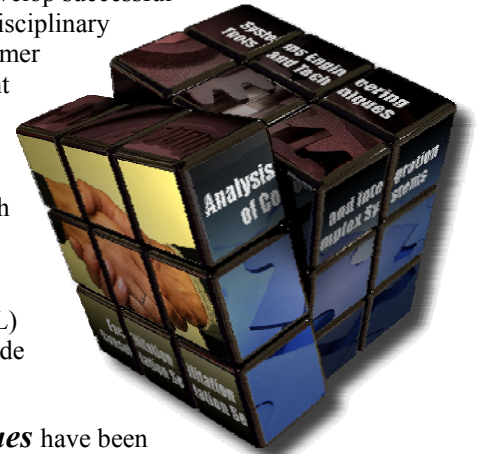


## Systems Engineering

**S**ystems Engineering is a holistic engineering discipline that provides systems analysis, systems integration, decision analysis, and systems science products and expertise to help government and private industry customers develop successful solutions to complex challenges. These interdisciplinary methodologies focus on defining and documenting customer needs and required functionality early in the development cycle, and then proceeding with design synthesis and system validation activities while considering the complete problem. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user's needs on time and within established budgets.

Systems engineers at the Idaho National Laboratory (INL) use proven and emerging systematic approaches to provide customers with reliable, quality products and services.



*Systems Engineering Principles and Techniques* have been successfully applied to a wide variety of operational, programmatic, and research problems for both the INL and other Department of Energy sites, and for many Department of Defense customers:

- ▶ **Mission Definition / Function Analysis** – INL systems engineers lead many projects in analyzing mission needs and aligning the current state of the project or system with those needs. This effort also examines the current functions of both the project and the potential solution in light of the mission needs to see if they are aligned for optimal solutions.
- ▶ **Requirements Identification, Analysis, and Management** – Requirements range from the highest level (usually mission need or functional requirements) down to specifications for individual parts or system components. INL systems engineers identify requirements through discussion with customer technical leads and solution providers, as well as through examination of governing laws, codes, standards, and contracts.
- ▶ **Trade Studies / Alternatives Analysis** – Trade studies and alternative analyses are performed any time a project needs to select from two or more options. INL systems engineers use a broad base of experience and expertise to affect these efforts and guide informed, defensible decisions through the assimilation, correlation, and/or distillation of available information.
- ▶ **System Synthesis, Integration, and Control** – INL systems engineers provide support to project managers and project engineers by integrating the many project and system functions and components. This includes ensuring consistent communication and collaboration between project elements, as well as documenting and disseminating key decisions and technical baseline changes.
- ▶ **Readiness / Startup Support (Verification and Validation)** – System startup usually requires a readiness review where requirements are validated in the system design and operating procedures. Since requirements for test and evaluation come directly from the technical and functional requirements, INL systems engineers are often in the best position to identify these connections and oversee verification and validation activities.

*Analysis and Integration of Complex Systems* integrates Systems Engineering resources, disciplines, and specialty groups into a team effort to help solve complex science and engineering

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challenges. The INL Systems Engineering team has over 500 years of combined experience applying systems analysis and integration principles in Department of Energy, Department of Defense, National Aeronautical and Space Administration, and Private Sector efforts.

- ▶ **System Modeling and Simulation** – Modeling and simulation activities can reduce projects costs, improve process efficiency, and provide safe mechanisms and environments for experimentation and system development. INL systems engineers create such models and run system simulations to achieve efficient and effective solutions.
- ▶ **Risk Mitigation and Management** – Risk mitigation and management are fundamental steps to maximizing the efficiency of risk management in any project. INL systems engineers provide the methods and tools needed to support risk-based decision making, thus yielding better overall risk management.
- ▶ **Economic / Marketing Analysis and Modeling** – Economic Analysis considers the benefits related to supplies and demands and the interrelated issues of production, consumption, and distribution of goods and services. INL systems engineers provide the methods and tools to analyze these economic factors and yield optimized solutions.
- ▶ **Programmatic and Technology Roadmapping** – The INL's advanced technology roadmapping process stands at the forefront of this emerging methodology and provides a means for projects to measure the relative merit of technologies, accelerate application of new technologies, minimize project costs and schedules, facilitate informed decision-making, and provide a defensible argument for acquisition and/or development choices.

The research arm of Systems Engineering provides new analysis and integration knowledge through scientific theories and methods that support advanced decision-making, engineering, and science. INL systems engineers use cutting-edge thinking, formal scientific methods, and emerging theories in the science of systems to solve complex systemic problems.

**Facilitation and Consultation Services (FACS)** integrates the technical and interpersonal skills necessary to help customers make logical, traceable, and defensible decisions. The FACS group uses highly trained and experienced facilitators in the application of organized, interdisciplinary approaches to solve a variety of operational, organizational, programmatic, and research problems and to provide customers with reliable, quality products, processes, and services at the lowest possible cost. INL Systems engineers are skilled in the various key elements of developing defensible decisions, including:

- ▶ **Results-Driven Meeting Design and Facilitation** – Decision-making is often the result of various forms of complex group interaction. Highly skilled facilitators and consultants at the INL provide a tailored approach to meeting diverse customer needs. This results in optimum output to support technical and programmatic decision making.
- ▶ **Organizational Effectiveness Consultation** – Working closely with the Strategic Planning and Organization Development Department, FACS consultants provide organizational effectiveness and development services with special emphasis on coaching, mentoring, alignment, culture assessment, development, communication, performance, and conflict management.
- ▶ **Value Engineering** – INL Value Engineering employs proven, systematic processes and techniques to help multidisciplinary teams achieve the essential functions of a project, product, process, system, design, or service at the lowest life-cycle cost while remaining consistent with required performance, reliability, availability, quality, and safety.
- ▶ **Computer-aided Decision Support** – As part of its informed decision making and analysis capability, the FACS group offers electronic meeting support using structured group intelligence technology to help teams achieve remarkable group collaboration and enhance organizational brainstorming and decision-making.