

# Systems Engineering and Engineering Management: Keys to the Efficient Development of Products and Services

John V. Farr, Stevens Institute of Technology  
Dennis M. Buede, Stevens Institute of Technology

---

**Abstract:** Because of globalization and technology, the roles of the traditional engineering manager are changing. All practicing engineering managers must be able to understand the tools available in order to develop innovative products and solutions that meet the customer's demands. Systems engineering (SE) is a relatively new discipline that is focused on developing requirements and functional and operational architectures of complex systems. In the 21st century market, engineers are becoming a profession of integrators of commercially existing components manufactured outside the U.S. This article presents an overview of SE and the overlap, differences, and synergies that are associated with the traditional engineering management functions.

---

With the globalization of our manufacturing base, the efficiencies derived from advances in information technology (and the subsequent decrease in mid-management positions), and the shifting of our economy to be service-based, the roles of the technical organization and engineering manager have changed. The 21st century technical organization must be concerned with (1) maintaining a strong business base of products or services in a fluctuating economy, (2) keeping a highly qualified and trained staff of engineers, scientists, and technicians in a rapidly changing technological environment, and (3) demonstrating a high level of capability maturity.

Meanwhile, the 21st century engineering manager must now be able to understand and operate in this new paradigm. Systems engineering (SE) is a key aspect of this paradigm. Outsourcing, reduced time to market, customer-driven requirements, and just-in-time inventory are just some of the

business practices required to achieve the concerns just outlined. Engineers who practice in the services and manufacturing domains must be able to understand the tools and processes available in defining the fuzzy front end associated with generating conceptual ideas and developing the architectures of innovative and efficient product solutions.

In the academic world, SE and engineering management (EM) are typically taught in the same academic department. The principles of SE are invaluable for enabling practicing engineering managers to deliver effective products on time and within budget that meet customer expectations.

In this article, we first discuss the process of systems development in which both engineering managers and systems engineers must flourish. Next, we outline the roles of systems engineers and engineering managers in the total product life cycle, highlighting the differences, overlap, and synergies. Last, we present a number of implications for technical organizations that are associated with integrating the activities of engineering managers and systems engineers. These implications include the role of systems engineers in building engineering organizations (peopled systems), and integrating and improving both systems and software capabilities within the technical organization.

## Nature of Systems Development

A system is an integrated composition of elements that provides a capability to satisfy a stated need or objective (McDonald, 1970). These integrated elements can be products of hardware and software, people, facilities, and procedures. To develop a system successfully, engineers must first define the problem that exists, identify the mission requirements (or business drivers) of the organization(s) needing the problem to be solved, evaluate

---

## About the Authors

**John V. Farr** is currently professor and founding director of the department of SE and EM at Stevens Institute of Technology, Hoboken, New Jersey. Previously he served for eight years in the department of SE at the United States Military Academy, West Point, New York and was promoted to the rank of professor and served as director of their EM program for three years. He holds a PhD in civil engineering from the University of Michigan and is currently president of the American Society of Engineering Management (ASEM) and serves on the Army Science Board and the Board of Advisors for the International Society of Logistics. He has authored over 70 technical publications, including one textbook on a wide variety of civil engineering and EM topics.

**Dennis M. Buede** received his PhD and MS from the engineering-economic systems department of Stanford University. He is currently professor of SE at Stevens Institute of Technology and director of the graduate SE programs. Previously he was professor associate director of the C3I Center at George Mason University. Prior to that he ran his own consulting and research company for eight years. He has pioneered in the development of new decision methodologies in the areas of system design and evaluation, and resource allocation. He is the author of *The Engineering Design of Systems: Methods and Models* and a coauthor of *Decision Synthesis*.

**Contact:** John V. Farr, Department of Systems Engineering and Engineering Management, Charles V. Schaefer Jr. School of Engineering, Stevens Institute of Technology, Castle Point on Hudson, Hoboken, NJ 07030; phone: 201-216-8103; jfarr@stevens-tech.edu

---

Refereed research manuscript. Accepted by Timothy Kotnour, editor.