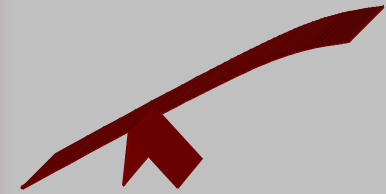


Processes for Engineering a System EIA - 632

Fundamental Processes for Engineering a System



Processes for Engineering A System

Acquisition and Supply

- Supply Process
- Acquisition Process

Technical Management

- Planning Process
- Assessment Process
- Control Process

System Design

- Requirements Definition Process
- Solution Definition Process

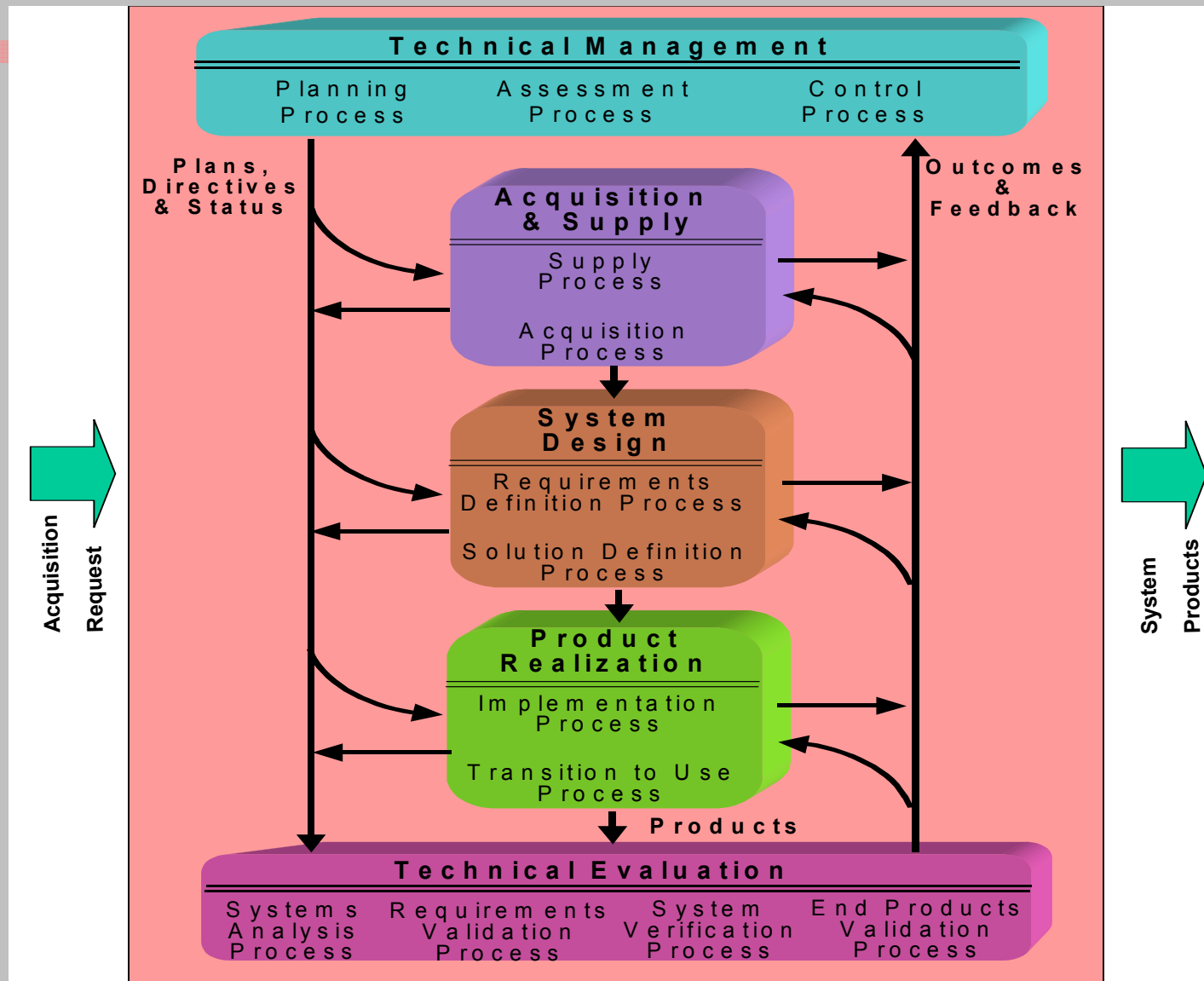
Product Realization

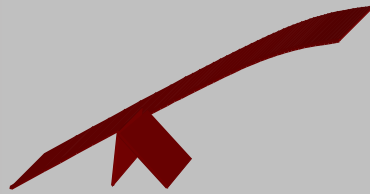
- Implementation Process
- Transition to Use Process

Technical Evaluation

- Systems Analysis Process
- Requirements Validation Process
- System Verification Process
- End Products Validation Process

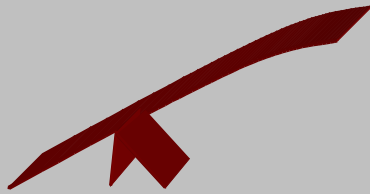
Relationship of Processes for Engineering a System





Relationship of Processes for Engineering a System - 2

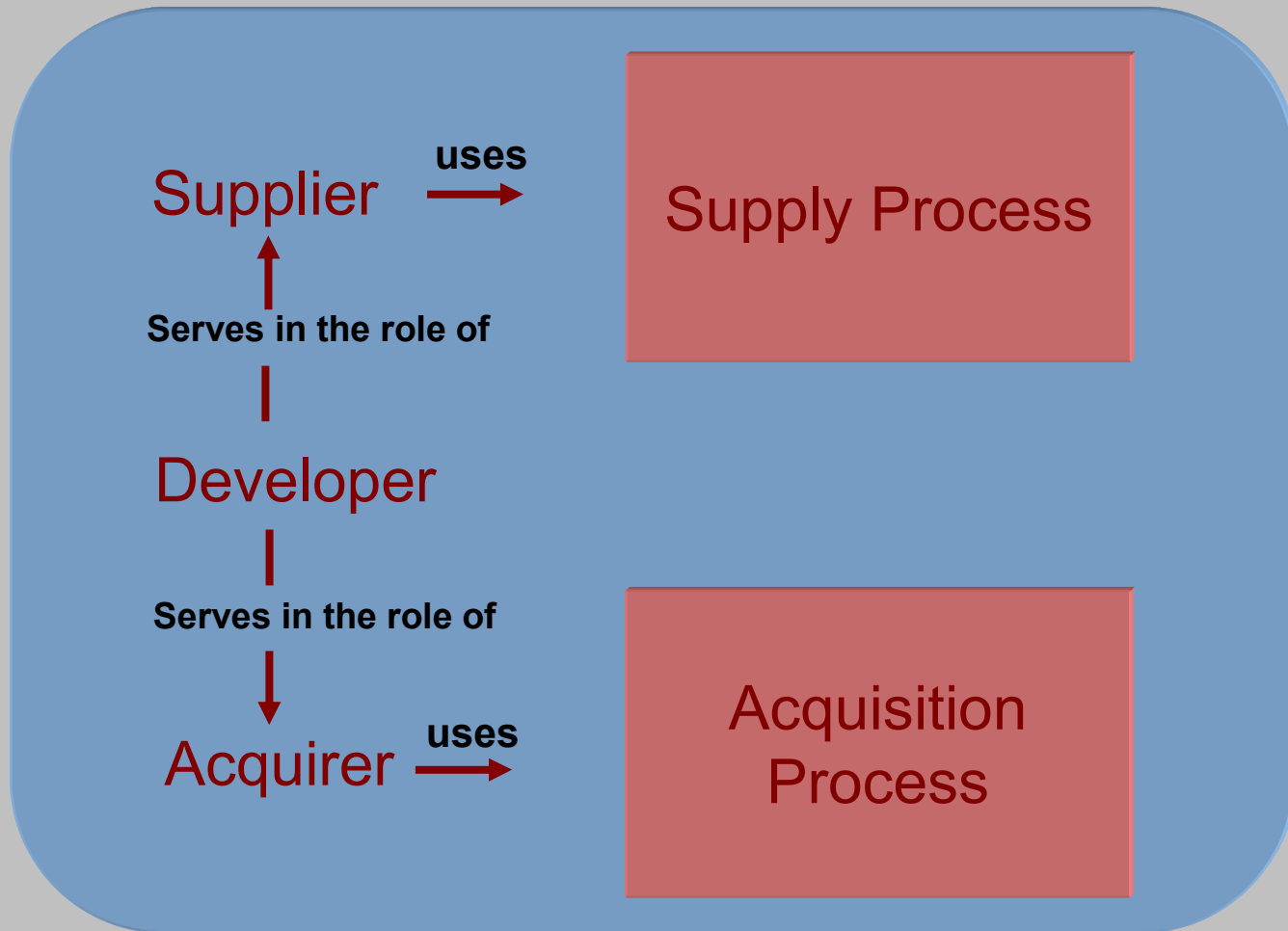
- ◆ The appropriate processes are applied recursively and iteratively to:
 - ◆ Define the system products of the system hierarchy from the top down
 - ◆ Implement and transition the system products from the bottom up to the user or customer
- ◆ The requirements that are assigned to the proposed engineering processes are, in practice, implemented concurrently and are highly iterative



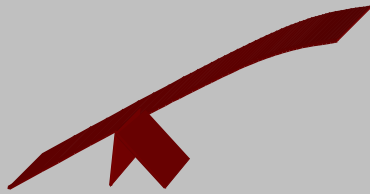
Acquisition and Supply

Acquisition and Supply Process

Acquisition Requirements

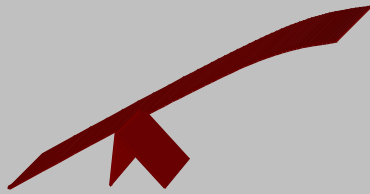


Agreement



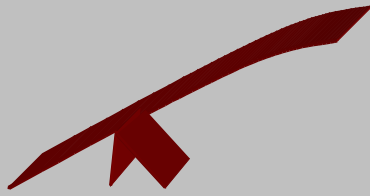
Acquisition and Supply

- ◆ The Acquisition and Supply Processes are used by a developer to arrive at an agreement with another party to accomplish specific work and to deliver required products
- ◆ The parties can be inside the developer's own enterprise (another project, functional organization, or project team) or can be in a different enterprise



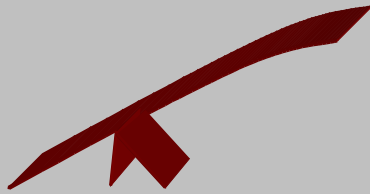
Acquisition and Supply - 2

- ◆ The agreement within an enterprise can take the form of a work directive, work package, work authorization, or project memorandum of agreement
- ◆ Agreements between enterprises can take the form of:
 - ◇ A formal contract for the delivery of a product
 - ◇ A memorandum of agreement that establishes the working relationship between two or more enterprises on a common project



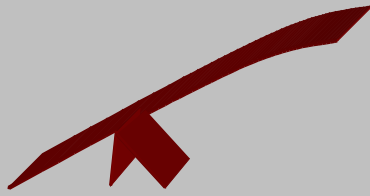
Acquisition and Supply - 3

- ◆ The agreement should include information such as:
 - ◆ Work to be performed
 - ◆ Concept of operations
 - ◆ Requirements to be satisfied
 - ◆ Product and data to be delivered
 - ◆ Information regarding cost, schedule, planning, delivery information, product structure, packaging and handling instructions, or installation instructions
 - ◆ Appropriate technical plans

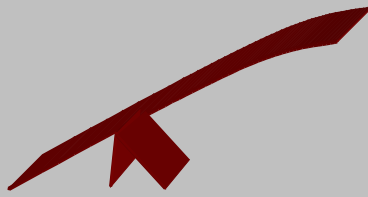


Acquisition and Supply - 4

- ◇ Applicable financial structure, management, and authority provisions
- ◇ Exit criteria for relevant life-cycle phases
- ◇ Identification of applicable engineering life-cycle phases
- ◇ Required technical reviews

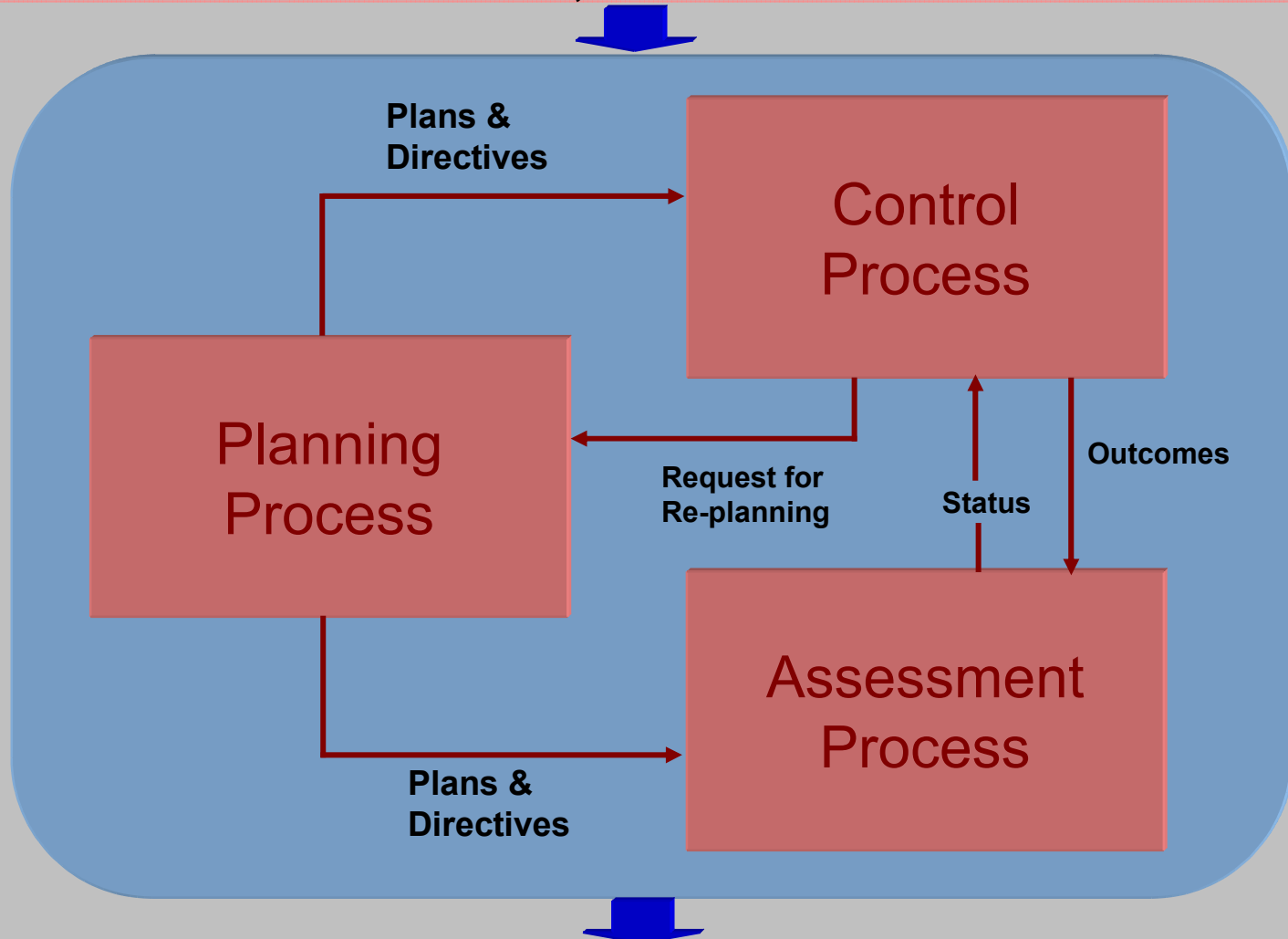


Technical Management

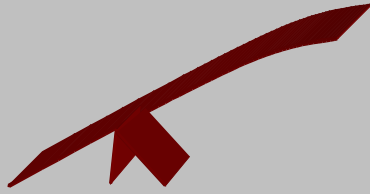


Technical Management Process

Acquisition, Documents, Agreement,
Outcomes, and Feedback



Plans, Directives, Status



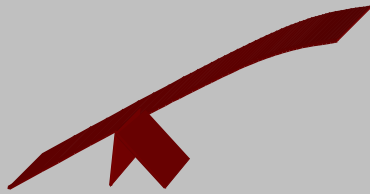
Technical Management

- ◆ The Technical Management Processes are to be used to plan, assess, and control the technical work efforts required to satisfy the established agreement.



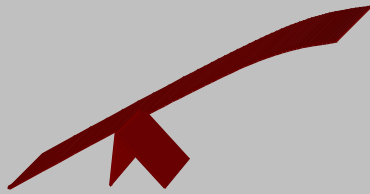
Planning Process

- ◆ This process is used to support enterprise and project decision making and to prepare all necessary plans that support and complement project plans to:
 - ◆ Arrive at a decision to supply services according to an external solicitation
 - ◆ Determine whether to proceed with an internal enterprise for a new product or a product improvement
 - ◆ Guide the work efforts that will meet the requirements of an established agreement



Planning Process - 2

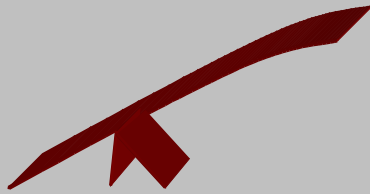
- ◇ Replan applicable processes for engineering a system. Replanning is normally initiated:



Planning Process - 3

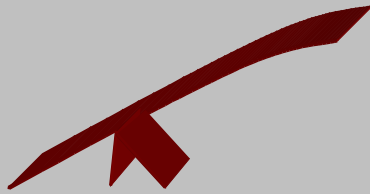
◆ Technical Plans

- ◆ The developer shall create technical plans to ensure an integrated and cost effective technical effort in accordance with the defined schedule and organization. The subordinate plans include:
 - ◆ Risk Management Plan
 - ◆ Technical Review Plan
 - ◆ Verification Plans
 - ◆ Validation Plans
 - ◆ Quality Plan
 - ◆ Configuration Management Plan
 - ◆ Measurement Plan



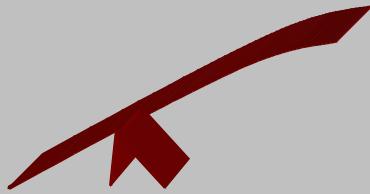
Assessment Process

- ◆ The Assessment Process is used to:
 - ◇ Determine progress of the technical effort against both plans and requirements
 - ◇ Review progress during technical reviews
 - ◇ Support control of the engineering of a system
- ◆ The product and process metrics selected for assessing progress should provide information for:
 - ◇ Risk aversion
 - ◇ Meaningful financial and non-financial performance
 - ◇ Support of project management



Control Process

- ◆ The Control Process is used to:
 - ◆ Manage the conduct and outcomes of the Acquisition and Supply Processes, System Design Processes, Planning and Assessment Processes, Product Realization Processes, and Technical Evaluation Processes
 - ◆ Monitor variations from the plan and anomalies relative to the requirements
 - ◆ Distribute required and requested information
 - ◆ Ensure necessary communications

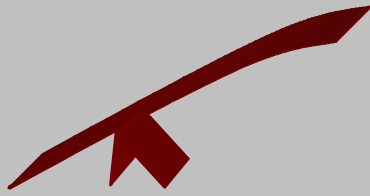


Control Process - 2

◆ Outcomes Management

◆ The developer shall manage the outcomes of technical effort through mechanisms like:

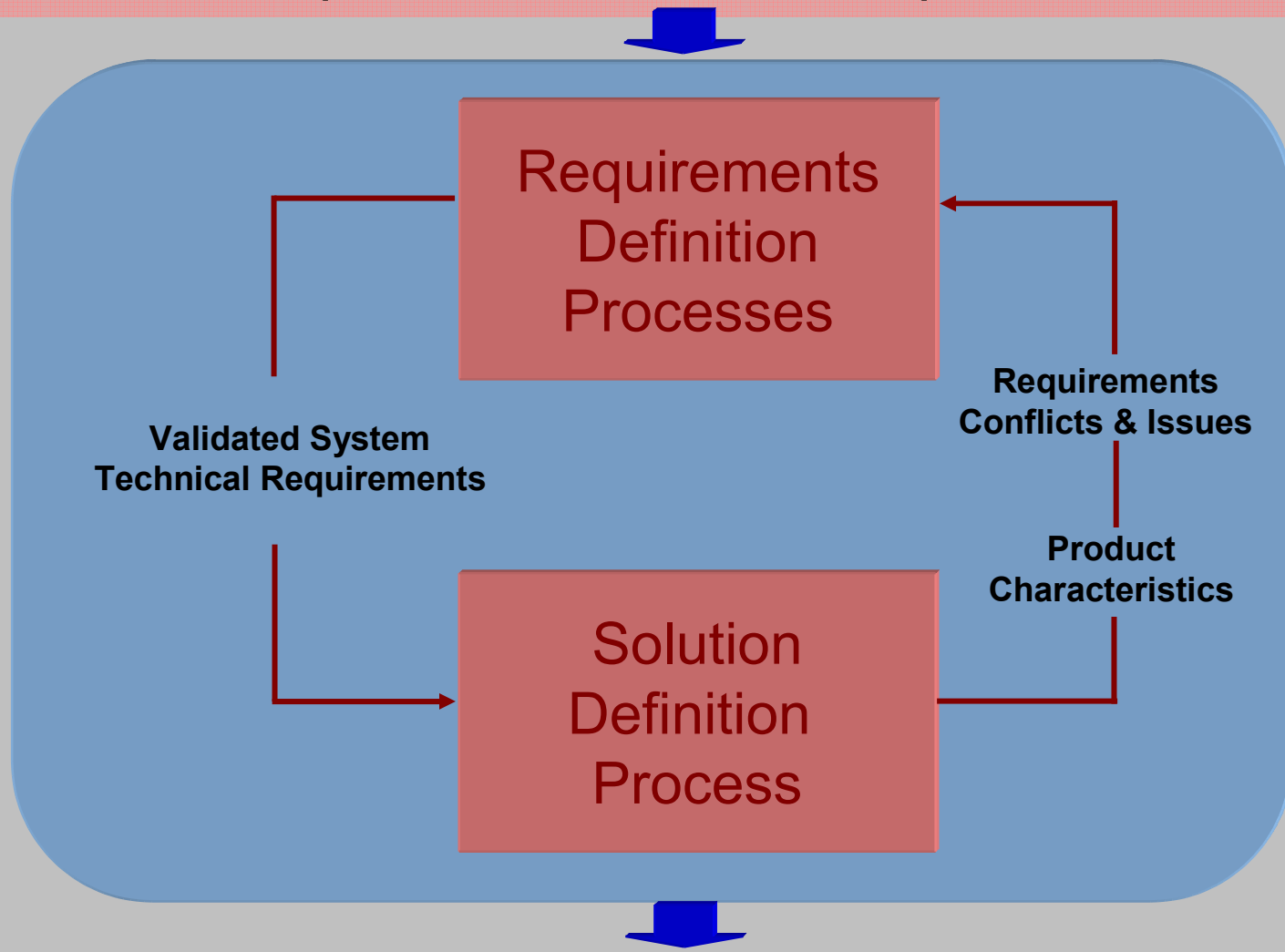
- ◆ Configuration Management
- ◆ Interface Management
- ◆ Risk Management
- ◆ Data Management
- ◆ Managing Information Databases
- ◆ Managing and tracking Stakeholder requirements



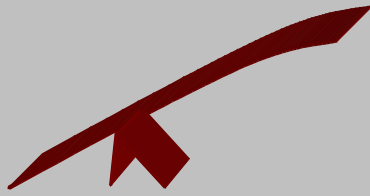
System Design

System Design Process

Acquirer and Other Stakeholder Requirements

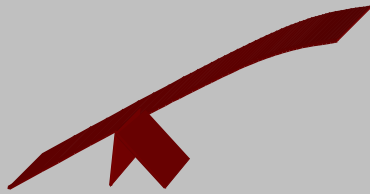


Specifications, Drawings, Models



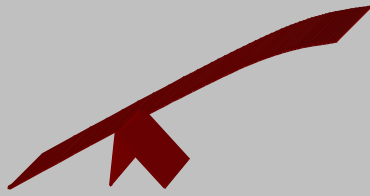
System Design Process - 2

- ◆ The System Design Processes are used to convert agreed-upon requirements of the buyer into a set of realizable products that satisfy buyer and other stakeholder requirements
- ◆ Two processes are linked together
 - ◆ Requirements Definition
 - ◆ Solution Definition



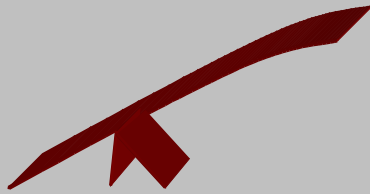
Requirements Definition Process

- ◆ Inputs to the Requirements Definition Process are of three types:
 - ◆ Requirements from the agreement, other documents, and individuals or groups that have a stake in the outcome of the engineering or reengineering of the system
 - ◆ Requirements in the form of outcomes from other processes such as technical plans, and decisions from technical reviews
 - ◆ Requested or approved changes in the requirements



Solution Definition Process

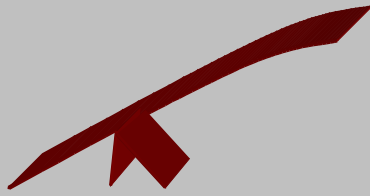
- ◆ The Solution Definition Process is used to generate an acceptable design solution and satisfy:
 - ◆ The system technical requirements resulting from completing the Requirements Definition Process
 - ◆ The derived technical requirements



Solution Definition Process - 2

◆ Logical Solution Representations

- ◆ The developer shall define one or more validated sets of logical solution representations that conform with the technical requirements of the system
- ◆ Tasks to consider include:
 - ◆ select and implement one or more appropriate approaches for providing an abstract definition of the solution to the system technical requirements
 - ◆ perform necessary tradeoff analyses
 - ◆ identify and define interfaces
 - ◆ assign performance requirements and constraints to elements of the logical solution representation (subfunctions, objects, data structures)



Product Realization

Product Realization Process

Specified Requirements
Supplier or Buyer-Provided Products



Implementation
Process

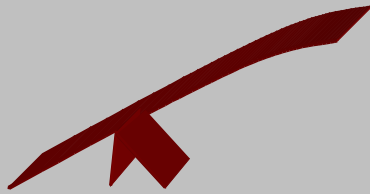
Verified Integrated Products



Transition
To Use
Process

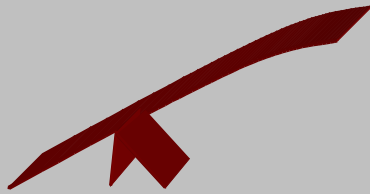


Agreement Satisfaction
Other Stakeholder Satisfaction



Product Realization Process - 2

- ◆ The Product Realization Processes are used to:
 - ◆ Convert the specified requirements and other design solution characterizations into either a verified end product or a set of end products in accordance with the agreement and other stakeholder requirements
 - ◆ Deliver these to designated operating, customer or storage sites
 - ◆ Install these at designated operating sites or into designated platforms
 - ◆ Provide interface service support



Implementation Process

- ◆ The Implementation Process deals with transforming the characterized design solution into an integrated end product that conforms to its specified requirements

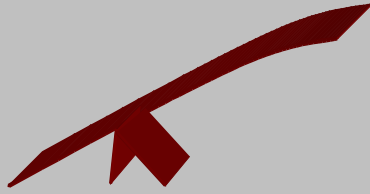


Implementation Process - 2

◆ Implementation

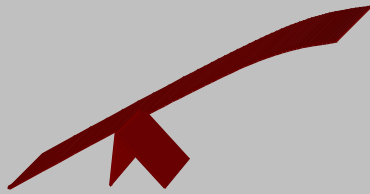
◆ Tasks to consider include:

- ◆ receive the subsystem products that make up the system's end products
- ◆ validate the subsystem products received
- ◆ assemble the validated subsystem or physically integrate the product components
- ◆ verify each test article against its requirements
- ◆ ensure the product will be ready and available to perform the intended functions required by the system's end products
- ◆ validate the verified end products



Transition to Use Process

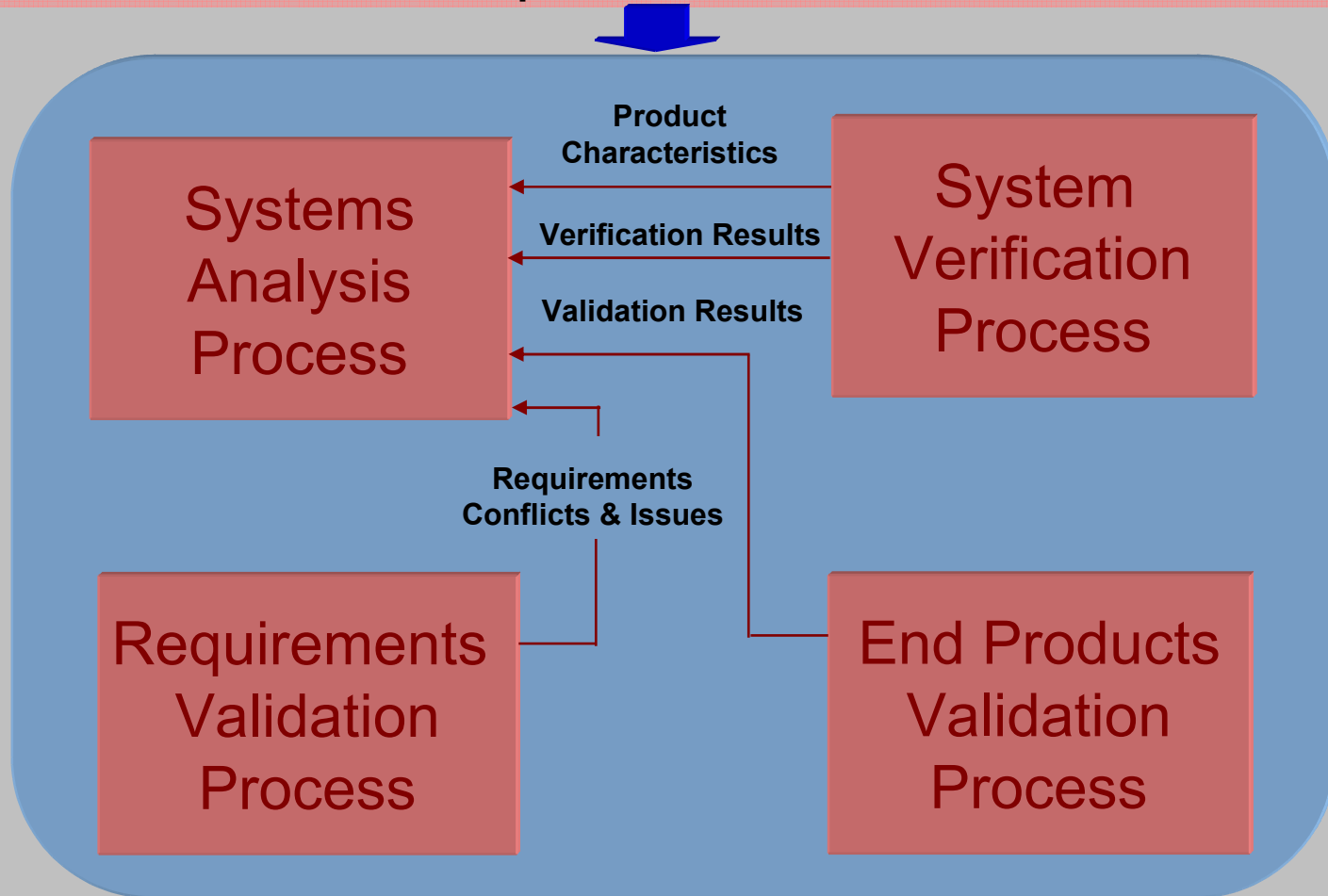
- ◆ The Transition to Use Process results in products delivered to the appropriate destination, in the required condition for use by the buyer, and for the appropriate training of installers, operators, and maintainers



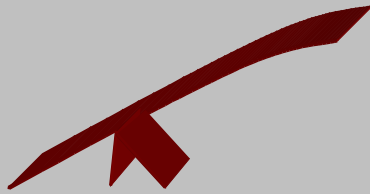
Technical Evaluation

Technical Evaluation Process

Analysis Requests, Requirements,
Implemented Products

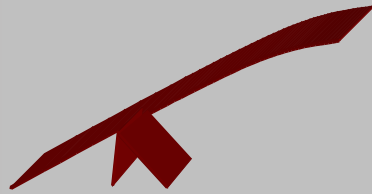


Analytical Models & Assessments, Validated Requirements
Verified System Products, Validated End Products



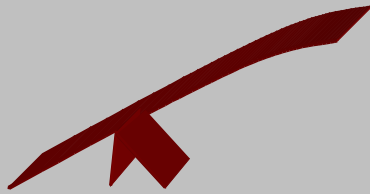
Technical Evaluation

- ◆ The Technical Evaluation Processes are intended to be invoked by one of the other processes for engineering a system
 - ◆ Systems Analysis
 - ◆ Requirements Validation
 - ◆ System Validation
 - ◆ End Products Validation



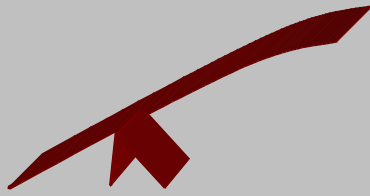
Systems Analysis Process

- ◆ The Systems Analysis Process is used to:
 - ◆ Provide a rigorous basis for technical decision making, resolution of requirements conflicts, and assessment of alternative physical solutions
 - ◆ Determine progress in satisfying technical and derived technical requirements
 - ◆ Support risk management
 - ◆ Ensure that decisions are made only after evaluating the cost, schedule, performance, and risk effects on the engineering or reengineering of the system



Systems Analysis Process - 2

- ◇ Evaluate the effectiveness of each design solution
- ◇ Define, calculate, and report the cost, schedule, performance, and risk effects of each functional, performance, and design alternative
- ◇ Applicable quality factors such as maintainability, reliability, safety and security must not be degraded



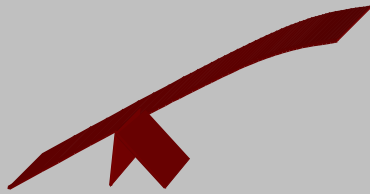
Requirements Validation Process

- ◆ Requirements are validated when it is certain that the set of requirements describes the input requirements and objectives such that the resulting system products can satisfy the requirements and objectives
- ◆ Validation ensure the product or product component will work in the intended use or operational environment



System Verification Process

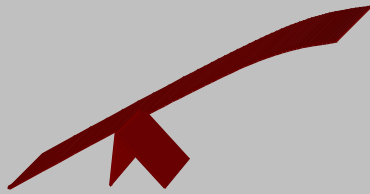
- ◆ The System Verification Process is used to ascertain that:
 - ◆ The system design solution generated by implementing the requirements is consistent with its source requirements
 - ◆ End products at each level of the system structure implementation, from the bottom up, meet their specified requirements
 - ◆ Enabling product development or procurement for each associated process is properly progressing
 - ◆ Required enabling products will be ready and available when needed to perform



System Verification Process - 2

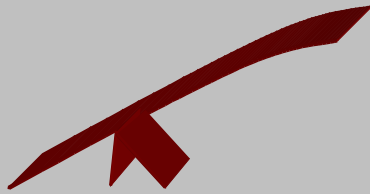
◆ Enabling Product Readiness

- ◆ The developer shall determine readiness of enabling products for development, production test, deployment, installation, training, support / maintenance, and retirement or disposal



End Products Validation Process

- ◆ The End Products Validation Process is used to demonstrate that the products to be delivered, or that have been delivered, satisfy the validated buyer requirements that were input to the system design processes and that are applicable to the resulting end products



Summary

- ◆ A system is one or more end products and sets of enabling products that allow end products, over their lifecycle of use, to meet stakeholder needs and expectations
- ◆ Products are an integrated composite of hierarchical elements so integrated as to meet the defined stakeholder requirements
- ◆ The engineering of a system and its related products is accomplished by applying a set of processes to each element of the system hierarchy by a multi-disciplinary team of people who have the requisite knowledge and skills