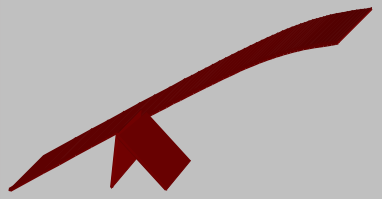
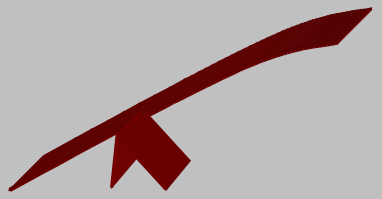


Systems Engineering and Systems Management Overview



Systems Engineering Roles

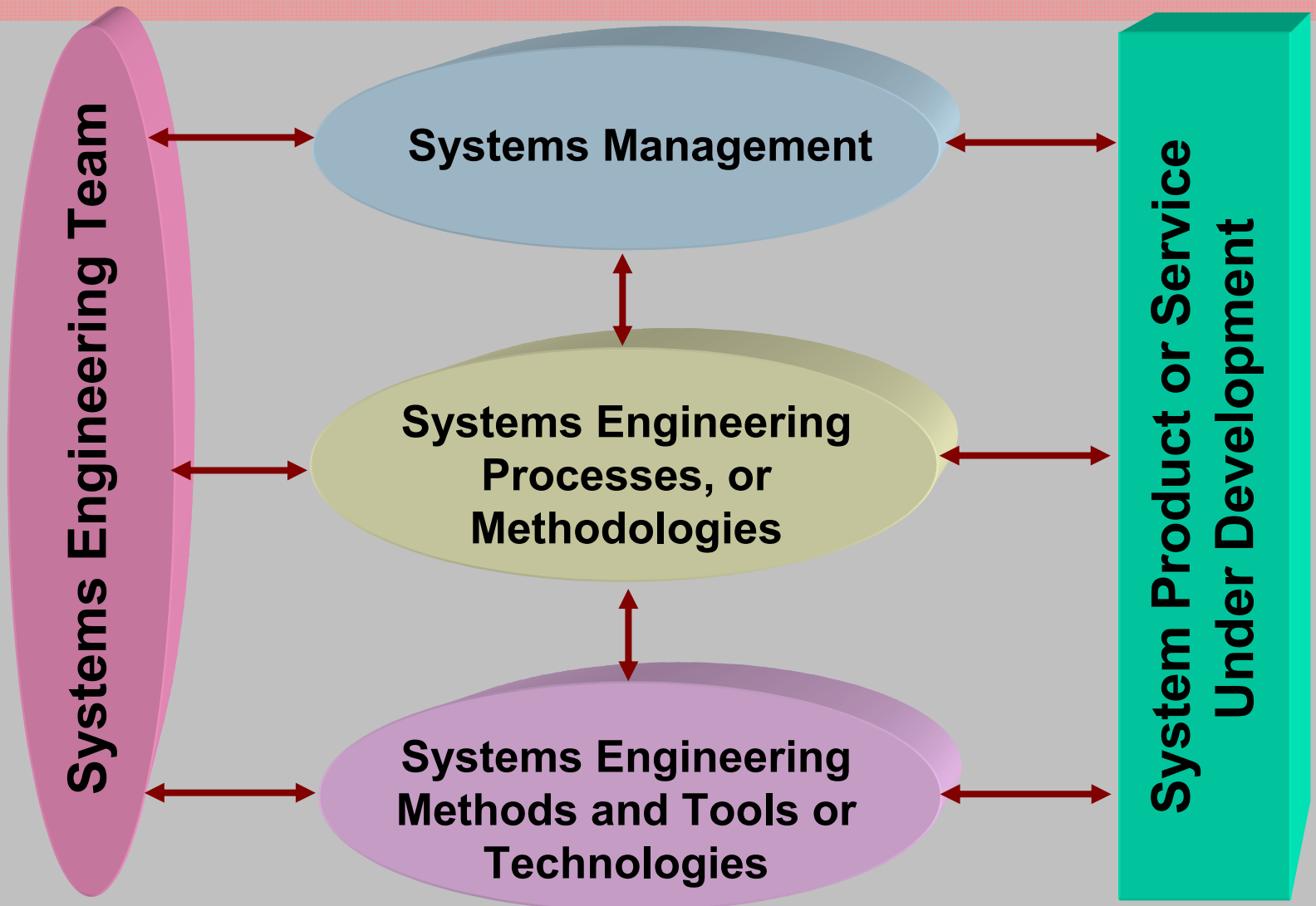
- Common and Not-So-Common names for systems engineering
  - Systems Engineers
  - Systems Architects
  - Systems Integrators
  - Systems Management Engineers
  - Systems Quality Assurance Engineers
  - Systems Theorists
  - Systems Reengineers
  - Operations Research
  - Management Science

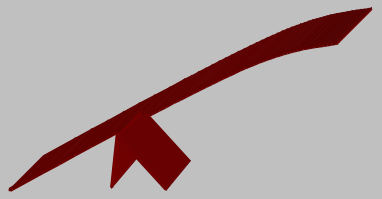
} Closely Related Professions

Engineering of Systems

- Systems Engineering is concerned with the engineering of systems
- Systems Management is concerned with strategic level Systems Engineering
- Systems Engineering efforts involve:
  - Systems engineering methods and tools or technologies
  - Systems process
  - Systems management

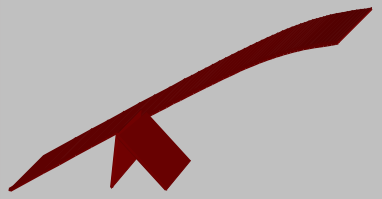
Three Levels of Systems Engineering





Management Technology

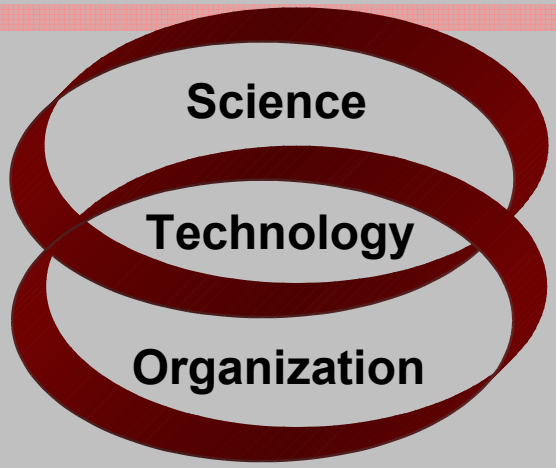
- Systems Engineering is a Management Technology
- Technology is the organization, application, and delivery of a scientific and other forms of knowledge for the betterment of a client group
- Technology can be viewed as a fundamentally human activity

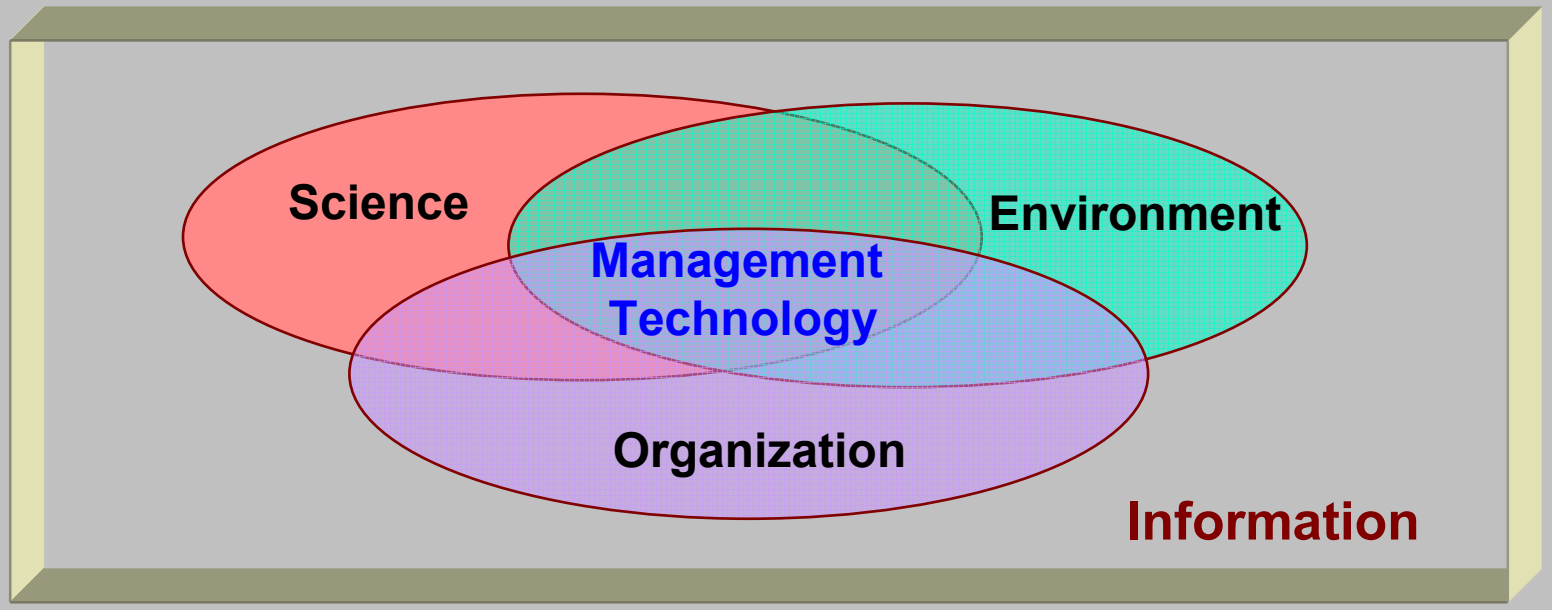


Management Technology - 2

- Management involves the interaction of the organization with the environment
- The purpose of management is to enable organizations to better cope with their environments in order to achieve purposeful goals and objectives
- Management Technology involves the interaction of:
  - Technology
  - Organizations that are collections of people concerned with the evolvement and use of technologies
  - Environment

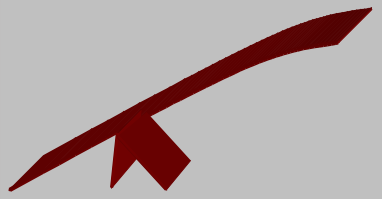
Management Technology - 3





Management Technology - 4

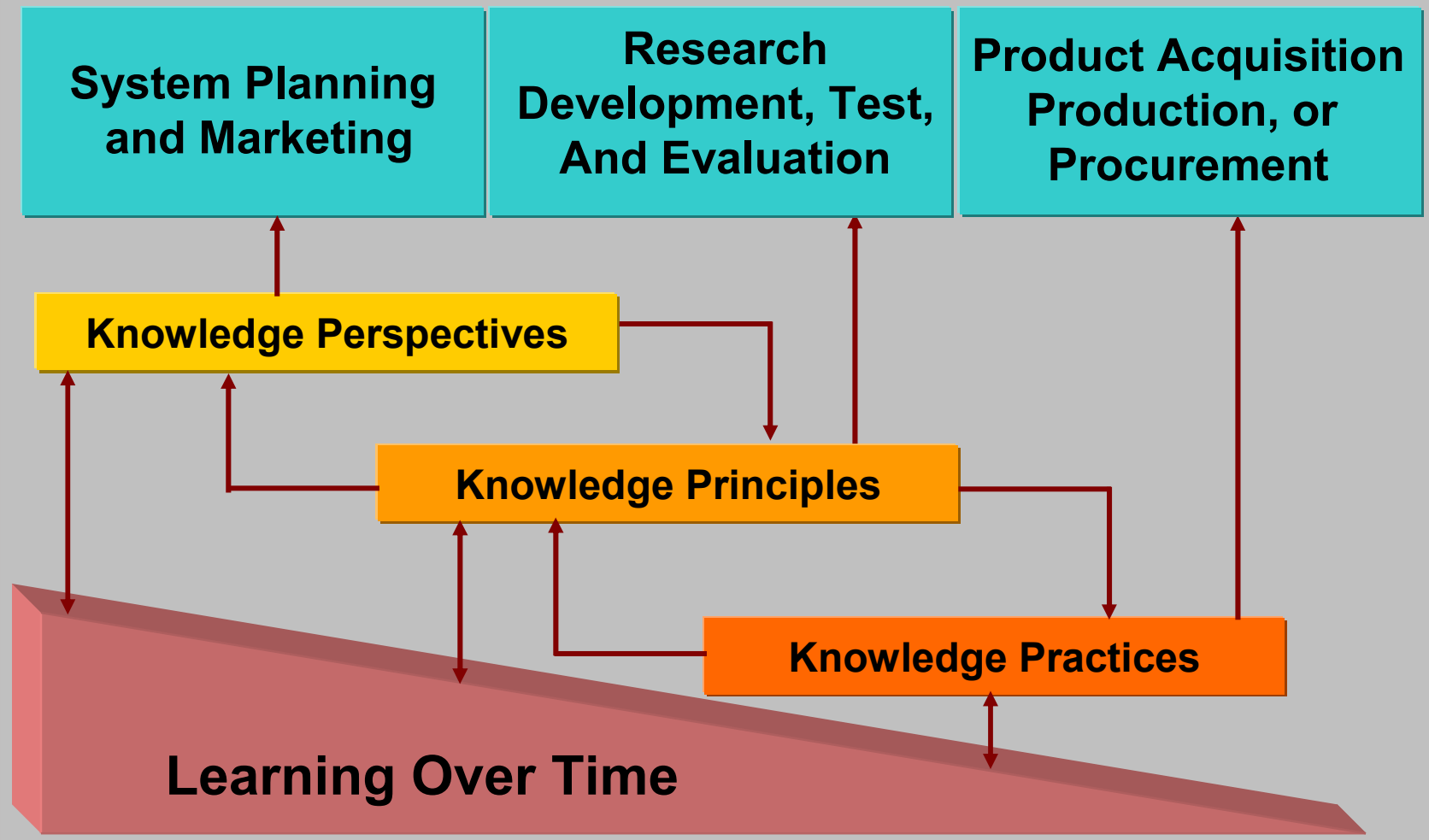
- Systems Engineering is the management technology that controls a total system life-cycle process, which evolves and which results in the **definition**, **development**, and **deployment** of a system that is of high quality, and is cost-effective in meeting the user's needs



Systems Engineering Knowledge Types

- Knowledge Principles
  - Generally represent formal problem-solving approaches to knowledge
  - Generally employed in new situations and/or unstructured environments
- Knowledge Practices
  - Represent the accumulated wisdom and experiences that have led to the development of standard operating policies for well-structured problems
- Knowledge Perspectives
  - Represent the view that is held relative to future directions and realities in the technological area under consideration

Systems Engineering Knowledge Types - 2



Knowledge

Information is defined as data that are of value for decision making

Information is associated with Context and Environment

Knowledge

Managing the environment and the three types of knowledge is referred to as **Knowledge Management**

Formulation, Analysis, and Interpretation

- Systems Engineering is management technology to assist and support policymaking, planning, decision making, and associated resource allocation or action deployment
- Systems Engineers utilize quantitative and qualitative formulation, analysis, and interpretation of
  - The impacts of action alternatives upon the needs perspectives
  - The institutionalization perspectives
  - The value perspectives of the clients or customers

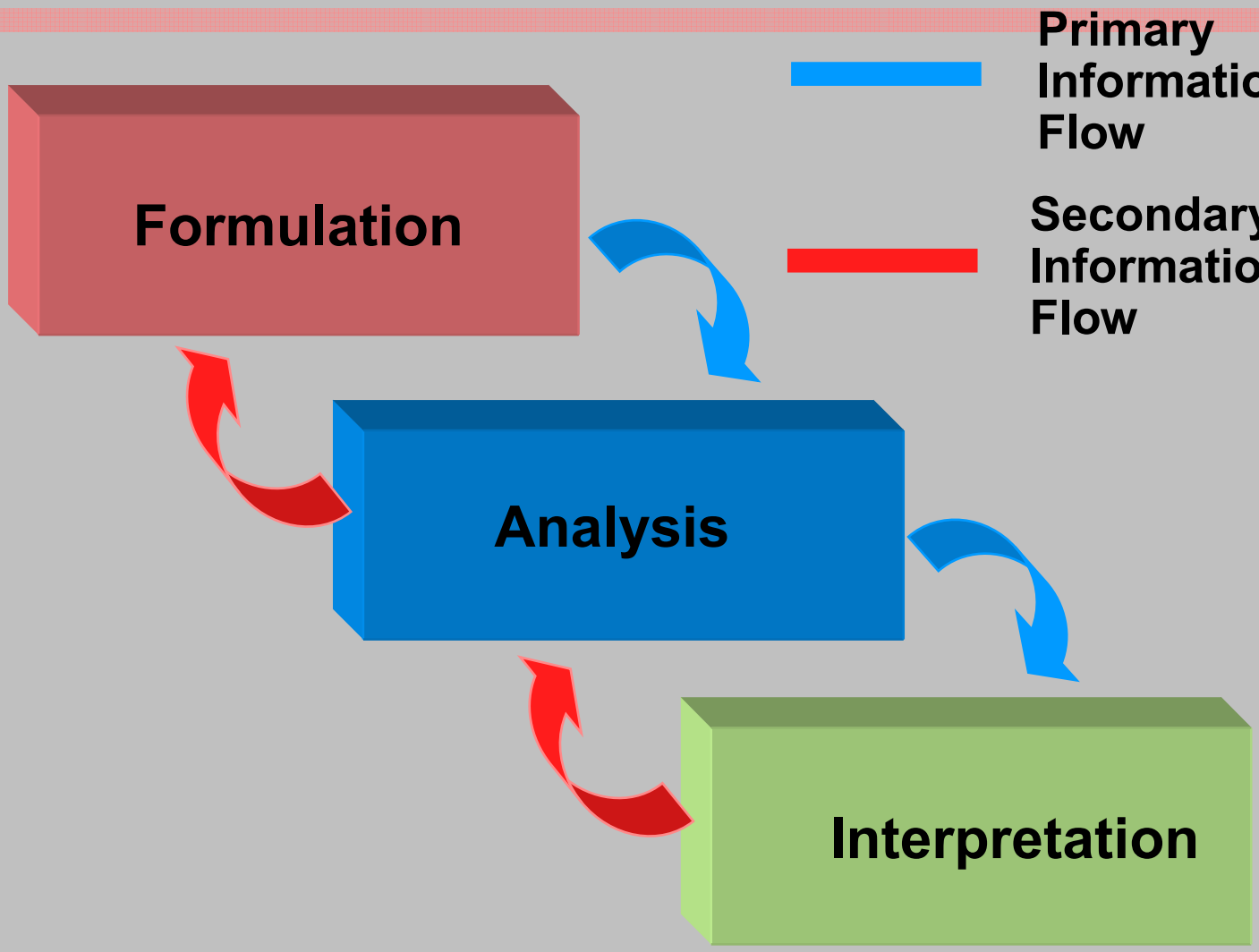
Formulation, Analysis, and Interpretation - 2

- Issue Formulation – Identifies the needs to be fulfilled and the requirements associated with these in terms of:
  - Objectives to be satisfied
  - Constraints and alterables that affect issue resolution
  - Generation of potential alternate courses of action
- Issue Analysis – Enables us to determine the impacts of the identified alternative courses of action, including possible refinement of the alternatives

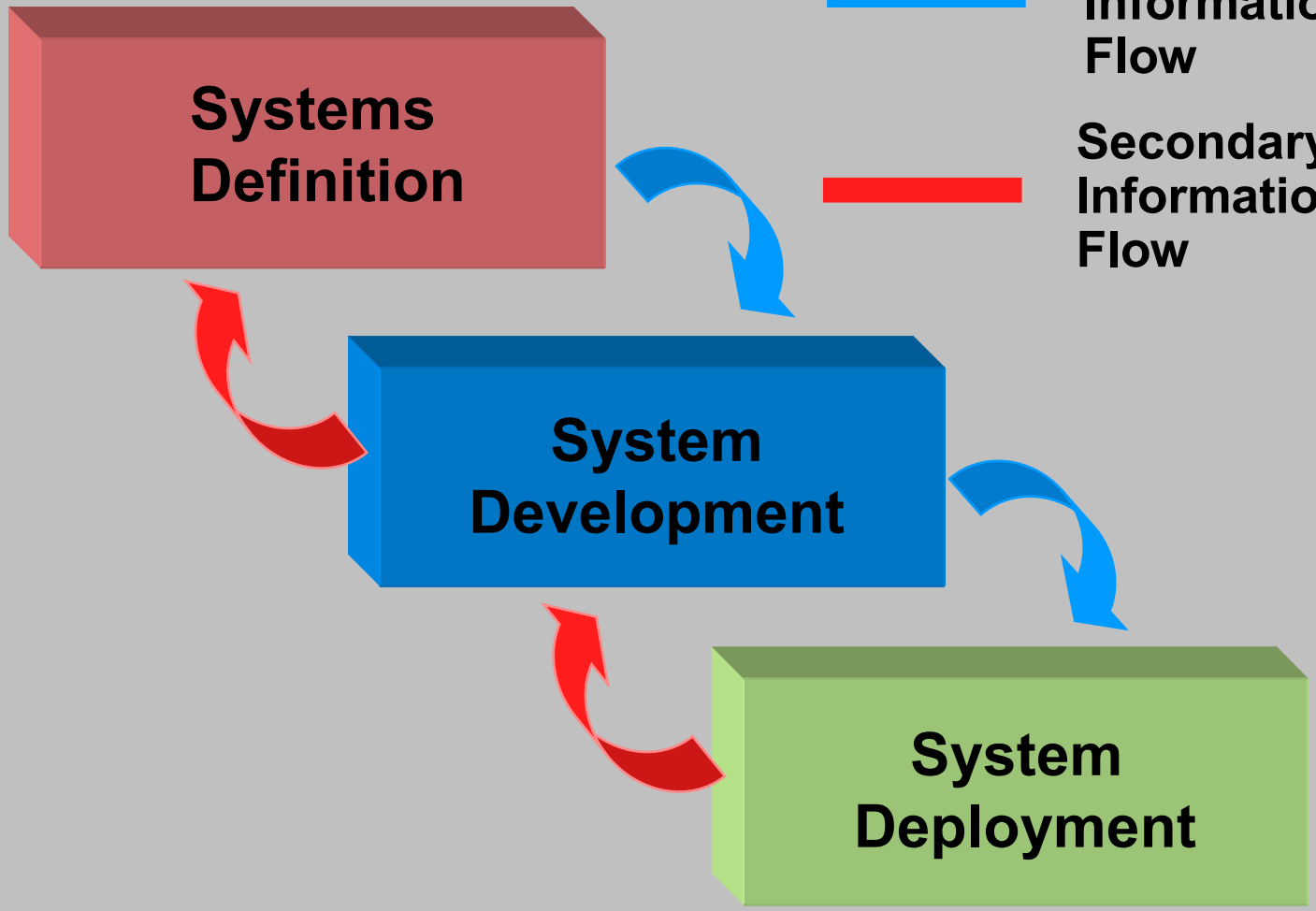
Formulation, Analysis, and Interpretation - 3

- Issue Interpretation – Enables us to rank the alternatives in terms of need satisfaction and to select one for implementation or additional study
- Systems Engineering can be thought of as consisting of formulation, analysis, and interpretation efforts, together with the system management and technical direction efforts necessary to bring this about

Primary Systems Engineering Steps

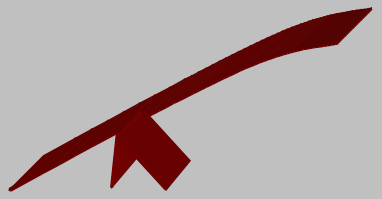


Primary Systems Engineering Life-Cycle Phases



Systems Management

- Systems Management can be viewed from an inactive, reactive, interactive, or proactive perspective
  - Inactive – Organization does not worry about issues and does not make efforts to resolve them
  - Reactive – Organization will examine a potential issue only after it has developed into a real problem
    - an outcomes assessment will be performed
    - symptoms that produced the problem will be eliminated

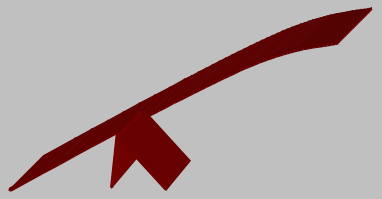


Systems Management - 2

- Interactive – Organization will attempt to examine issues while they are in the process of evolution in order to detect problems at the earliest possible time
  - efforts at diagnosis and correction will be implemented as soon as possible
  - recycling, feedback, and retrofit to and through that portion of the life-cycle process in which the problem occurred will take place
- Proactive – Organization predicts the potential for progress hindering issues and synthesizes an appropriate life-cycle process that is sufficiently mature

Systems Management - 3

- Systems Engineering often fails at the level of systems management:
  - Purpose, function, and structure of a new system are not identified sufficiently before the system is defined, developed, and deployed
  - Formulation, analysis, or interpretation efforts are deficient



Systems Management - 4

- Systems Management and integration issues are of major importance in determining the effectiveness, efficiency, and overall functionality of systems design
- To achieve a high measure of functionality, it must be possible for a system (product or service) to be efficiently and effectively:
  - Produced
  - Used
  - Maintained
  - Retrofitted
  - Modified

Systems Management - 5

- Ingredients necessary to engineer large systems, solve large and complex problems, resolve complicated issues, or manage large systems are normally associated with the following needs to deal successfully with:
  - Issues involving many considerations and interrelations including changes over time
  - Issues in which there are far-reaching and controversial value judgments
  - Issues whose solutions require a multi-disciplined approach

Systems Management - 6

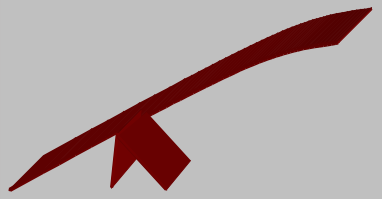
- Issues in which future events are difficult to predict
- Issues in which the environments, external and internal, are difficult to predict
- Issues in which structural and human elements are given full consideration
- The need to implement integrated knowledge management across the diversity of stakeholders
- The need to engineer systems that are sustainable

Systems Management - 7

- Systems Management places considerable emphasis on the accurate definition of a system including identification of what it should do and how people should interact with it before the system is developed and deployed

DoD Definitions of Systems Engineering

- Systems Engineering is the application of scientific and engineering efforts to:
  - Transform an operational need into a description of system performance parameters and a system configuration through an iterative process of definition, synthesis, analysis, design, test, and evaluation
  - Integrate reliability, maintainability, expandability, safety, survivability, human engineering and other factors into the total engineering effort to meet cost, schedule, supportability, and technical performance objectives



DoD Definitions of Systems Engineering - 2

- Systems Engineering is an interdisciplinary approach that:
  - Encompasses the scientific and engineering efforts related to the development, manufacturing, verification, deployment, operations, support, and disposal of systems products and processes
  - Develops needed user training, equipment, procedures, and data
  - Establishes and maintains configuration management of the system
  - Develops work breakdown structures and statements of work and provides information for management decision making

Structure, Function, or Purpose

- Structure – Systems Engineering is Management Technology to assist clients through the formulation, analysis, and interpretation of the impacts of proposed policies, controls, or complete systems upon the need perspectives, institutional perspectives, and value perspectives of stakeholders to issues under consideration

Structure, Function, or Purpose - 2

- Function – Systems Engineering is an appropriate combination of the methods and tools of systems engineering, made possible through use of a suitable methodological process and systems management procedures

Structure, Function, or Purpose - 3

- Purpose – The purpose of systems engineering is to organize and manage information and knowledge
  - To assist clients who desire to develop policies for management, direction, control, and regulation activities relative to forecasting, planning, development, production and operation of total systems
  - To maintain overall quality, integrity, and integration as related to performance, trustworthiness, reliability, availability, and maintainability

Structure, Function, or Purpose - 4