

Before the  
POSTAL RATE COMMISSION  
WASHINGTON, D.C. 20268-0001

Evolutionary Network Development )  
Service Changes, 2006 )

Docket No. N2006-1

OFFICE OF THE CONSUMER ADVOCATE  
INTERROGATORIES TO UNITED STATES POSTAL SERVICE  
(OCA/USPS-44-48)  
May 23, 2006

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Pursuant to Rules 25 through 28 of the Rules of Practice of the Postal Rate Commission, the Office of the Consumer Advocate hereby submits interrogatories and requests for production of documents. Instructions included with OCA interrogatories OCA/USPS-1-5, dated March 3, 2006, are hereby incorporated by reference.

Respectfully submitted,

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April E. Boston  
Officer of the Commission

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OCA/USPS-44. The following interrogatory refers to the USPS website section identified as “About USPS & News,” and its subsection known as “Area Mail Processing [AMP], Background and guideline summaries.” (See website: <http://www.usps.com/all/amp.htm>. A copy of the information is provided at the end of this interrogatory.) The Postal Service provides information on the AMP process, as well as providing a summary of the Sioux City, IA, to Sioux Falls, SD, AMP proposal.

The information provided on this website in the copy attached hereto (“AMP Development and Evaluation Process”) does not include any procedures for collecting public input or Postal Service procedures for responding to public input.

- a. Does USPS plan to provide similar website summaries of all pending and future AMP studies? If not, please explain.
- b. Does the Postal Service plan on updating the individual summaries to reflect the: (1) current status of a proposal, and (2) actions plans that remain to be completed? If not, please explain.
- c. For each AMP consolidation proposal, does the Postal Service plan on posting on its website the title, mailing address and the e-mail address of either a District level and/or Headquarters level contact to whom interested parties may direct their comments? If not, please explain.
- d. For each AMP consolidation proposal, does the Postal Service plan to post on its website deadlines for receiving comments from interest parties? If not, please explain.
- e. For each AMP consolidation proposal that has received comments from interested parties, does the Postal Service plan on making those comments available on its website?

- (i) If your response is affirmative, please identify where on the USPS website the information will be provided.
  - (ii) If your response is other than affirmative, please explain.
- f. Does the Postal Service plan on posting on its website the individual results of each of the two post-implementation reviews performed on every consolidation completed?
  - (i) If your response is affirmative, please identify where on the USPS website the information will be provided.
  - (ii) If your response is other than affirmative, please explain.
- g. Will the letters that will be sent to those parties identified on the AMP worksheet 3, include information on where comments regarding the AMP consolidation should be sent? For example: (1) an e-mail address, (2) a physical address, and (3) a contact name with his/her phone number. If not, please explain.
- h. Please refer to part g of this interrogatory. Will a copy of the letter sent be posted on the Postal Service's website? If not, please explain.
- i. Please refer to part g of this interrogatory. Will the letter identify the applicable deadline for submission of comments? If not, please explain.
- j. To better insure that the information given to the public is consistent with Postal Service policy and correct when the local area public AMP consolidation meeting occurs, will a representative from Headquarters attend?
  - (i) Please identify the title and organization of the Headquarters employee who would attend.
  - (ii) If not, please explain how the Postal Service will insure that the public is provided clear and consistent information at each and every meeting.

**Area Mail Processing : See**  
**<http://www.usps.com/all/amp.htm>**

The U.S. Postal Service continually examines elements of its nationwide network to identify opportunities to improve efficiency by making better use of space, staffing, equipment and transportation in processing the nation's mail. This practice has become increasingly important as we have experienced a significant reduction in the amount of single-piece First-Class Mail that enters our system. In fact, mail volume for this category has declined by 11 billion pieces — 20 percent of its volume — since 1998. At the same time, the deployment of state-of-the-art automated mail-processing equipment allows us to sort this type of mail more efficiently than ever. In many cases, larger mailers are entering their mail deeper into our system, closer to its final delivery point, bypassing many Postal Service processing and transportation operations.

Considered together, these factors have created excess processing capacity at many postal facilities where mail is canceled and sorted. The Postal Service is actively looking into opportunities to increase efficiency by consolidating some mail processing operations, allowing us to make better use of our resources. Area Mail Processing is a key element of this important effort.

- ▶ [What is Area Mail Processing?](#)
- ▶ [AMP Guidelines](#)
- ▶ [AMP Development and Evaluation Process](#)

## ▶ [What is Area Mail Processing?](#)

Area Mail Processing (AMP) is the consolidation of some mail processing operations from one or more postal facilities to other facilities to improve operational efficiency and/or service. AMP may involve the consolidation of originating distribution operations (canceling/sorting locally generated mail), destinating distribution operations (sorting and preparing mail received from more distant areas for local delivery), or both. The intent is to make more efficient use of Postal Service assets such as equipment, facilities, staffing and transportation.

Today's mail processing system — a network of large, centralized mail processing facilities — represents about three decades of experience with AMP initiatives. However, as we continue to experience shifts in the types of mail we handle and changes in how and where mail enters our system, we must continue to examine opportunities for improvement.

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## ▶ [AMP Guidelines](#)

The Postal Service has developed a formal process for the review and implementation of Area Mail Processing proposals. This process is defined in Handbook PO-408, Area Mail Processing (AMP) Guidelines.

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## ▶ [AMP Development and Evaluation Process](#)

- **Feasibility Study:** An AMP study analyzes the feasibility of relocating processing and distribution operations, as well as necessary support functions, from one location to another. The study examines how a consolidation would affect employees, the community, and customers. It also considers the consolidation's effect on service, costs, productivity and future strategic initiatives. Postal Service field operations are divided into 80 districts, each of which is supported by a number of mail processing facilities. Our nine Area offices are responsible for the administration of multiple district offices. An AMP study may be initiated at any time by the manager of the appropriate Postal Service District or Processing and Distribution Center to examine the feasibility of consolidating processing operations. After notifying the Area office of its intent to conduct an AMP feasibility study, the initiating office has six months to complete the study. Following a preliminary determination indicating that service and/or efficiency might be effectively improved by the AMP consolidation, the sponsoring Area office must inform the senior vice president, Operations, at Headquarters, that the AMP study is being conducted.
- **AMP Proposal Documentation:** An AMP proposal is supported by the development and submission of specific documentation through appropriate approving officials prior to final Headquarters consideration. AMP documentation consists of an executive summary, required supporting worksheets addressing issues such as local notification, costs, mail volumes, transportation, equipment, service impacts, and a map of the area with geographic descriptions.
- **Proposal Approval:** The approval process of an AMP proposal begins at the local level with the signatures of the managers of each affected processing facility after their final evaluation of the operational feasibility. The district manager must then evaluate the proposal on the merit of customer service and satisfaction, and forward the locally approved AMP proposal to the vice president, Area Operations. The vice president, Area Operations, will review all aspects of the AMP proposal to establish that all human resource and employee impacts are correctly administered; appropriate government officials have been notified; customer, community, service, and operational effects are explored and have been resolved; workhour, costs, savings, and budget adjustments are addressed; and that all transportation and network modifications are correct for each class of mail. The Area has up to thirty days for its review and approval of the proposal which often involves repeated interaction with the supporting district. The district and area development and review process should not exceed seven months. Once this evaluation is completed, the Area office will either disapprove and return the AMP proposal package to the local originator or approve and forward it to Headquarters. The senior vice president, Operations, Headquarters, will coordinate the final review of the AMP proposal with other functional offices at Headquarters and once their review is completed, and any issues resolved, give final approval. The AMP review and approval process at the headquarters should be completed within 30 days once a complete AMP study documentation package has been assembled.
- **AMP Implementation:** As soon as practicable following final approval of the AMP proposal, an implementation date is established and communicated to the managers of the affected facilities, as well as the District and Area offices. Notification is also provided to affected employees, national and local employee organization representatives, government officials and customers. There must be close coordination between Area and local Human Resources throughout the implementation so that any necessary reassignment and/or excessing of bargaining and nonbargaining unit employees conforms to the provisions of the applicable collective bargaining agreements and the Employee and Labor Relations Manual.
- **Post-Implementation Reviews:** Two post-implementation reviews are conducted after the AMP has been completely implemented, to determine if projected operational and service efficiencies have been achieved. The first post-implementation review will occur within nine months of implementation. The Post-Implementation Reviews must be reviewed by the vice president, Area Operations, for accuracy.

## Sioux City IA to Sioux Falls SD AMP Proposal Summary ( See <http://www.usps.com/all/siouxsummary.htm>)

### **Background:**

This summary is the result of a study that was conducted to determine if we could increase efficiency and productivity by consolidating mail processing operations for some First-Class mail that are currently being performed at the Sioux City, IA Processing and Distribution Facility (P&DF) by taking advantage of available processing capacity at the Sioux Falls, SD Processing and Distribution Center (P&DC). Sioux City would continue to process other types of mail including mail sent from areas for delivery in The Sioux City service area.

### **Effect on Delivery:**

- If implemented, the consolidation will involve the shift of 366,941 pieces of First-Class Mail to be processed in Sioux Falls. Of that, 17,710 pieces will have its service upgraded, from two-day to overnight delivery. The rest of the mail will continue to receive its same level of service.

### **Effect on Customers:**

The same services that are currently available at the Sioux City, IA Post Office will not be affected by this consolidation. In addition:

- There will be no changes to local mail collection box pick-up times.
- A local postmark will continue to be available for stamped, First-Class Mail.

### **Effect on Bulk-Mailers:**

- Bulk-Mailers will continue to deposit their mail at the Sioux City, IA Post Office Bulk Mail Entry Unit (BMEU).

### **Effect on Postal Employees:**

Due to the reduced workload at the Sioux City, IAA P&DF, 47 career employees will be reassigned to other positions, no layoffs will occur.

### **Impact on Costs:**

A one-time cost of \$102,300 will be incurred for relocation of equipment. After that, the total annual savings that would be realized if this proposal is approved would be \$975,276

OCA/USPS-45. The Postal Service posted its Corporate Flats Strategy on its RIBBS website, <http://www.ribbs.usps.gov/files/FLATSTRATEGY/>.

- a. Does the Postal Service plan to post on either the RIBBS or USPS.gov website, a presentation on the END process that is similar in content to that provided for the Corporate Flats Strategy?
  - (i) If your response is affirmative, please identify the internet location for the report.
  - (ii) If your response is other than affirmative, please explain.
- b. Referring to part a of this interrogatory, does the Postal Service plan to include in the END presentation: (1) near term objectives; (2) mid-term objectives and (3) long-term objectives? If not, please explain.
- c. The Corporate Flats Strategy website has a section identified as the "Upcoming Events Calendar." The calendar provides the following information: (1) events that have or will take place; (2) the location of the event; (3) the date the event will take place; (4) the contact person's name and e-mail address; and (5) a phone number where the person may be reached. Does the Postal Service plan to provide a similar calendar, on either

the USPS.gov or RIBBS website, for each consolidation under review? (See also, <http://www.ribbs.usps.gov/flatstrategy/events.htm>. A copy of the upcoming events calendar provided on the site is provided below.)

- (i) If your response is affirmative, please identify where the information will be posted.
- (ii) If your response is other than affirmative, please explain.

EVENT	LOCATION	DATE	CONTACT	PHONE
<b>2006</b>				
NY Metro/Northeast Area Periodicals Focus Groups	Boston GMF - rm 3001 25 Dorchester Ave Boston, MA	Apr 20	Jim Gorman <a href="mailto:james.j.gorman@usps.gov">james.j.gorman@usps.gov</a> Charles Mancuso <a href="mailto:charles.c.mancuso@usps.gov">charles.c.mancuso@usps.gov</a>	(860) 285-7104 (718) 321-5836
Southeast Area Periodicals Focus Groups	Atlanta, GA	Apr 27	Kelly Nixon <a href="mailto:kelly.l.nixon@usps.gov">kelly.l.nixon@usps.gov</a>	(901) 747-7592
NY Metro/Northeast Area Periodicals Focus Groups <b>CALENDAR OF FLAT-SIZE MAIL RELATED EVENTS</b>	USPS - JAF Bldg Rm 4500 380 W 33rd St New York City, NY 10199-1002	Jul 13	Jim Gorman <a href="mailto:james.j.gorman@usps.gov">james.j.gorman@usps.gov</a> Charles Mancuso <a href="mailto:charles.c.mancuso@usps.gov">charles.c.mancuso@usps.gov</a>	(860) 285-7104 (718) 321-5836
Pacific/Western Area Periodicals Focus Groups	Seattle, WA	Aug 8	Wanda Scott <a href="mailto:wanda.j.scott@usps.gov">wanda.j.scott@usps.gov</a> Cathy Curtis <a href="mailto:cathy.e.curtis@usps.gov">cathy.e.curtis@usps.gov</a>	(415) 536-6506 (303) 313-5425
Southeast Area Periodicals Focus Groups	Atlanta, GA	Oct 3	Kelly Nixon <a href="mailto:kelly.l.nixon@usps.gov">kelly.l.nixon@usps.gov</a>	(901) 747-7592
NY Metro/Northeast Area Periodicals Focus Groups	USPS - JAF Bldg Rm 4500 380 W 33rd St New York City, NY 10199-1002	Oct 12	Jim Gorman <a href="mailto:james.j.gorman@usps.gov">james.j.gorman@usps.gov</a> Charles Mancuso <a href="mailto:charles.c.mancuso@usps.gov">charles.c.mancuso@usps.gov</a>	(860) 285-7104 (718) 321-5836

OCA/USPS-46. When a consolidation plan is implemented, what procedures (including timeframe) does the USPS currently have in place to notify local business mailers of potential

changes in drop off locations? Please include in your response, a copy of any documentation used in the notification process.

OCA/USPS-47. When the USPS has consolidated operations, have there been complaints by mailers that they were not notified of the changes in the mail drop off locations? If your response is affirmative, please explain what measures are taken to insure that the problem is not repeated.

OCA/USPS-48. Please review the attached "Management Advisory" Report No. NO-MA 05-001, from the USPS Office of the Inspector General to Paul E. Vogel, USPS Vice President, Network Operations Management, dated March 29, 2005. This report explains how the OIG assisted the Postal Service's END Independent Verification and Validation (IV &V) team, (Project Number 05YC001NO000). The report indicates one of the purposes of the OIG participation was to ensure compliance with independent verification and validation guidelines. The report points out verification and validation have specialized meanings—verification determines whether the model accurately represents the developer's conceptual description and specifications; validation determines if the model is built correctly. The process reduces risk in the use of the models and improves the credibility of results. The report states the Postal Service's IV&V team issued a draft report in January 2005.

- a. Has the IV&V team issued a final report? If so, please provide a copy of that report. If not, please provide a copy of the draft report and please explain why the final report has not been issued.

- b. If a final report has been issued, please summarize the findings of the report and discuss any findings which indicate the model failed the verification and/or validation tests or required improvement.
- c. If the model was modified to meet verification and validation tests, please state when the model was adjusted, corrected, or changed, and whether any further modifications are planned in response the report and findings of the IV&V team.
- d. If further modifications to the END process are required to meet verification and validation tests, please explain the impact the changes will have on the output of the optimization and simulation models, including how the modifications will reduce the risks of using the models and improve the credibility of the models.



[Office of Inspector General](#)

March 29, 2005

PAUL E. VOGEL

VICE PRESIDENT, NETWORK OPERATIONS MANAGEMENT

SUBJECT: Management Advisory - Office of Inspector General Assistance to Evolutionary Network Development Independent Verification and Validation Team (Report Number NO-MA 05-001)

In January 2004, the senior vice president, Operations, requested that an Office of Inspector General (OIG) auditor serve as an advisor to the Postal Service's Evolutionary Network Development (END)<sup>1</sup> Independent Verification and Validation (IV&V) team (Project Number 05YC001NO000). This report explains how the OIG assisted the team.

In support of the END initiative, the OIG served on the team in an advisory capacity to help ensure compliance with IV&V guidelines; benchmarked best practices with other agencies; facilitated meetings with subject matter experts; and assisted in providing third-party training opportunities. We are not making recommendations in this report. Management had an opportunity to comment on the report and had no changes.

### **Background**

The OIG issued a report recommending the Postal Service conduct an IV&V of END models and establish policies and procedures for determining IV&V requirements for modeling efforts.<sup>2</sup> The Postal Service subsequently formed an internal team to perform an IV&V of the END models. In modeling and simulation, the terms "verification" and "validation" have specialized meanings. "Verification" determines that a model's implementation and its data accurately represent the developer's conceptual description and specifications.

<sup>1</sup> Formerly known as Network Integration and Alignment (NIA). We use END throughout this report for consistency.

<sup>2</sup>

[Network Integration and Alignment Models - Independent Verification and Validation](#) (Report Number NO-AR-04-005, February 24, 2004).

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Verification answers the question, "Did I build the model correctly?" "Validation" determines the degree to which a model and its associated data accurately represent the real world from the perspective of the intended uses of the model. Validation answers the question, "Did I build the correct model?" Verification and validation help ensure that network changes cause minimal disruptions in service and that results are logical. Validation efforts include a comprehensive audit of the:

- Modeling process.
- Development of the distribution concept.
- Assumptions and criteria for decision making.
- Development and use of all underlying input data.<sup>3</sup>

The goal of an IV&V process is to reduce risk in the use of models and simulations by improving the credibility of results.

Conducting an effective IV&V is important for the successful completion of complex and large-scale simulation applications such as the Postal Service's END initiative. Verification and validation are processes performed primarily by analysts, modelers, and subject matter experts who are knowledgeable about the history of the problem, previous approaches, software development, technical issues in modeling and simulation, and environments. The results of an IV&V give Postal Service management evidence to assess whether a model is sufficient for use in particular situations and under specific conditions. One of the purposes of an IV&V is to provide objective, quantified data on which to base decisions. The Postal Service's IV&V team issued a draft IV&V report in January 2005.

### **Objectives, Scope, and Methodology**

Our objectives were to provide information to the IV&V team on best practices obtained from benchmarking with other agencies that have experience in performing IV&Vs and to work with the team to ensure compliance with IV&V guidelines. We conducted this review from January 2004 through March 2005, in accordance with the President's Council on Integrity and Efficiency, Quality Standards for Inspections. We do not draw conclusions or make recommendations in this report. We attended monthly IV&V team meetings from February through December 2004, benchmarked best practices with other agencies, facilitated meetings with subject

<sup>3</sup> Postal Service Response to Congress, Infrastructure and Workforce Rationalization: Funding Key Capital Investments, January 2004.

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matter experts, served on the team in an advisory capacity, and attended IV&V working group conferences and training events.

### **Prior Audit Coverage**

The OIG issued a report titled Network Integration and Alignment Models - Independent Verification and Validation (Report Number NO-AR-04-005, February 24, 2004). We recommended the Postal Service conduct an IV&V of the END models and establish policies and procedures for determining IV&V requirements for END models. Management concurred with the recommendations and formed an internal team to perform an IV&V and develop Postal Service policy for future IV&Vs.

### **Results**

The OIG assisted the Postal Service with the IV&V of the END models as follows:

Served on the IV&V team in an advisory capacity and attended monthly team meetings from February through December 2004.

The Postal Service IV&V team consisted of two groups: field managers with operational expertise and headquarters staff with experience in Postal Service databases and cost analysis. The operations group focused on the feasibility of outputs from the simulation models, while the headquarters group focused on verifying inputs and the model itself. During the meetings, the OIG representative helped the IV&V team formulate its process for conducting the IV&V. For example, the OIG representative provided examples of completed IV&V reports from other agencies, discussed sampling methodologies, and helped the team focus on risk and coverage.

- Identified best practices through benchmarking efforts.<sup>4</sup>

Identified best practices included understanding risk, developing an IV&V plan, selecting an IV&V team, and becoming familiar with IV&V techniques. In April 2004, the OIG representative provided the IV&V team with detailed documentation that included a discussion of best practice elements. (See the appendix for more information on IV&V best practices.) The team used the information for reference in developing its approach to conducting the IV&V.

<sup>4</sup> Agencies benchmarked included the Defense Modeling and Simulation Office, the National Institute of Standards and Technology, the National Aeronautics and Space Administration, and other sources. Best practices were offered as guidelines, not absolutes. The Postal Service considered them as the IV&V process was developed and used the applicable ones.

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- Identified subject matter experts and facilitated meetings with the experts. As part of our benchmarking effort, the OIG representative met several times with the technical director of verification, validation and accreditation for the Defense Modeling and Simulation Office (DMSO). Based on those meetings, the OIG representative recommended the technical director as a subject matter expert and arranged to have the technical director meet with the IV&V team. The technical director provided expert guidance on IV&V methodology and made suggestions that the IV&V team welcomed and considered.

The OIG representative also consulted with an OIG statistician and suggested that a Postal Service statistician be added to the IV&V team. The Postal Service subsequently added a statistician to the team.

Attended IV&V working group conferences and training events to gain knowledge of the IV&V process. On March 11, 2004, the OIG representative attended a meeting of the Verification, Validation, and Accreditation Technical Working Group hosted by the DMSO. These periodic meetings featured presentations from various IV&V experts in government and the private sector. The OIG representative also arranged for several members of the Postal Service's IV&V team to attend the meeting.

On December 14, 2004, the OIG representative attended a two-day IV&V training workshop, along with two members of the IV&V team. This training focused on the IV&V process and included case studies. The training also allowed members of the Postal Service's IV&V team to network with other IV&V practitioners. Information provided in the training will be helpful to the Postal Service in developing policy for future IV&V efforts.

We appreciate the cooperation and courtesies provided by your staff. If you have any questions or need additional information, please contact Robert J. Batta, Director, Network Operations - Processing, or me at (703) 248-2300.

Mary W. Demory  
Deputy Assistant Inspector General for Core Operations  
Attachment

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Richard J. Strasser Pranab Shah William W. Batterton David C. Fields Steven R. Phelps

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## **BEST PRACTICES Risk**

"Risk" is defined as the potential realization of undesirable consequences from hazards arising for a possible event.<sup>5</sup> The primary risk in modeling and simulation is that the simulation will produce an incorrect result or will fail. An Independent Verification and Validation (IV&V) collects the evidence that illuminates the risk.

The following two types of risk can be associated with making a decision: rejecting correct evidence and accepting incorrect evidence as correct. In modeling and simulation, accepting incorrect evidence as correct is usually considered the bigger risk.

Operational risks arise from using the incorrect outputs of a simulation that are believed to be correct. Operational risk is concerned with credibility. While modeling and simulation requirements establish what the simulation must do and how well it must be done, the desired level of credibility determines how much information is needed about the simulation to draw a reasonable and acceptable conclusion. The amount of confidence that the user needs in the simulation's results depends on how much risk the user is willing to tolerate. Often, an operational risk assessment or analysis is performed. Risk analysis provides a specific, objective, and frequently quantitative method for identifying potential problems with developing and applying a simulation.<sup>6</sup> Model credibility refers to the decision maker's confidence in the model. One goal of the IV&V process is to ensure that the user gains this credibility.<sup>7</sup>

### **Typical IV&V Plan**<sup>8</sup>

A typical IV&V plan includes some or all of these elements:

- Purpose and description of the IV&V.
- Scope of the IV&V effort and responsibilities.
- Identification and responsibilities of each participant.
- Intended use(s)/application(s) of the simulation.

<sup>5</sup> Definition from McGraw-Hill Dictionary of Engineering.

<sup>6</sup> From Defense Modeling and Simulation Office (DMSO) Recommended Practices Guide, Risk Assessment and Its Impact on VV&A.  
From article "Model Verification and Validation" by John S. Carson, II, Brooks-PRI Automation, Marietta, Georgia. <sup>8</sup> From DMSO Recommended Practices Guide, The V&V Agent's Role in the VV&A of New Simulations, Appendix B: An Adequate V&V Plan.

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- IV&V schedule.
  - Information needed:
    - o Development products and processes.
    - o Data sources.
    - o Information about the user and problem domains.
- Description of developer's configuration management system and how it will be used for IV&V.
- Description of the IV&V process model used.
  - IV&V techniques and methods matched to development paradigm:
    - o Verification processes in the context of planned simulation development.
    - o Definitions of activities to be completed in each development phase.
    - o Descriptions of verification tasks to be performed.
    - o Validation processes in the context of planned simulation development.
    - o Definitions of activities to be completed in each development phase.
    - o Descriptions of validation tasks to be performed.
- Validation data to be used during validation of results, data sources, and plans for obtaining and reducing this data.
- IV&V tools, products, and deliverables.
  - IV&V reporting procedures, reports, and formats.
  - IV&V baseline (approved) budget.
  - Description and locations of IV&V archives.
  - Appendices (as required).

**Skills Needed for IV&V Team**

- Knowledge of/experience with similar types of models and simulations.
  - Knowledge of/previous experience with the systems being modeled.
- Extensive knowledge of the domains involved (e.g., problem, user, simulation).

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- Familiarity with selecting and using appropriate automated tools.
- Familiarity with the software languages and hardware platforms being used.
- Experience with modeling and simulation development.
- Solid analytical skills.
- Willingness to accept challenge.
- Technical curiosity.

### **IV&V Techniques**

Numerous IV&V and statistical techniques can be used to validate models. The term "testing" is frequently used when referring to the implementation of these techniques because IV&V involves testing the model or simulation to assess its credibility. The Defense Modeling and Simulation Office (DMSO) separates techniques into four categories:

Informal techniques are the most commonly used. These tools and approaches rely heavily on human reasoning and subjectivity.

Static techniques reveal a variety of information about the structure of the model and the modeling techniques used.

Dynamic techniques evaluate the model based on its execution behavior. These techniques involve inserting additional code into the model to collect information about model behavior during execution. Formal techniques are based on formal mathematical proofs or correctness and are the most thorough means of verifying and validating models. You should apply formal methods early in the model development process to achieve maximum benefit.

The IV&V process involves a series of activities and tasks that are selected to address the particular needs of the application. Selecting the best techniques to apply to a given IV&V task in a given situation is not always straightforward. The tasks that are selected and the techniques chosen to accomplish them depend upon a number of factors, such as:

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- The type of simulation (legacy, new modeling and simulation).
- The problem that needs to be solved.
- Objectives and requirements and their acceptability criteria.
- The user's risks and priorities.
- Constraints of time, money, personnel, and equipment.<sup>9</sup>

A common technique is to conduct a software traceability analysis. In such an analysis, software requirements and implementation would be traced to system requirements (and vice versa) to check the relationships for accuracy, completeness, consistency, and correctness.<sup>10</sup>

All techniques selected for IV&V should be carefully documented. The documentation of each IV&V technique should include the objectives, assumptions, constraints, methods employed, data, tools, artifacts produced, and the results of the assessment and review.<sup>11</sup>

<sup>9</sup> Excerpted from DMSO Recommended Practices Guide, V&V Techniques.

<sup>10</sup> National Institute of Standards and Technology Special Publication 500-234, Reference Information for the Software Verification and Validation Process, March 29, 1996.

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DMSO Recommended Practices Guide, The V&V Agent's Role in the VV&A of New Simulations.