Afit S Systems Engineering Case Studies

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The theme of this volume on systems engineering research is disciplinary convergence: bringing together concepts, thinking, approaches, and technologies from diverse disciplines to solve complex problems. Papers presented at the Conference on Systems Engineering Research (CSER), March 23-25, 2017 at Redondo Beach, CA, are included in this volume. This collection provides researchers in academia, industry, and government forward-looking research from across the globe, written by renowned academic, industry and government researchers.

A new edition of a bestselling industrial and systems engineering reference, Handbook of Industrial and Systems Engineering, Second Edition provides students, researchers, and practitioners with easy access to a wide range of industrial engineering tools and techniques in a concise format. This edition expands the breadth and depth of coverage, emphasizing new systems engineering tools, techniques, and models. See What's New in the Second Edition: Section covering safety, reliability, and quality Section on operations research, queuing, logistics, and scheduling Expanded appendix to include conversion factors and engineering, systems, and statistical formulae Topics such as control charts, engineering economy, health operational efficiency, healthcare systems, human systems integration, Lean systems, logistics transportation, manufacturing systems, material handling systems, process view of work, and Six Sigma techniques The premise of the handbook remains: to expand the breadth and depth of coverage beyond the traditional handbooks on industrial engineering. The book begins with a general introduction with specific reference to the origin of industrial engineering and the ties to the Industrial Revolution. It covers the fundamentals of industrial engineering and the fundamentals of systems engineering. Building on this foundation, it presents chapters on manufacturing, production systems, and ergonomics, then goes on to discuss economic and financial analysis, management, information engineering, and decision making. Two new sections examine safety, reliability, quality, operations research, queuing, logistics, and scheduling. The book provides an updated collation of the body of knowledge of industrial and systems engineering. The handbook has been substantively expanded from the 36 seminal chapters in the first edition to 56 landmark chapters in the second edition. In addition to the 20 new chapters, 11 of the chapters in the first edition have been updated with new materials. Filling the gap that exists between the traditional and modern practice of industrial and systems engineering, the handbook provides a one-stop resource for teaching, research, and practice.

Few people have experienced as much aerospace history as Bob Brulle (Lt. Col. Robert V. Brulle, USAF, Ret.), and fewer still possess his meticulous recall and research skills. The P-47 fighter pilot turned engineer, inventor, educator, and author found himself immersed in the Cold War race to the moon, developing cutting-edge technology, instructing future astronauts in aerodynamics and orbital mechanics, perfecting high-performance fighter aircraft to meet the Soviet challenge, overseeing the procurement of new weapon systems, and exploring alternative energy sources. In this book, he shares his unique personal insights into the triumphs and tragedies of one of the most exciting eras in American history.

Sustainability is one of the most embraced topics nowadays. Everybody is affected by issues of sustainability. Every organization needs to pay attention to these issues. As long as more people and more organizations are engaging in business and industry activities, there will always be a need for sustainability. This book presents tools such as lean six sigma to help sustain results by using process focused decisions. This book covers tools and techniques of

industrial engineering to promote sustainability. It discusses a systems approach, the evolution of new products, development of sustainability alliances, and highlights the role of sustainability in advancing organizational goals. The book also addresses sustainability as a coordinated project using a project management approach. It includes the interface of humans and technology and presents an integration of analytics. The book is ideal for all engineering, business, and management fields.

The Air Force requires technical skills and expertise across the entire range of activities and processes associated with the development, fielding, and employment of air, space, and cyber operational capabilities. The growing complexity of both traditional and emerging missions is placing new demands on education, training, career development, system acquisition, platform sustainment, and development of operational systems. While in the past the Air Force's technologically intensive mission has been highly attractive to individuals educated in science, technology, engineering, and mathematics (STEM) disciplines, force reductions, ongoing military operations, and budget pressures are creating new challenges for attracting and managing personnel with the needed technical skills. Assessments of recent development and acquisition process failures have identified a loss of technical competence within the Air Force (that is, in house or organic competence, as opposed to contractor support) as an underlying problem. These challenges come at a time of increased competition for technical graduates who are U.S. citizens, an aging industry and government workforce, and consolidations of the industrial base that supports military systems. In response to a request from the Deputy Assistant Secretary of the Air Force for Science, Technology, and Engineering, the National Research Council conducted five fact-finding meetings at which senior Air Force commanders in the science and engineering, acquisition, test, operations, and logistics domains provided assessments of the adequacy of the current workforce in terms of quality and quantity.

With their ability to cross traditional boundaries and achieve a level of functionality greater than their component elements, mega-systems have helped corporations and government organizations around the world resolve complex challenges that they otherwise couldn’t address with stand-alone systems. Engineering Mega-Systems: The Challenge of Systems Engineering in the Information Age provides a clear understanding of the engineering of this class of systems—a process that demands consideration of increasing program scale and the rapid change of underlying technologies. Written by Renee Stevens, a Senior Principal Engineer at The MITRE Corporation with decades of experience analyzing, engineering, and acquiring large-scale systems for the U.S. Department of Defense and other government agencies, this book explains how the engineering of mega-systems is inherently different from that of large-scale monolithic systems. It supplies the vocabulary and framework needed to explore the issues relevant to mega-systems. This framework then evolves into the Profiler diagnostic tool that helps you understand the nature and context of the system at hand and, on that basis, select the most appropriate processes, tools, and techniques. Stevens examines commercial and government applications of mega-systems to provide insight into the contemporary challenges of engineering these systems in three critical dimensions: engineering processes, management processes, and the larger context in which these systems are developed and deployed. Complete with two case studies in engineering mega-systems that illustrate valuable lessons learned and highlight emerging practices, this book supplies the understanding and the tools needed to begin engineering, characterizing, and acquiring mega-systems across multiple dimensions.

This is one of a series of systems engineering case studies prepared by the Air Force Center for Systems Engineering. This case study analyzes the Global Positioning System (GPS). It is a satellite-based radio navigation system. It provides suitably equipped users the capability to precisely determine three-dimensional position and velocity and time information on a global basis. The capability was developed to provide the United States and DoD with worldwide

navigation, position, and timing capabilities to support military operations by enhancing ground, sea, and air warfighting efficiencies. However, by presidential directive, it was officially made available to the civilian community in 1983. GPS also provides the capability to conduct time transfer for synchronization purposes through the use of precise time standards. GPS supports a secondary mission to provide a highly survivable military capability to detect, locate, and report nuclear detonations in the Earth's atmosphere and in near-Earth space in real time. The study provides a wealth of technical information about this vital satellite-based system and its complex history. The Department of Defense is exponentially increasing the acquisition of joint complex systems that deliver needed capabilities demanded by our warfighter. Systems engineering is the technical and technical management process that focuses explicitly on delivering and sustaining robust, high-quality, affordable solutions. The Air Force leadership has collectively stated the need to mature a sound systems engineering process throughout the Air Force. Gaining an understanding of the past and distilling learning principles that are then shared with others through our formal education and practitioner support are critical to achieving continuous improvement. Table of Contents * Preface * Foreword * Acknowledgements * Chapter 1. SYSTEMS ENGINEERING PRINCIPLES * 1.1 General Systems Engineering Process * 1.1.1 Introduction * 1.1.2 Case Study * 1.1.3 Framework for Analysis * 1.2 GPS Friedman-Sage Matrix * Chapter 2. SYSTEM DESCRIPTION * 2.1 Mission * 2.2 Features * 2.3 System Design * 2.3.1 Space Vehicle * 2.3.2 User Equipment * 2.3.3 Control Segment * 2.3.4 Nuclear Detection System (NDS) * 2.3.5 "NAVSTAR/GPS" * Chapter 3. GPS PROGRAM EXECUTION * 3.1 Early Programs * 3.2 Establishment of a Joint Program * 3.3 Concept/Validation Phase (Phase I) * 3.3.1 Objectives * 3.3.2 Requirements * 3.3.3 Acquisition Strategy * 3.3.4 Trade Studies * 3.3.5 Risk Mitigation * 3.3.6 System Integration * 3.3.7 Systems Engineering * 3.3.8 DSARC II * 3.4 System Development (Phase II, Block I) * 3.4.1 Objectives * 3.4.2 Systems Engineering (JPO) * 3.4.3 Interface Requirements * 3.4.4 Budgetary Impacts to Functional Baseline * 3.4.5 Rockwell International Systems Engineering * 3.4.6 Atomic Clocks * 3.4.7 Control Segment * 3.4.8 User Equipment * 3.4.9 Design Reviews * 3.4.10 System Integration * 3.4.11 ICWG * 3.5 Production and Deployment (Phase III, Block II/IIA) * 3.5.1 Objective * 3.5.2 Acquisition Strategy * 3.5.3 Nuclear Detection System * 3.5.4 Shuttle Impact to Functional Baseline * 3.5.5 User Equipment (UE) Development Testing Effects * 3.5.6 Control Segment * 3.5.7 Requirements Validation & Verification * 3.6. Replenishment Program Block IIR * 3.6.1 Objective * 3.6.2 Acquisition Strategy * 3.6.3 Requirements * 3.6.4 Critical Design Reviews * 3.6.5 User Equipment * 3.7 Full Operational Capability * Chapter 4. SUMMARY * Chapter 5. QUESTIONS FOR THE STUDENT * Chapter 6. REFERENCES

The Systems Modeling Language (SysML) extends UML with powerful systems engineering capabilities for modeling a wider spectrum of systems and capturing all aspects of a system's design. SysML Distilled is the first clear, concise guide for everyone who wants to start creating effective SysML models. (Drawing on his pioneering experience at Lockheed Martin and NASA, Lenny Delligatti illuminates SysML's core components and provides practical advice to help you create good models and good designs. Delligatti begins with an easy-to-understand overview of Model-Based Systems Engineering (MBSE) and an explanation of how SysML enables effective system specification, analysis, design, optimization, verification, and validation. Next, he shows how to use all nine types of SysML diagrams, even if you have no previous experience with modeling languages. A case study running through the text demonstrates the use of SysML in modeling a complex, real-world sociotechnical system. Modeled after Martin Fowler's classic UML Distilled, Delligatti's indispensable guide quickly teaches you what you need to know to get started and

helps you deepen your knowledge incrementally as the need arises. Like SysML itself, the book is method independent and is designed to support whatever processes, procedures, and tools you already use. Coverage Includes Why SysML was created and the business case for using it Quickly putting SysML to practical use What to know before you start a SysML modeling project Essential concepts that apply to all SysML diagrams SysML diagram elements and relationships Diagramming block definitions, internal structures, use cases, activities, interactions, state machines, constraints, requirements, and packages Using allocations to define mappings among elements across a model SysML notation tables, version changes, and sources for more information

Theoretical and practical interests in additive manufacturing (3D printing) are growing rapidly. Engineers and engineering companies now use 3D printing to make prototypes of products before going for full production. In an educational setting faculty, researchers, and students leverage 3D printing to enhance project-related products. Additive Manufacturing Handbook focuses on product design for the defense industry, which affects virtually every other industry. Thus, the handbook provides a wide range of benefits to all segments of business, industry, and government. Manufacturing has undergone a major advancement and technology shift in recent years.

This Focus book presents the basic principles and practice of project management and simple analytics for project control, using the systems framework of Design, Evaluation, Justification, and Integration (DEJI). The overriding theme of the book is that every pursuit can be organized as a project. This short form book presents the evolution of products in the classical era of introducing new projects needing project management. It discusses the development of project alliances, includes the role of project management in advancing organization goals, illustrates the early applications of project management, and includes humans in the loop. The book will also cover project systems and work design, while showing the integration of quantitative and qualitative analytics. This book can serve as a reference for everyone, since everyone is engaged in project management, whether formal or informal

Industrial engineering is the profession dedicated to making collective systems function better with less waste, better quality, and fewer resources, to serve the needs of society more efficiently and more effectively. This book uses a story-telling approach to advocate and elaborate the fundamental principles of industrial engineering in a simple, interesting, and engaging format. It will stimulate interest in industrial engineering by exploring how the tools and techniques of the discipline can be relevant to a broad spectrum of applications in business, industry, engineering, education, government, and the military. Features Covers the origin of industrial engineering Discusses the early pioneers and profiles the evolution of the profession Presents offshoot branches of industrial engineering Illustrates specific areas of performance measurement and human factors Links industrial engineering to the emergence of digital engineering Uses the author’s personal experience to illustrate his advocacy and interest in the profession

F-111 Systems Engineering Case Study - Technical Details, Program History, Combat Operational History of Controversial Fighter-Attack Aircraft

Innovation: A Systems Approach Subject Guide: Engineering-Industrial & Manufacturing It is a systems world. This concise book uses a systems-based

approach to show how innovation is ubiquitous in all facets of endeavors, including business, industry, government, and academia. The systems approach facilitates process design, evaluation, justification, and integration. This book explicitly highlights the crucial role of integration in any innovation project. It presents conceptual and operational definitions of innovation. Emphasis is placed on the context related to the theme of systems thinking. Features Covers the intrinsic basis for innovation from a systems perspective Describes the use of the DEJI systems model for actuating innovation Highlights the role of humans in the innovation loop Provides guidance for innovation project management Presents a case example of linking quality and innovation Introduces the Umbrella Theory of Innovation

Systems Engineering for Business Process Change: New Directions is a collection of papers resulting from an EPSRC managed research programme set up to investigate the relationships between Legacy IT Systems and Business Processes. The papers contained in this volume report the results from the projects funded by the programme, which ran between 1997 and 2001. An earlier volume, published in 2000, reported interim results. Bringing together researchers from diverse backgrounds in Computer Science, Information Systems, Engineering and Business Schools, this book explores the problems experienced by IT-dependent businesses that have to implement changing business processes in the context of their investment in legacy systems. The book presents some of the solutions investigated through the collaborations set up within the research programme. Whether you are a researcher interested in the ideas that were generated by the research programme, or a user trying to understand the nature of the problems and their solutions, you cannot fail to be inspired by the writings contained in this volume.

Dr. Greg Zacharias, former Chief Scientist of the United States Air Force (2015-18), explores next steps in autonomous systems (AS) development, fielding, and training. Rapid advances in AS development and artificial intelligence (AI) research will change how we think about machines, whether they are individual vehicle platforms or networked enterprises. The payoff will be considerable, affording the US military significant protection for aviators, greater effectiveness in employment, and unlimited opportunities for novel and disruptive concepts of operations. Autonomous Horizons: The Way Forward identifies issues and makes recommendations for the Air Force to take full advantage of this transformational technology.

Global Manufacturing Technology Transfer: Africa-USA Strategies, Adaptations, and Management presents practical strategies for developing and sustaining manufacturing technology transfers. It is particularly useful for helping developing nations achieve and sustain a solid footing of economic development through manufacturing. The book examines Afr

This book describes how the Systems Engineering (SE) methodology can be used to harness technology and enhance democracy within any political system. Moreover, it provides a practical roadmap for countries and politicians who are willing to change their existing system of governance to one that allows the people to have a meaningful say. In this regard, the book compares and contrasts two countries, Mauritius and Australia, highlighting how SE and e-democracy can be implemented in different contexts.

Work is all around us and permeates everything we do and everyday activities. Not all work is justified, not all work is properly designed, or evaluated accurately, or integrated. A systems model will make work more achievable through better management. Work is defined as a process of performing a defined task or activity, such as research, development, operations,

maintenance, repair, assembly, production, and so on. Very little is written on how to design, evaluate, justify, and integrate work. Using a comprehensive systems approach, this book facilitates a better understanding of work for the purpose of making it more effective and rewarding.

This book covers important performance characteristics of aeronautical structures. The subject matter is presented in layman's terms without complicated mathematical details. This has been a basic one quarter course for safety, contracting, maintenance, research management, professional engineers and other professionals dealing with related aeronautical and systems engineering fields in the US Air Force Institute of Technology (AFIT). The topics covered are aircraft design/ analysis, performance and their maintenance. The book addresses response characteristics of materials, and types of failures in aeronautical structures (e.g., fatigue, creep, fracture, buckling, and stress concentration) in both conventional metallic structures and composites. In most of the cases, as can be seen from publications resulting from AFIT masters level and PhD students' work (Chapter 11), this subject matter was one of the preparatory courses for their thesis or dissertation. The author has more than 40 years' experience in industry, research and academia including teaching this course for 5 years in AFIT.

This is one of a series of systems engineering case studies prepared by the Air Force Center for Systems Engineering. This case study analyzes the Hubble Space Telescope program. The incredible story of the HST program from the early dreams and visions of a space-based telescope in 1946, through extensive, more formal program formulation and developments in the 1970s, tumultuous re-direction in the 1980s (especially due to the impact of the 1986 Challenger disaster), initial launch in 1990, and unplanned major on-orbit repairs in 1993 provides the basis for an exciting case study in all aspects of systems engineering. As we will see, this case represents a program dramatically impacted by a variety of scientific, technical, economic, political, and program management events and factors, many of them unpredictable. The study provides a wealth of technical information about the project and its complex history. The Department of Defense is exponentially increasing the acquisition of joint complex systems that deliver needed capabilities demanded by our warfighter. Systems engineering is the technical and technical management process that focuses explicitly on delivering and sustaining robust, high-quality, affordable solutions. The Air Force leadership has collectively stated the need to mature a sound systems engineering process throughout the Air Force. Gaining an understanding of the past and distilling learning principles that are then shared with others through our formal education and practitioner support are critical to achieving continuous improvement. FOREWORD * ACKNOWLEDGEMENTS * EXECUTIVE SUMMARY * 1.0 SYSTEMS ENGINEERING PRINCIPLES * 1.1 General Systems Engineering Process * 1.2 HST Major Learning Principles * 2.0 SYSTEM DESCRIPTION * 3.0 HST SYSTEMS ENGINEERING LEARNING PRINCIPLES * 3.1 Learning Principle 1 - Early Customer/User Participation * 3.2 Learning Principle 2 - Use of Pre-Program Trade Studies * 3.3 Learning Principle 3 - System Integration * 3.4 Learning Principle 4 - Life Cycle Support Planning and Execution * 3.5 Learning Principle 5 - Risk Assessment and Management * 4.0 SUMMARY * 5.0 REFERENCES

Electro-optical and infrared systems are fundamental in the military, medical, commercial, industrial, and private sectors. Systems Engineering and Analysis of Electro-Optical and Infrared Systems integrates solid fundamental systems engineering principles, methods, and techniques with the technical focus of contemporary electro-optical and infrared optics, imaging, and detection methodologies and systems. The book provides a running case study throughout that illustrates concepts and applies topics learned. It explores the benefits of a solid systems engineering-oriented approach focused on electro-optical and infrared systems. This book covers fundamental systems engineering principles as applied to optical systems,

demonstrating how modern-day systems engineering methods, tools, and techniques can help you to optimally develop, support, and dispose of complex, optical systems. It introduces contemporary systems development paradigms such as model-based systems engineering, agile development, enterprise architecture methods, systems of systems, family of systems, rapid prototyping, and more. It focuses on the connection between the high-level systems engineering methodologies and detailed optical analytical methods to analyze, and understand optical systems performance capabilities. Organized into three distinct sections, the book covers modern, fundamental, and general systems engineering principles, methods, and techniques needed throughout an optical system’s development lifecycle (SDLC); optical systems building blocks that provide necessary optical systems analysis methods, techniques, and technical fundamentals; and an integrated case study that unites these two areas. It provides enough theory, analytical content, and technical depth that you will be able to analyze optical systems from both a systems and technical perspective.

With the continuing frequency, intensity, and adverse consequences of cyber-attacks, disruptions, hazards, and other threats to federal, state, and local governments, the military, businesses, and the critical infrastructure, the need for trustworthy secure systems has never been more important to the long-term economic and national security interests of the United States. Engineering-based solutions are essential to managing the growing complexity, dynamicity, and interconnectedness of today's systems, as exemplified by cyber-physical systems and systems-of-systems, including the Internet of Things. This publication addresses the engineering-driven perspective and actions necessary to develop more defensible and survivable systems, inclusive of the machine, physical, and human components that compose the systems and the capabilities and services delivered by those systems. It starts with and builds upon a set of well-established International Standards for systems and software engineering published by the International Organization for Standardization (ISO), the International Electrotechnical Commission (IEC), and the Institute of Electrical and Electronics Engineers (IEEE) and infuses systems security engineering methods, practices, and techniques into those systems and software engineering activities. The objective is to address security issues from a stakeholder protection needs, concerns, and requirements perspective and to use established engineering processes to ensure that such needs, concerns, and requirements are addressed with appropriate fidelity and rigor, early and in a sustainable manner throughout the life cycle of the system.

"A useful guide for scholars, practitioners and those involved in engineering, management, and business fields"--

Perfluoroalkyl substances are compounds that have been around since the 1950s. Only recently has their adverse human health and ecological consequences become known. There are books that either investigate the chemistry or explore the toxicity of these compounds. This is the only book that will provide a holistic look at this very complex problem and will cover the toxicology, analytical, remediation, and regulatory perspectives, and how it affects everyone personally. The book will serve as a reference for practicing environmental engineers, regulators, toxicologist, researchers, and concerned members of the public.

Graduate research is a complicated process, which many undergraduate students aspire to undertake. The complexity of the process can lead to failures for even the most brilliant students. Success at the graduate research level requires not only a high level of intellectual ability but also a high level of project management skills. Unfortunately, many graduate students have trouble planning and implementing their research. Project Management for Research: A Guide for Graduate Students reflects the needs of today’s graduate students. All graduate students need mentoring and

management guidance that has little to do with their actual classroom performance. Graduate students do a better job with their research programs if a self-paced guide is available to them. This book provides such a guide. It covers topics ranging from how to select an appropriate research problem to how to schedule and execute research tasks. The authors take a project management approach to planning and implementing graduate research in any discipline. They use a conversational tone to address the individual graduate student. This book helps graduate students and advisors answer most of the basic questions of conducting and presenting graduate research, thereby alleviating frustration on the part of both student and advisor. It presents specific guidelines and examples throughout the text along with more detailed examples in reader-friendly appendices at the end. By being more organized and prepared to handle basic research management functions, graduate students, along with their advisors, will have more time for actual intellectual mentoring and knowledge transfer, resulting in a more rewarding research experience.

Suitable as a reference for industry practitioners and as a textbook for classroom use, Case Studies in System of Systems, Enterprise Systems, and Complex Systems Engineering provides a clear understanding of the principles and practice of system of systems engineering (SoSE), enterprise systems engineering (ESE), and complex systems engineering (CSE). Multiple domain practitioners present and analyze case studies from a range of applications that demonstrate underlying principles and best practices of transdisciplinary systems engineering. A number of the case studies focus on addressing real human needs. Diverse approaches such as use of soft systems skills are illustrated, and other helpful techniques are also provided. The case studies describe, examine, analyze, and assess applications across a range of domains, including: Engineering management and systems engineering education Information technology business transformation and infrastructure engineering Cooperative framework for and cost management in the construction industry Supply chain modeling and decision analysis in distribution centers and logistics International development assistance in a foreign culture of education Value analysis in generating electrical energy through wind power Systemic risk and reliability assessment in banking Assessing emergencies and reducing errors in hospitals and health care systems Information fusion and operational resilience in disaster response systems Strategy and investment for capability developments in defense acquisition Layered, flexible, and decentralized enterprise architectures in military systems Enterprise transformation of the air traffic management and transport network Supplying you with a better understanding of SoSE, ESE, and CSE concepts and principles, the book highlights best practices and lessons learned as benchmarks that are applicable to other cases. If adopted correctly, the approaches outlined can facilitate significant progress in human affairs. The study of complex systems is still in its infancy, and it is likely to evolve for decades to come. While this book does not provide all the answers, it does establish a platform, through which analysis and knowledge application can take place and conclusions can be made in order to educate the next generation of systems engineers.

Organizations implement information systems (IS) for various reasons such as streamlining daily functions and keeping pace with changes in technology. Influence behaviors demonstrated by key leaders in reference to the implementation of such information systems play a key role in their acceptance and success. This research

looks at a specific case of IS implementation and the role influence behaviors played in the successfulness of the system. This research is a case study of the Air Force Institute of Technology's (AFIT) implementation of an academic support system called my.afit.edu. Interviews and documentation gathered from key parties involved in the implementation provided a basis for understanding the implementation effort and the effect influence behaviors had on the successfulness. This research showed how the use of positive influence behaviors by key leaders results in a successful implementation effort. In addition to the use of positive influence behaviors by key leaders, the success of the implementation effort is tied to management and implementers and their ability to address user concerns early in the implementation effort.

The ability of U.S. military forces to field new weapons systems quickly and to contain their cost growth has declined significantly over the past few decades. There are many causes including increased complexity, funding instability, bureaucracy, and more diverse user demands, but a view that is gaining more acceptance is that better systems engineering (SE) could help shorten development time. To investigate this assertion in more detail, the US Air Force asked the NRC to examine the role that SE can play during the acquisition life cycle to address root causes of program failure especially during pre-milestone A and early program phases. This book presents an assessment of the relationship between SE and program outcome; an examination of the SE workforce; and an analysis of SE functions and guidelines. The latter includes a definition of the minimum set of SE processes that need to be accounted for during project development.

This book thoroughly covers the fundamentals of the QFT robust control, as well as practical control solutions, for unstable, time-delay, non-minimum phase or distributed parameter systems, plants with large model uncertainty, high-performance specifications, nonlinear components, multi-input multi-output characteristics or asymmetric topologies. The reader will discover practical applications through a collection of fifty successful, real world case studies and projects, in which the author has been involved during the last twenty-five years, including commercial wind turbines, wastewater treatment plants, power systems, satellites with flexible appendages, spacecraft, large radio telescopes, and industrial manufacturing systems. Furthermore, the book presents problems and projects with the popular QFT Control Toolbox (QFTCT) for MATLAB, which was developed by the author.

This book focuses on the importance of human factors in optimizing the learning and training process. It reports on the latest research and best practices and discusses key principles of behavioral and cognitive science, which are extremely relevant to the design of instructional content and new technologies to support mobile and multimedia learning, virtual training and web-based learning, among others, as well as performance measurements, social and adaptive learning and many other types of educational technologies, with a special emphasis on those important in the corporate, higher education, and military training contexts. Based on the AHFE 2017 Conference on Human Factors in Training, Education, and Learning Sciences, held July 17–21, 2017 in Los Angeles, California, the book offers a timely perspective on the role of human factors in education. It highlights important new ideas and will foster new discussions on how to optimally design learning experiences.

The Principal Deputy to the Assistant Secretary of the Air Force for Acquisition requested that the National Research Council (NRC) review the Air Force's planned acquisition programs to determine if, given its scale, the highly talented scientific, technical, and engineering personnel base could be maintained, to identify issues affecting the engineering and science work force, and to identify issues affecting the aerospace industry's leadership in technology development, innovation, and product quality, as well as its ability to support Air Force missions.

If engineering is the art and science of technical problem solving, systems architecting happens when you don’t yet know what the problem is. The third edition of a highly respected bestseller, The Art of Systems Architecting provides in-depth coverage of the least understood part of systems design: moving from a vague concept and limited resources to a satisfactory and feasible system concept and an executable program. The book provides a practical, heuristic approach to the "art" of systems architecting. It provides methods for embracing, and then taming, the growing complexity of modern systems. New in the Third Edition: Five major case studies illustrating successful and unsuccessful practices Information on architecture frameworks as standards for architecture descriptions New methods for integrating business strategy and architecture and the role of architecture as the technical embodiment of strategy Integration of process guidance for organizing and managing architecture projects Updates to the rapidly changing fields of software and systems-of-systems architecture Organization of heuristics around a simple and practical process model A Practical Heuristic Approach to the Art of Systems Architecting Extensively rewritten to reflect the latest developments, the text explains how to create a system from scratch, presenting invention/design rules together with clear explanations of how to use them. The author supplies practical guidelines for avoiding common systematic failures while implementing new mandates. He uses a heuristics-based approach that provides an organized attack on very ill-structured engineering problems. Examining architecture as more than a set of diagrams and documents, but as a set of decisions that either drive a system to success or doom it to failure, the book provide methods for integrating business strategy with technical architectural decision making.

This is one of a series of systems engineering case studies prepared by the Air Force Center for Systems Engineering. This case study analyzes the General Dynamics (GD) F-111, unarguably the most controversial fighter-attack aircraft ever developed. It suffered from a nearly impossible multi-role/multi-service requirement specification, and a protracted development cycle in which numerous serious technical problems had to be identified and corrected. Of the 1,726 total aircraft buy that had originally been planned in 1962, only 562 production models of seven different variants were completed when production ended in 1976. The systems engineering process and its application to the F-111 program from 1958 to 1976 will be examined through discussion of five fundamental systems engineering learning principles that were derived from research on the F-111 program and from interviews with key F-111 government and contractor managers. Through examination of these systems engineering learning principles, the reader will gain an appreciation of the circumstances in the F-111 program that had the most influence on the outcome of the program and the government and contractor personnel who managed the F-111 systems development. The study provides a wealth of technical information about the

aircraft and its complex history. The Department of Defense is exponentially increasing the acquisition of joint complex systems that deliver needed capabilities demanded by our warfighter. Systems engineering is the technical and technical management process that focuses explicitly on delivering and sustaining robust, high-quality, affordable solutions. The Air Force leadership has collectively stated the need to mature a sound systems engineering process throughout the Air Force. Gaining an understanding of the past and distilling learning principles that are then shared with others through our formal education and practitioner support are critical to achieving continuous improvement. These cases support academic instruction on SE within military service academies, civilian and military graduate schools, industry continuing education programs, and those practicing SE in the field. Each of the case studies is comprised of elements of success as well as examples of SE decisions that, in hindsight, were not optimal. Both types of examples are useful for learning. Along with discovering historical facts, we have conducted key interviews with program managers and chief engineers, both within the government and those working for the various prime and subcontractors. From this information, we have concluded that the discipline needed to implement SE and the political and acquisition environment surrounding programs continue to challenge our ability to provide balanced technical solutions. FOREWORD * ACKNOWLEDGEMENTS * EXECUTIVE SUMMARY * 1.0 SYSTEMS ENGINEERING PRINCIPLES * 1.1 General Systems Engineering Process * 1.2 F-111 Major Learning Principles * 2.0 F-111 SYSTEM DESCRIPTION * 2.1 F-111 Characteristics * 3.0 F-111 SYSTEMS ENGINEERING PRINCIPLES * 3.1 Learning Principle 1 - Requirements Definition and Management * 3.2 Learning Principle 2 - Systems Architecture and Design Trade-Offs * 3.3 Learning Principle 3 - Communications and Systems Management * 3.4 Learning Principle 4 - Validation and Verification * 3.5 Learning Principle 5 - Program Management * 4.0 SUMMARY * 5.0 REFERENCES * 6.0 LIST OF APPENDICES * Appendix 1 - Completed Friedman Sage Matrix for F-111 * Appendix 2 - Biography * Appendix 3 - F-111 History and Variants * Appendix 4 - Program Milestone Charts * Appendix 5 - Combat Operations * Appendix 6 - Transonic Drag * Appendix 7 - F-111 Inlet-Engine Compatibility Problem * Appendix 8 - Wing Carry Through Box Failure and Impact on Subsequent Aircraft Development

When you look closely, nature is nanotechnology at its finest. From a single cell, a factory all by itself, to complex systems, such as the nervous system or the human eye, each is composed of specialized nanostructures that exist to perform a specific function. This same beauty can be mirrored when we interact with the tiny physical world that is the realm of quantum mechanics. This book focuses on the application of nanotechnology to modern semiconductor optoelectronic devices. Electrons, photons, and even thermal properties can all be engineered at the nanolevel. The 2D quantum well, possibly the simplest aspect of nanotechnology, has dramatically enhanced the efficiency and versatility of electronic and optoelectronic devices. While this area alone is fascinating, nanotechnology has now progressed to 1D (quantum wire) and 0D (quantum dot) systems that exhibit remarkable and sometimes unexpected behaviors. With these components serving as the modern engineer's building blocks, it is a brave new world we live in, with endless possibilities for new technology and scientific discovery.

The book uses a systems-based approach to show how innovation is pervasive in all

facets of endeavors, including business, industrial, government, the military, and even academia. It presents chapters that provide techniques and methodologies for achieving the transfer of science and technology assets for innovation applications. By introducing Innovation, the book and offers different viewpoints, both qualitative and quantitative. It includes the role that systems can play and discusses approaches along technical and process issues. There is a showcase of innovation applications, and coverage on how to manage innovation individually as well as within a team and it also includes how to develop, manage, and sustain innovation in various organizations. Open-ended questions and exercises are included at the end of chapters with no need for a solutions manual. Written for the advance-level textbook market as well as for the professional reader, it targets those within the engineering, business, and management fields.

A Practical Guide to SysML: The Systems Modeling Language is a comprehensive guide to SysML for systems and software engineers. It provides an advanced and practical resource for modeling systems with SysML. The source describes the modeling language and offers information about employing SysML in transitioning an organization or project to model-based systems engineering. The book also presents various examples to help readers understand the OMG Systems Modeling Professional (OCSMP) Certification Program. The text is organized into four parts. The first part provides an overview of systems engineering. It explains the model-based approach by comparing it with the document-based approach and providing the modeling principles. The overview of SYsML is also discussed. The second part of the book covers a comprehensive description of the language. It discusses the main concepts of model organization, parametrics, blocks, use cases, interactions, requirements, allocations, and profiles. The third part presents examples that illustrate how SysML supports different model-based procedures. The last part discusses how to transition and deploy SysML into an organization or project. It explains the integration of SysML into a systems development environment. Furthermore, it describes the category of data that are exchanged between a SysML tool and other types of tools, and the types of exchange mechanisms that can be used. It also covers the criteria that must be considered when selecting a SysML. Software and systems engineers, programmers, IT practitioners, experts, and non-experts will find this book useful. *The authoritative guide for understanding and applying SysML *Authored by the foremost experts on the language *Language description, examples, and quick reference guide included