

## Evaluating integrity and quality of hardware and software

### Opportunity

More than ever, systems developers are relying on information technology to automate critical decisions, but this practice increases the risk of errors. To counteract the risks resulting from this trend, there needs to be a way to ensure that systems maintain their integrity. Risks associated with the development of a software system are the product of (1) the severity of the consequences of failure and (2) the likelihood that the failure will occur. Such risks can have marginal to catastrophic consequences when safety or security is at stake, for example, in the case of international arms control software applications.

Independent verification and validation, commonly referred to as IV&V, minimizes risk and instills confidence in the final product. IV&V works best when incorporated into the entire software and hardware development life cycle — from requirements definition to product development to testing.

### Approach

A key component of Argonne National Laboratory's approach to IV&V is the concept that early detection of risks and deficiencies leads to more efficient, less costly, and more accurate systems. By stressing the "practical" aspects of IV&V, Argonne staff members adjust the tasks to match the level of consequence involved. Argonne's unique approach recognizes four essential components:

- IV&V tasking must be *flexible*.
- Efforts must be *tailored* to the needs of the customer. An IV&V review may require either individual activities or a highly structured team approach.
- IV&V must be *applied* at the systems level to include hardware and software interactions.
- High-consequence projects can demand *large-scale efforts*.

Argonne's IV&V approach generally includes the following activities:

- Requirements analysis
- Risk assessment
- Development analysis
- Code review
- Independent testing
- Contract verification
- Algorithm analysis
- Software metrics



### Expertise

**Integrity**, **surety**, and **competence** form the cornerstone of Argonne's IV&V programs. Our team of experts unites these three elements to ensure high-quality IV&V in every project. Experience counts — and Argonne has the edge needed for ensuring integrity of systems applications. Argonne's experience in both small- and large-scale efforts has produced a fine-tuned process for evaluating software applications. Not only does Argonne have established capabilities, its staff also is knowledgeable about the latest methods and standards, which are essential components of IV&V.

Argonne's team of IV&V specialists has been an integral part of the software development program performed for an organization within the Department of Defense. The organization has been responsible for performing the research, development, testing, and evaluation of arms control verification technology. In recognition of Argonne's track record, the Laboratory was invited to perform IV&V on several international arms control software applications, including:

- CMTS – Compliance Monitoring and Tracking System
- OSMAPS – Open Skies Management and Planning System
- ACINS – Arms Control Information and Notification System
- INA – Integrated Notification Application

## What is IV&V?

IV&V is a systems engineering process used for evaluating the integrity and quality of the process and products of a systems development effort. The purpose of IV&V is to identify problems early in the development process, thereby enhancing the quality of ongoing development efforts. IV&V activities promote better use of development resources and add value to the overall development effort by improving product performance and adding to the development schedule.

IV&V incorporates **independence** (technical, managerial, and financial); **verification** (“Is the product being built right?”); and **validation** (“Is the right product being built?”).

IV&V can be characterized as:

- **Rigorous** – conducting according to a master plan
- **Adaptive** – tailoring to the scope of the target program
- **Integrated** – working closely with development teams
- **Self-improving** – using statistics and summaries to adjust the effectiveness of the activities themselves

### Argonne's expertise is based on sound knowledge of IV&V standards and methods

- IEEE, Standard for Software Verification and Validation, IEEE Standard 1012 (2004)
- NIST, Reference Information for the Software Verification and Validation Process, Special Publication 500-234 (1996)
- NASA, Software Formal Inspections Guidebook, NASA-GB-A302 (1993)
- SEI, Introduction to Software Verification and Validation, Curriculum Module SEI-CM-13-1.1 (1988)
- DoD, Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs, Department of Defense, Regulation 5000.2-R (2001)
- DII COE, Defense Information Infrastructure Common Operating Environment, Integration and Runtime Specifications, Version 4.1 (2000)

**Learn more about Independent Verification and Validation at:**

<http://www.dis.anl.gov/exp/is>

### For more information, contact:

Paula Narducci (narducci@anl.gov) or Craig Swietlik (swietlik@anl.gov)

Independent Verification and Validation

Decision and Information Sciences Division

Information Sciences Group

Argonne National Laboratory

9700 S. Cass Avenue, Bldg. 900

Argonne, IL 60439, USA

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UChicago  
Argonne<sub>LLC</sub>

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