analysts are expected to know a variety of conventional operations research methods, techniques and approaches. At this level, analysts also learn about the overall system assigned to complete technically competent analyses. This knowledge usually is acquired from subject matter experts, technical reports, professional journals, and advice and assistance from more experienced analysts.

The analyst is given a problem, study, or project in which the significant variables must be investigated. The analyst is responsible for examining the underlying relationships, selecting appropriate methods or techniques from a variety of possible alternatives, and drawing conclusions. Grade 12 analysts judge the adequacy of various factors used to describe the system and test the sensitivity of those factors to change to ensure that the factors selected are the most appropriate for the purposes of the project. While the variables and data may be complex to treat because of their number, the resulting conclusions are usually are not controversial.

Considerable originality is needed to modify or adapt problem solving or other techniques such as mathematical techniques to fit specific situations. Most organizations do not apply all of the techniques available in the field of operations research, but the grade 12 analyst is expected to recognize those situations in which the application of different techniques is appropriate. Typically, innovation is required to deal with the higher level of problem complexity and to explain the underlying relationships of a system which involves uncertainties in some significant aspects.

Precedents and guidelines are often available, but unlike the grade 11 level, are inadequate, inappropriate, or lacking for major aspects of the project.

The work involves analysis of an existing system to determine the effect of proposed changes or to implement a change in the system. When the analysis involves a new system, the analyst typically is responsible for a major subsystem or segment of the project.

*Level of responsibility*

Grade 12 assignments are stated in general terms. The supervisor or team leader describes overall objectives to be achieved and provides guidance on potential problem areas. Grade 12 analysts independently organize the work to accomplish the objectives of the assignment, recognize the limitation of current approaches, and suggest additional work that may be required.

While the overall goals and conditions which govern the project typically are defined by the customer or management, the analyst is responsible for determining the value criteria, making assumptions, and recognizing additional constraints that may be uncovered during the course of the project. Grade 12 analysts are responsible for factual accuracy, as at the grade 11 level, and for the thoroughness of the analytic design and the cogency of interpretations.

Frequently grade 12 analysts provide technical guidance and coordinate the efforts of others involved in providing necessary information or carrying out various aspects of the assignment. Contacts are widespread within the organization and may involve professional staff from other organizations. The purpose of contacts primarily is to coordinate work efforts, report on results, and resolve problems.

Analysts are expected to report progress on significant milestones and difficulties encountered and to seek supervisory guidance on matters for which established policies and procedures are inadequate. Completed work is reviewed for technical adequacy in meeting objectives, and the validity and soundness of approaches and conclusions.

## **GS-12 Operations Research Analyst Illustrations**

### **Illustration #1**

Serves as a member of a team responsible for conducting data analysis, modeling, and special studies of endangered species in a designated geographical area. The analyst's portion of the team's efforts involves sea turtles. Provides assistance to team members engaged in studying marine mammals and other fishery stocks under the purview of the regional office. Designs and coordinates sea turtle surveys and monitors their progress. Conducts quantitative analyses of biological populations using population dynamics models and techniques associated with line transect analysis, multivariate statistics, and Leslie matrix analysis. Plans aerial and beach surveys and population experiments to collect data. Designs appropriate data bases for use in conducting analyses, evaluates data, interprets results, and prepares technical reports. Serves as a primary source of information to the team on statistical design of experiments and sampling techniques. Through cooperative agreements, coordinates field surveys and the exchange of data with state representatives, other federal agencies, industry, and universities. Provides technical guidance to direct the efforts of support personnel such as computer specialists, statistical clerks, or biological technicians who assist in data collection and analysis.

**Illustration #2**

Serves as a member of a team conducting analytical studies of a developmental ground warfare system. Is assigned lead responsibility for studying a major subsystem of such materiel. Studies are aimed at determining technical feasibility and combat effectiveness, developing optimal design parameters, and establishing desirable performance characteristics. Typical examples include: (1) a study to determine the optimum system characteristics for a given time frame or for the accomplishment of a given objective, (2) a study to develop models and predict the outcome of duels and engagements, or (3) a study to forecast the requirements for essential component parts needed to replace those which are combat damaged or failed. Analyzes numerous factors affecting system capability and the results of field experiments and testing. Uses combat, peacetime, wargame and similar data in the study process. Considers such important factors as the evasive action of targets, the size, location and vulnerability of the target, its probability of being detected and accuracy of location, the kill mechanisms of munitions, casualty and damage criteria, defeat levels, rates of fire, organization and operational factors, environmental conditions, logistics issues, attrition rates, survivability, etc. The results of work either stand alone or are integrated into an overall team effort.

**Illustration #3**

As a member of a team, conducts cost analysis of alternative ways to improve the reliability of a proposed satellite system in space. Alternatives considered include the purchase of components that are very reliable, but also more expensive, or the provision of redundancy by using duplicate components. Relationships among variables such as reliability, satellite useful life, weight, and fuel usage must be considered. For example, adding duplicate components for redundancy increases reliability and satellite useful life, but it also increases weight, the cost of fuel needed for launch and in-flight course correction, and the cost of the duplicate components. To investigate and model relationships, the analyst must get data from scientists and engineers who are developing the satellite. In many cases the analyst must work with estimates of performance factors. Applies probability theory, linear programming, and other operations research techniques to the prediction of reliability degradation and the mathematical simulation of satellite performance. Results form a portion of the final study report.

**Illustration #4**

Works in an organization responsible for planning and analyzing the test and evaluation of developmental systems. As a team member is assigned a major segment of the overall analysis for a highly complex program. As an individual analyst has complete responsibility for a major subsystem. The purpose of the work is to provide decision makers with an independent assessment of the relative values, strengths, and weaknesses of competing systems or an assessment of the performance of a particular system or concept compared to stated requirements. Emphasis of work is on test planning, test design, data analysis, and reporting results. Analyzes documents describing the system and its operational environment and expected performance capabilities. Structures tests, usually conducted by other organizations, to ensure that data obtained is sufficient to conduct a sound analysis. Prepares documents that include: (1) a technical description of the test; (2) conditions under which the test will be

conducted; (3) the test objectives and measures of effectiveness; and (4) methods of data analysis. Attends meetings to coordinate work with other organizations involved in the project such as the developer or contractor, tester, and other analytical organizations.

### **Illustration #5**

Works in an organization responsible for analyzing the effectiveness of training systems. Assignments involve complete responsibility for a specific course or a major segment of a more comprehensive training program. Examines tasks to be performed, training objectives, educational curricula, instructional evaluation and feedback mechanisms, and current evaluation methodologies. Designs or participates in the design of assessment plans and evaluation strategies. Develops measures of effectiveness, sampling procedures, and data collection instruments. Identifies variables that may impact on training effectiveness and investigates cause and effect relationships. As appropriate, designs and monitors field tests. Extrapolates from experimental, historical, and analytical data. Applies a variety of mathematical and statistical techniques to the analysis of data. Conducts analytical studies to predict the effect of changes in training policies, correlates results with other work in the field, and prepares quantitative information for decision makers.

### **Illustration #6**

Works in an organization responsible for analyzing logistics systems to support system design, development, and acquisition decisions. As a specialist in the group, is responsible for the design, development, validation, adaptation, and maintenance of an assigned logistics model or one of the major submodels used in analytic studies. Models the load on the logistics system caused by scheduled maintenance, reliability failures, and combat damage. Simulates the supply system that provides replacement parts and end items, the maintenance system that moves items to a particular repair level, delay times in supply and maintenance operations, and maintenance float policies. Researches the operations involved. Develops a methodology that represents the process consistent with the intended application of the model(s). Designs, develops and tests the computer code to implement the methodology. Provides instructions to users. Assists others in the construction of data files and loading, storing, and documenting data. Modifies the existing computer programs as required. Also performs analytical studies of logistics systems.

## **OPERATIONS RESEARCH ANALYST, GS-1515-13**

### *Assignment characteristics*

Operations research analysts grade 13 receive a wide variety of assignments which are characterized either by their breadth or depth. Technical precedents and guidelines are generally not available or those which do exist only provide a framework or foundation for departure.

Generally, any of the following, or comparable conditions, characterize the difficulty of grade 13 assignments:

- (1) Assignments involve very difficult, complex problems that have facets that are new, strange or unfamiliar. These unique problems require considerable ingenuity in determining the approach and in identifying the relevant factors for analysis.
- (2) The work requires innovation in the selection or application of techniques to solve problems, enhance performance, or increase efficiency and effectiveness. This may involve the use of advanced techniques or the use of techniques recently developed to treat a particular class of problems. In other cases, the grade 13 analyst demonstrates innovation by applying standard techniques in a new or creative fashion, or by applying techniques that were developed for unrelated purposes. The key is not in the development of new techniques, but in the innovative analytical approach and the creative manner in which the techniques are applied.
- (3) The work involves the analysis of the feasibility of advanced approaches or radically different policies; evaluation of the impact of new technology on current systems or policies; or assessment of the performance and effectiveness of a new or substantially modified system. Such work may involve analyses of prototype systems for which some quantitative data exists, or analyses of new approaches based on estimated data.
- (4) The work involves projects with high visibility, unusual urgency or program criticality. These situations require highly developed organizational skills, particular emphasis on attention to detail, ability to negotiate, and ability to work under time pressure without compromising quality of analysis.

The grade 13 operations research analyst may serve as an independent worker, as a team member, as an ad hoc team leader, or as a permanent team leader. Grade 13 work performed by analysts in any one of these roles is more complex and difficult to accomplish than grade 12 work. Grade 13 operations research analysts may serve as:

- (1) An independent analyst responsible for the execution of an entire project which meets grade 13 complexity characteristics. In these situations, the analyst usually coordinates and gathers information from others.
- (2) A team member responsible for a complete project that is part of a much larger overall effort. Although such service as a team member appears similar to what is found in some grade 12 positions, the grade 13 team member is assigned complete segments that meet grade 13 breadth and complexity aspects. In addition, the grade 13 team member carries out the assignment with a greater degree of independence and technical authority.
- (3) A team leader for the duration of a specific project that is considered difficult to organize and direct because of its breadth of coverage and the large number of variables involved. The work requires the efforts of several team members, often from different disciplines, who may not work in the same organization as the team leader.
- (4) A permanent team leader for a variety of projects falling within a defined area of responsibility. In these situations, the analyst is responsible for the technical direction of

several related, but separate and discrete projects, where the participants are permanent members of the group. The grade 13 analyst is accountable for the technical accomplishment of all work carried out by the team members. As a whole, the projects of the team are characteristic of grade 13.

Assignments require application of a variety of operations research techniques. Some assignments require the analyst to explore mathematical, statistical, information handling, and other techniques from related fields for potential application to the problem at hand. The analyst also is expected to acquire a thorough understanding of the problem's substantive area.

The analyst assesses the broad objectives of the assignment, identifying the relevant factors, and investigating them personally or breaking them down for investigation by others. The work requires insight and vision to examine the entire situation, problem, or system, considerable creativity to represent the problem or system in such a way that it can be analyzed quantitatively; and the ability to identify the significant variables and determine their underlying relationships. Relationships developed may be new or a significant departure from the relationships established in previous investigations.

#### *Level of responsibility*

Work at the grade 13 level is performed with a marked degree of professional independence and technical authority.

Grade 13 operations research analysts, as distinct from the grade 12 level, receive broadly stated or ill-structured problems, studies, or projects. Analysts are responsible for ascertaining the exact nature of the problem, identifying the ramifications involved and delimiting the context in terms of the alternatives to be considered. They are responsible for providing expert judgements concerning the validity of assumptions made and the criteria by which alternatives will be evaluated. Grade 13 analysts are responsible for conceptualizing the system and reducing it to the most effective, simplified, and manageable representation and treatment.

Analysts at this level are responsible not only for the thoroughness of the study, but for the significance of the findings and effectiveness of the presentation.

As at the grade 12 level, the overall goals and conditions which govern the project typically are defined by the customer or management. However, grade 13 analysts have more independence to negotiate suitable refinements with those for whom the project is undertaken to clarify issues, overcome obstacles, or change directions. The work is expected to be a finished product reflecting a high order of professional competence as to adequacy and critical evaluation.

Assignments generally involve extensive contacts. The purpose of contacts is to summarize, interpret, and exchange information on difficult or misunderstood issues; to present and defend results of work; to negotiate with other groups and individuals holding differing viewpoints and goals; and to establish working relationships with other organizations, agencies, universities, or industry. The establishment of contacts is frequently an important aspect of work at this level and requires tact and negotiating skills.



Supervisory control usually is limited to approval of the overall approach, priorities, schedule, and staff requirements, the extension or limitation of work in progress, and recommendations for additional work or new directions. Completed work is reviewed for adequacy in meeting the problem or purpose.

## **GS-13 Operations Research Analyst Illustrations**

### **Illustration #1**

Serves as a senior project leader responsible for planning, directing, and coordinating systems analyses and cost effectiveness evaluations on which the development of future communication and electronic support systems will be based. Assesses feasibility of changed or proposed concepts; predicts (in quantitative terms) performance characteristics and the degree of effectiveness of the system in accomplishing its desired military function; and defines the complete system and its performance as permitted by present or predicted state-of-the-art. For example, investigates the requirements for a subsystem of a multi-channel field Army communication system, predicts communication link performance using computer models to verify a diverse set of measurements on radio propagation, and predicts subsystem performance in tactical situations and its impact upon total system performance. Analyzes and describes military requirements and operating environment in terms of equipment design and performance characteristics; analyzes tradeoffs between conflicting systems characteristics to determine optimum values; defines measures of effectiveness and translates technical performance parameters into predictions of effectiveness in various postulated military situations; and analyzes initial and operating costs based on technical details such as operating reliability and maintenance demands.

### **Illustration #2**

The analyst is responsible for the development, maintenance, and enhancement of a major aspect of a widely used, large-scale combat simulation model or has total responsibility for a less significant or smaller model. In the former, the analyst is responsible for changing the model to reflect new scenarios, or updated data requirements, or modifications to the underlying physical or mathematical relationships. In the latter, the analyst develops or maintains a simulation for use within a subdivision of the agency. Applies a thorough understanding of the process being simulated, conducting the most detailed modeling for those features of the process known to be the most critical. The analyst is responsible for selecting or evaluating equations or algorithms for their applicability to simulating features of the real-world system. For example, the analyst changes the combat simulation model to consider moving defenders where in previous scenarios the defenders remained stationary, or changes the model so that one side counterattacks where in previous scenarios that side had only to contain the attackers. Anticipates what kind of data and parameters will be required for upcoming analyses using the simulation. Coordinates with laboratories and analysis activities to obtain data for the model when needed.

**Illustration #3**

Serves as an independent analyst in a customer-funded information management support activity responsible for managing in-house and contract projects. Analyzes the customer agency's needs for data communications and networking, acquisition support, or facilities management and establishes queuing-theory or network-analysis models of present and alternative systems. Also conducts economic analyses of the various alternatives. For example, a customer may want to provide the shortest possible response time to interactive users and the best turnaround time to batch-job users, while minimizing the loss of service to system reboots. The analyst will use a broad range of analytical and mathematical skills to model the customer's mixture of computational, data-storage and input/output capacities to determine what combination of these capacities will best satisfy the customer's requirements for serving the users. Breaks the solution of the customer agency's problem into well-defined tasks suitable for performance by a contractor. Evaluates each qualified contractor's bids in terms of the bidder's understanding of the scope of the problem and the qualifications of proposed contractor personnel; resolves disputes between the client agency and the contractor; and oversees the final report for quality and technical accuracy. The analyst must know what the contractor is doing, both technically and operationally, to make sure that the technical quality of the work meets the standards of the field, and that the customer is being provided accurate conclusions and sound recommendations.

**Illustration #4**

Serves as a senior analyst responsible for analyzing the cost impact of water controls on individual companies that discharge pollutants, considering the effect of prices, production, plant closures, employment, and community economies. Develops cost impact models which reflect economic, scientific, and engineering considerations appropriate to the industry segment or geographic area studied. Examines the economic cost of various alternatives such as changing the manufacturing process, installing pollution control equipment, using other pollutant disposal methods, or closing the plant. Uses economic, financial, statistical, engineering, science, and operations research methodologies to forecast effects associated with implementation of standards, regulations, and policies for pollution abatement. Exercises creativity in visualizing the impact of alternative pollution control strategies and in assessing their feasibility, practicality, and necessity.

**Illustration #5**

Serves in an organization responsible for the development, execution, and presentation of analytical models, methodologies and results to solve problems and conduct analyses relating to improved program operations and management systems for the agency. Leads the conceptualization, design, and conduct of complex operational research studies into any aspects of the operation and management of programs within the agency. A typical project would evaluate more efficient alternatives for applying the agency's investigative resources to detect clients who are ineligible or who are receiving more benefits than they are entitled to. Reviews the results of field investigations, assesses a number of independent variables, such as client age or geographic region, as possible predictors of such "error cases," and develops a model for scoring the likelihood that a client with a particular combination of values for these variables is

an error case. Applies this model to a universe of several million clients, dividing them into High Error Profile, Medium Error Profile, and Low Error Profile cases in such a way that the expected payoff ("error dollars") from investigating a High Error Profile case is significantly higher than the expected payoff from investigating cases at random. The list of High Error Profile clients is immediately turned over to investigators for redetermination of those clients' eligibility for benefits. Also identifies actual or potential problem areas, trends, and similar factors in agency program operations and management systems, and recommends new or amended legislation, policies, procedures, management systems affecting the agency and other Federal and State agencies with program responsibilities. Guidelines include the statute, regulations, policies, and a variety of texts related to operations research concepts and techniques, and sampling and statistical methods. The analyst depends largely on professional knowledge and creativity, often developing innovative approaches to complex situations.

### **Illustration #6**

Independently responsible for planning, designing and developing performance requirements and methodologies for conducting valid user tests of major, complex systems in an operational environment to assess relative performance. Develops methods and requirements for testing systems in an operational environment. Precedents are few or nonexistent, or only vaguely applicable. Assignments require careful planning, efficient coordination of efforts and application of mature, practical scientific judgement combined with a high degree of creativity and originality. Develops analytical and/or mathematical models for use in preparing evaluation criteria, testing sequences, and data collection/reduction requirements. Identifies and solves testing problems pertaining to factors that may be hidden, and to subtleties and variables.

## **OPERATIONS RESEARCH ANALYST, GS-1515-14**

### *Assignment characteristics*

Grade 14 analysts work on projects of major importance to agency programs and operations which may have national or international impact. Assignments characteristically reflect a need for recognized competence in the methodologies of operations research. Frequently grade 14 analysts have developed expertise in a highly specialized program area.

Analysts at this level work on problems that are unique and very difficult to define, require unconventional approaches, or require the application and adaptation of sophisticated analytical techniques. Results are usually original in nature. Grade 14 analysts are frequently relied upon to generate ideas for new programs, policies, or approaches, or to consider different and unconventional alternatives. They often work on projects that are self-initiated. Because of their experience and creativity, they often plant the seeds for other work which may lead to a series of projects. Sometimes these new ideas extend beyond the immediate organization and are carried out by professionals in other organizations.

Assignments frequently arise from previous studies which expose problems or highlight other applications and are very large, extremely complex, controversial, or sensitive. Problems may

be controversial because of differences of opinions or interpretations among experienced and respected professionals; because of the political or economic sensitivity of alternatives under consideration; or because the work is of significant interest to the general public or the military.

Results answer important questions, open significant new avenues for further study; represent an important contribution to the validation or modification of methodology relating to the topic area; or result in important changes to existing or proposed systems.

Typically, assignments differ from the grade 13 level in that the grade 14 analyst has a significant responsibility for redefining or further defining major and critical problems and for advising management officials of the advantages and disadvantages of various approaches for the intended purposes. Grade 14 analysts are expected to anticipate the organization's need for knowledge and to identify available alternatives that may not have originally been considered.

At this level the analyst may participate with decision-makers in setting goals and defining the conditions for a project. The analyst is also required to think in terms of the overall mission, objective, or policy to be achieved and to question not only how best to accomplish those goals, but also their fundamental purpose. Grade 14's also are expected to be aware of nontechnical issues that may bear on the decisions. They must ensure that results are presented to decision-makers in a balanced, clear, meaningful manner, free from bias.

Major difficulties and complexities are manifested throughout the course of the project because of the pioneering nature of the assignment, or because the variables involved are extensive, many-faceted, and obscure in their relationships. Solutions to such difficulties depend primarily on the professional knowledge and imagination of the analyst in assessing and understanding the problems, in developing plans and approaches, devising new methods or extending existing theory to new and unusual applications.

Precedents, guidelines, and methodology usually do not exist. The methodology and procedures developed often serve as precedents for other analysts to follow.

Some grade 14 analysts work as independent analysts or investigators. These analysts possess highly developed expertise in a specialty area and often serve as consultants to their own and outside organizations.

Some problems are so complex, broad, and important that a team of experts is formed to study it. In such cases, grade 14 analysts may be selected as team members because of their expertise in the problem area. Other grade 14 analysts serve as team leaders. There are many combinations of projects and teams for which the grade 14 analyst exercises leadership (e.g., a single investigation team; one project, many teams; many projects, many teams). These projects are characterized by either (1) a broad range of assignments in a variety of program areas or (2) an intensive systematic exploration of problems of an unprecedented nature or of problems that have not been previously susceptible of analysis by the operations research approach.

Grade 14 team leaders are expected to coordinate the efforts of the team(s) in the analytical aspects of the project to ensure that efforts are properly directed and to assume technical

responsibility for the interpretation and application of findings. When the project involves the exploration of unique problems, the analyst typically functions as the principal investigator. As at the grade 13 level, some grade 14 analysts may function as permanent team leaders. As a whole, the projects of the team are characteristic of Grade 14.

#### *Level of responsibility*

Grade 14 analysts are not only responsible for the professional and technical aspects of the work, as at the grade 13 level, but are also responsible for identifying the need for fruitful areas of analysis, formulating proposals for original studies, and justifying and presenting such proposals to appropriate authorities within the organization.

Overall assignments are made in terms of broadly defined functions of the employing organization. Some assignments originate out of the analyst's own liaison activities with other persons or organizations.

The analyst is responsible for planning, coordinating, and carrying out projects and is accountable for technical appropriateness, soundness, and interpretation of results. The solutions to problems at this level require originality and creativity in the development of plans, design of experiments, invention of methods or the extension of existing theory to new and unusual applications. Frequently there is a dearth of applicable precedent, pertinent literature, or proved methodology.

Grade 14 analysts are often the most authoritative professionals in a particular area within the organization. Their work is, therefore, generally considered to be technically accurate and is not subject to technical review by the supervisor. Review of work generally is limited to administrative matters and the effect of the work on policy decisions.

Contacts at this level may be similar to those found at the grade 13 level. However, because the projects typically are of broader scope, of greater importance, or more controversial than at the previous level, the need to negotiate, compromise, persuade, and influence key officials is greater. Many grade 14 analysts represent their organizations at conferences, meetings, and presentations. They are expected to present and defend the organization's position on certain issues and may be delegated authority to commit the organization to a particular course of action or to undertake additional work.

## **GS-14 Operations Research Analyst Illustrations**

### **Illustration #1**

Serves as team leader or senior analyst responsible for conducting independent cost and economic analyses for a category of conceptual and advanced weapon systems (such as all artillery systems) to support agency acquisition, strategy, programming and funding decisions. Systems analyzed are of major importance to the agency and sometimes involve development efforts with foreign governments. Examines base line cost estimates prepared by project management offices and develops alternative or new cost methodologies to arrive at independent cost estimates. Analyzes differences, resolves conflicts, and selects the best estimates which form the basis for the agency's cost position in subsequent congressional programming and budgeting decisions. Investigates new cost methods and approaches, proposes new cost strategies, and develops agency cost estimating policies using a wide range of analytical and statistical techniques such as linear programming, multiple regression, probability, sensitivity analysis, and learning curves.

### **Illustration #2**

Serves as principal investigator in a cost-benefit study to examine alternative means of transporting hazardous material over the national railroad network to avoid densely populated areas. The impact is national in scope, each alternative is highly controversial, and the conclusions reached are expected to be challenged by local communities and public action groups. Applies considerable subject matter knowledge of both transportation and hazardous materials to generate the range of alternatives to be considered. Examines each of the alternatives in terms of public safety, cost to the agency, and cost to the industry. Develops advantages and disadvantages associated with each alternative and presents results to decision makers. Initiates contacts with state and local governments, industry representatives, and other Federal agencies to gather information and resolve controversies. The problem under investigation is of critical importance to the agency and the results serve as the basis for agency policy and subsequent regulatory actions.

### **Illustration #3**

As a team leader or independent analyst, is responsible for the development, maintenance, and enhancement of a very large and complex computerized simulation model used to analyze and forecast energy demands and supplies for the next 20 years. The model is a large-scale simulation that is used to make major policy, strategy, or regulatory decisions having significant impact upon the agency's mission. The analyst is a recognized expert on all aspects of the model and is consulted by decision makers and study teams as to the proper use of the simulation. Based on a thorough understanding of the work performed in the agency, the analyst anticipates possible uses for the model and conceives plans for additional modules or changes to the model to meet future agency needs. The model is dynamic and highly complicated and considers such factors as fuel consumptions, available resources, historical data (demands, prices, productions), expectations of world oil prices, estimates of new technologies (such as enhanced oil recovery

techniques or unconventional gas recovery techniques), estimates of frontier resource areas (such as Arctic or off shore), economic variables (such as industry cost of facilities and services, tax policies), and characteristics of the industry infrastructure (such as current facilities and pipelines). The analyst examines advancements in computer hardware capabilities or simulation techniques that may increase processing speed, may improve efficiency, or provide a capability previously unavailable, and decides how to incorporate such changes into the model. Other changes to the model may be prompted by changes in agency policies or different scenarios that demand adjustments in the structure of the model or the kinds of data required to run it. In either case, the assumptions, rules, constraints, accuracy, mathematical algorithms, computer code, and many other details must be reexamined and adjusted while ensuring that the model continues to behave as close to reality as possible. The importance of these changes is magnified because of the significance of the decisions made on the basis of simulation results.

#### **Illustration #4**

Serves as a senior project officer, sometimes in the capacity of team leader, in a staff office of a major subordinate military command or civilian organization, responsible for monitoring and evaluating proposed, ongoing, and completed systems analysis efforts carried out by subordinate elements, such as developmental combat aircraft. Programs monitored are among the most important in the command and agency; often involve dealing with foreign governments; generally involve the analysis of new or advanced technology; and provide the scientific and quantitative basis for critical agency decisions. Monitors many projects simultaneously (for example, in a typical year the analyst was responsible for overseeing about 15 active projects and many others in various stages of completion). Reviews studies for adequacy of methodology, including the use or development of computerized models, to ensure that techniques are valid and appropriate to the problem, that alternative strategies have been considered, and that assumptions made and conclusions drawn are analytically sound. Conducts studies to provide rapid response to urgent questions from the command group. Anticipates future needs and develops policy and guidance material to ensure that high quality standards are maintained. The analyst has the authority to make technical decisions regarding the alteration or redirection of study efforts.

Results of work influence the direction and scope of studies conducted at subordinate elements, the eventual success of the program, and the appropriateness of decisions made as a consequence of the studies. Applies a knowledge of a broad range of techniques in the areas of mathematics, statistical analysis, parametric and non-parametric analysis, computer modeling, decision theory, mathematical programming, regression analysis, and economic analysis.