

**The Lean Aerospace Initiative  
Working Paper Series  
WP01-01  
October 2001**

**Output from the 1998 Product Development  
Value Stream Workshop:  
A Framework for Understanding Information Flow  
in the Product Development Process**

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The authors acknowledge the financial support for this research made available by the Lean Aerospace Initiative at MIT sponsored jointly by the US Air Force and a consortium of aerospace companies. All facts, statements, opinions, and conclusions expressed herein are solely those of the authors and do not in any way reflect those of the Lean Aerospace Initiative, the US Air Force, the sponsoring companies and organizations (individually or as a group), or MIT. The latter are absolved from any remaining errors or shortcomings for which the authors take full responsibility.

Editors Note:

The descriptions below and the attached diagrams are outputs of the 1998 LAI Product Development Focus Team workshop on the Value Chain in Product Development. A working group at that workshop was asked to model the product development process: in terms of the phases of product development and their interfaces, boundaries and outputs. Their work has proven to be generally useful to LAI researchers and industry members, and so is formalized here.

The words below have been lightly edited to remove some typos and ambiguities, and to reflect current LAI terminology (e.g. value stream rather than value chain). Otherwise, it reflects the original work of workshop team 1:

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## **Output from the 1998 Product Development Value Stream Workshop: Interfaces, Boundaries and Outputs working group**

The attached diagrams provide a system-level representation for the product development value stream. They have been constructed by a multi-disciplined team with representatives from the airframe, aircraft engine, space, commercial space and avionics industries, as well as MIT participants. It is based on the program phases defined in IEEE1220 to allow for comparison to other process definitions. While it was initially thought that it would not be possible to develop a value chain that could be used for both low rate and high rate systems, as well as commercial and government contracted variants, this proved to be an incorrect assumption. The attached flow was developed at a level that can be adapted to any of the mentioned program types.

While the attached flow does divide the product development into what look to be discrete program phases, it is actually more advantageous to look at it in terms of product data phases that may or may not overlap with the associated program phase. Tasks may be performed during various program phases depending on the business or program, but for the purpose of the model, they remain in a common data phase.

The uses for this information are numerous. First, it provides a common language for communication between the various types of programs. Second, it will provide a means to remain focused on the value stream through the interfaces between the program phases as the process is further decomposed. Finally, it will provide a common means for measuring and benchmarking the product development process.

The following is a description of the diagrams that defines some of the methodologies used in mapping the value chain.

The Value Stream begins with the System Definition phase which has input into it a set of customer requirements (cost, schedule, performance), company business position (desired ROI, portfolio management), and the customer's operational risk position. The indicated constraints are then applied as the customer needs are converted into system requirements.

The Preliminary Design phase takes the systems requirements from the System Definition phase and applies program attributes to develop a design-to package. At this point the operational risk is further defined to include the design risk, or risk that the desired system is not feasible given technological constraints. The activities of this phase must be focused on mitigating this design risk.

The Detailed Design phase takes the design-to package generated in the Preliminary Design phase and applies design standards to develop a build-to package. The design risk defined in the Preliminary Design phase is further mitigated during this process by technology investment and multiple design concepts. With the design risk mitigated, the operational risk is further defined to include manufacturing and performance risk, the

risks of being unable to manufacture a product, or that it won't perform as desired. Simulation and analysis are used to mitigate these new risk factors.

The FAIT (Fabrication, Assembly, Integration and Test) phase takes the build-to package generated in the Detailed Design phase and applies prototyping and qualification standards to qualify the design. At this point, the phases begin to become closely coupled. Results of qualification testing are fed back directly into the Detail Design process. This phase also serves as a test bed for the mitigation of the manufacturing and performance risk. A key factor in this risk mitigation is the level and degree to which prototyping is performed, and how these prototypes are used in the actual qualification testing (vs. using production hardware or analytical methods of qualification). The output of this phase is a qualified design.

The Production phase takes the qualified design and applies production standards to generate deliverable hardware. At this point, risk is generally in the form of production yields or rates.

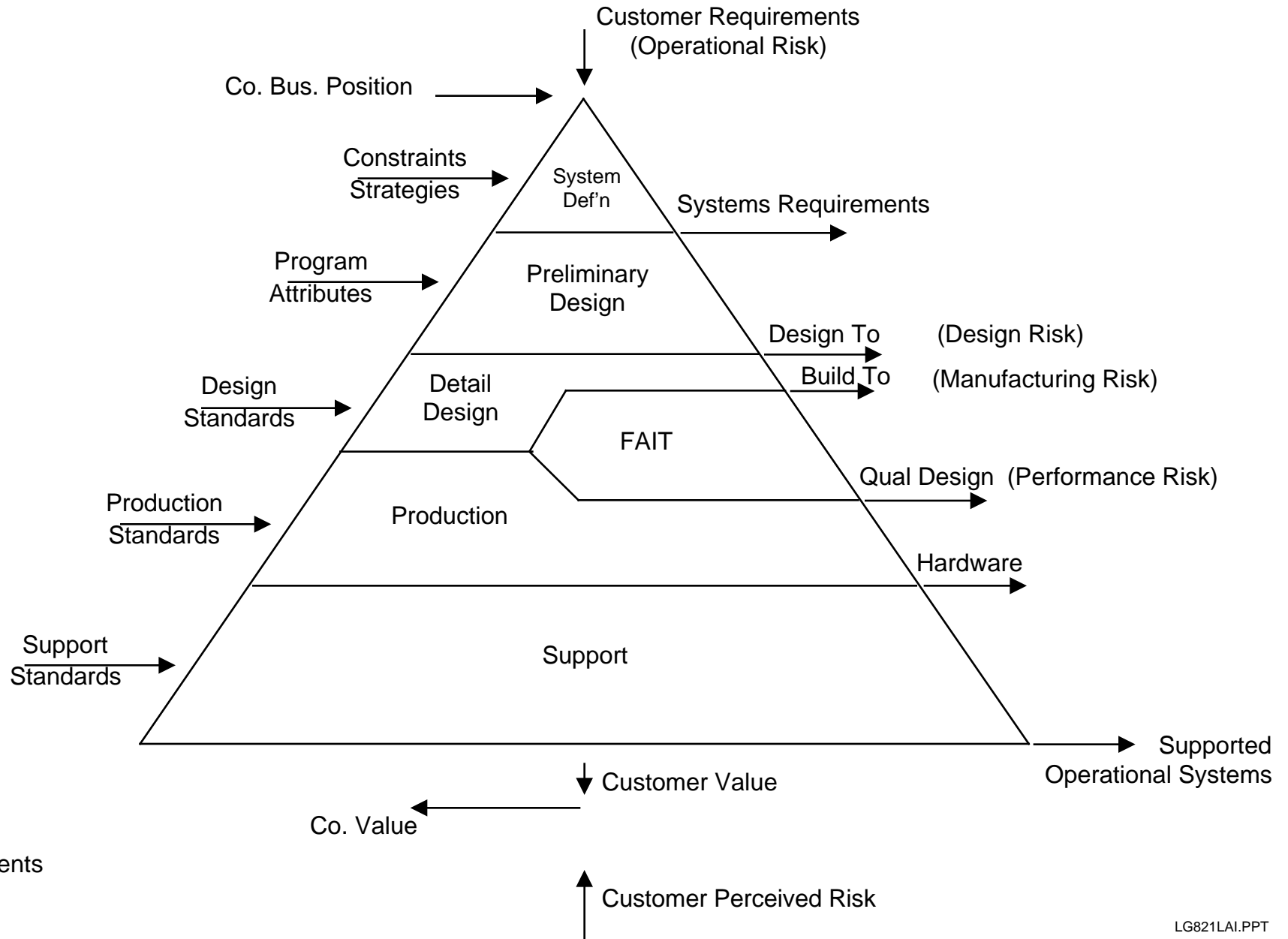
The Support phase takes the deliverable hardware and provides the necessary resources to keep the customer's systems operational.

The direct outputs of the overall process is customer value (needs satisfied within cost and schedule constraints) and company value (desired profit, portfolio enhancement). These diagrams do not directly represent the values of other stakeholders (employees, subcontractors, community, etc.) but can be used to organize thinking about how to provide value to each of these stakeholders at each phase.

While this model is but a starting point for further refinement, already it can be used for several purposes. Using this model, it is possible to look at any phase of a program, and determine what are the key values during a particular phase, and the upstream and downstream considerations that must be addressed as decisions are made. It defines what must be achieved to move from one phase to another. It also defines the risks that are addressed in each phase. Most importantly, it provides a graphical representation of the key elements of any program that can be used to ensure that activities are focused on maximizing stakeholder value.

# LAI VALUE CHAIN IN PRODUCT DEVELOPMENT

## *Product Development Process*



# LAI VALUE CHAIN IN PRODUCT DEVELOPMENT

## Product Development Process Inputs/Outputs

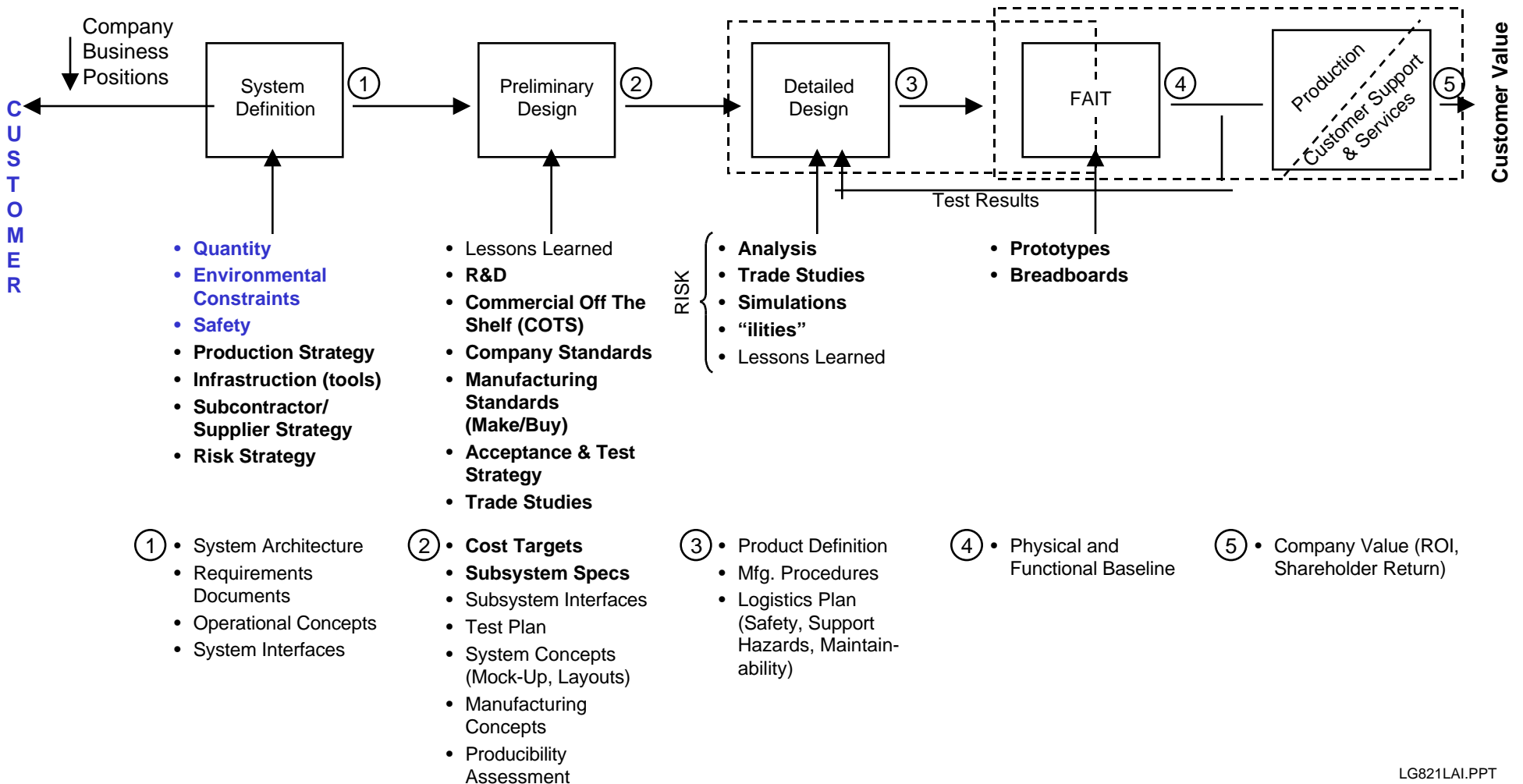
### Inputs

(Overall Process)

External Customer Requirements

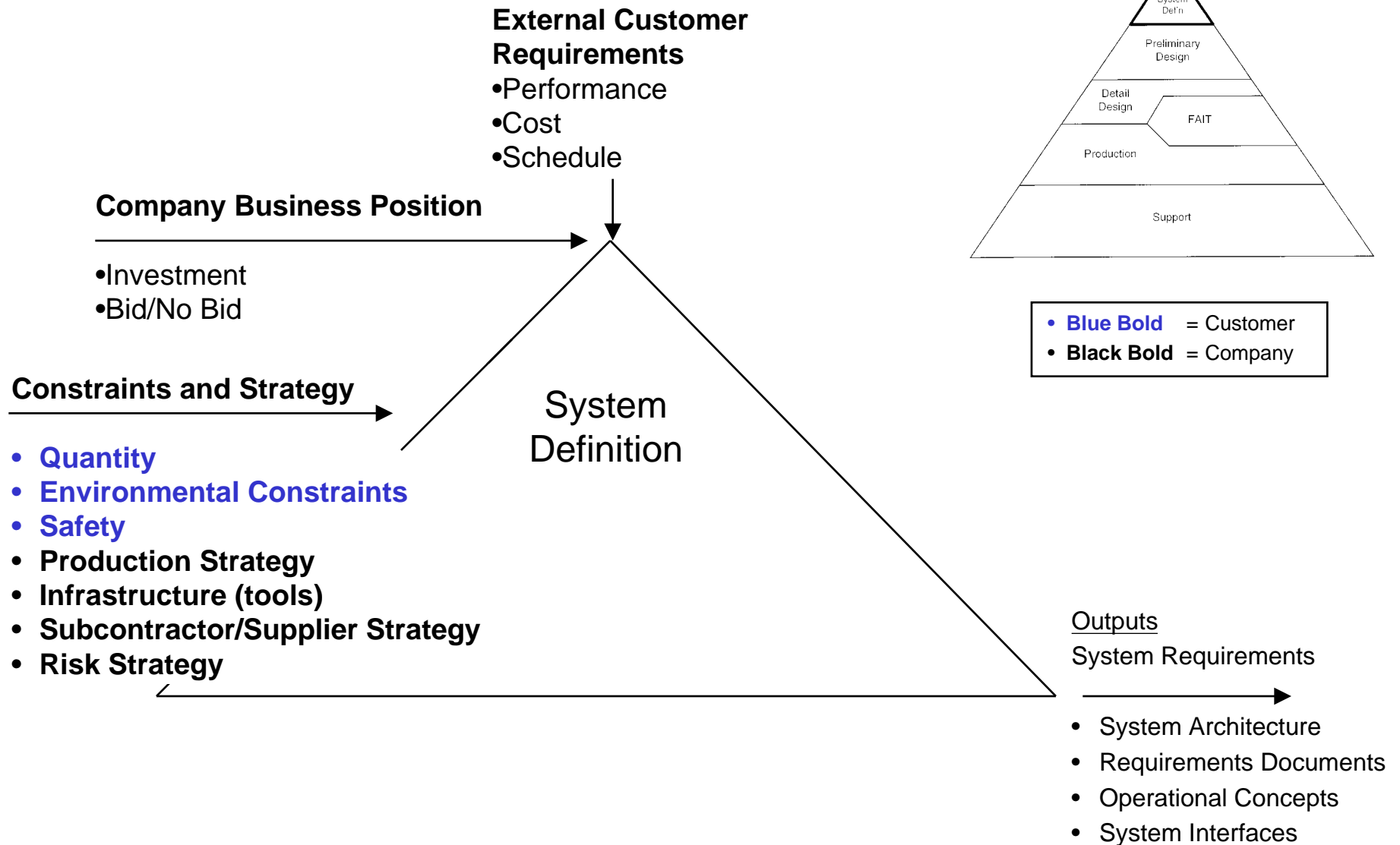
Performance } Risk  
 Cost }  
 Schedule }

• **Blue Bold** = Customer  
 • **Black Bold** = Company



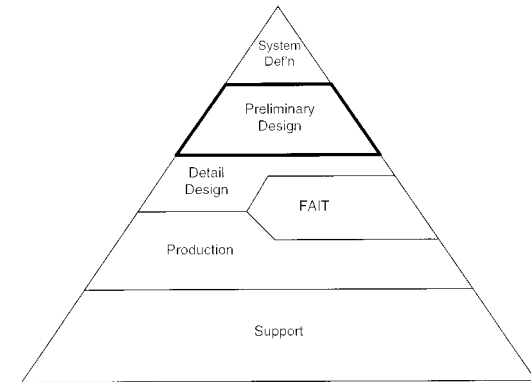
# LAI VALUE CHAIN IN PRODUCT DEVELOPMENT

## Product Development Process Inputs/Outputs



# LAI VALUE CHAIN IN PRODUCT DEVELOPMENT

- Lessons Learned
- **Research and Development**
- **Commercial Off The Shelf (COTS)**
- **Company Standards**
- **Manufacturing Standards (Make/Buy)**
- **Acceptance and Test Strategy**
- **Trade Studies**



## Inputs

System Requirements



Preliminary Design

## Outputs

Design-to Package

- System Requirements Document
- **Cost Targets**
- **Subsystem Specs**
- System Interfaces
- Test Plans
- System Concepts (Mock-Up Layouts)
- Manufacturing Concepts
- Producibility Assessment

- **Blue Bold** = Customer
- **Black Bold** = Company



# LAI VALUE CHAIN IN PRODUCT DEVELOPMENT

- **Blue Bold** = Customer
- **Black Bold** = Company

- **Analysis**
- **Trade Studies**
- **Simulations**
- **“ilities”**
- **Lessons Learned**

Inputs

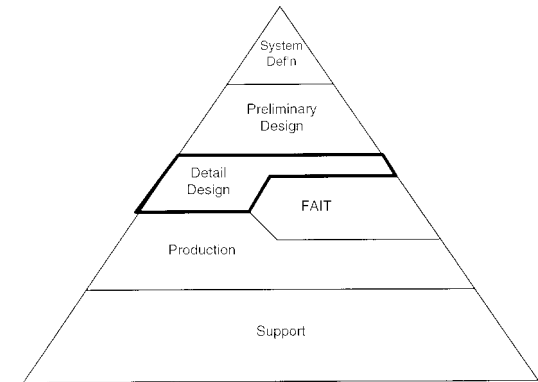
Design-to Package



Outputs

Build-to package

- Product Definition
- Manufacturing Procedures
- Logistics Plan (Safety, Support, Hazards, Maintainability)

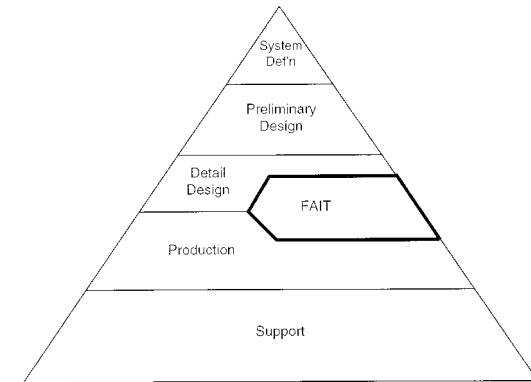
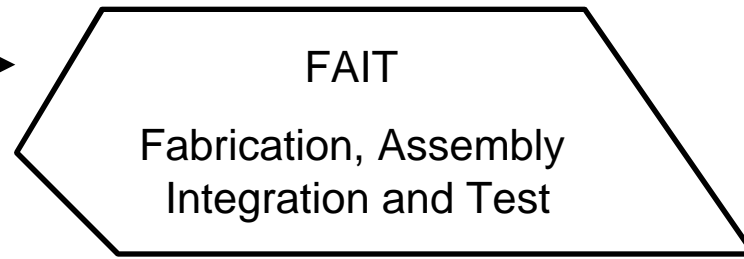


# LAI VALUE CHAIN IN PRODUCT DEVELOPMENT

- **Blue Bold** = Customer
- **Black Bold** = Company

Inputs

Build-to package



Outputs

Qualified Product

- Physical and Functional Baseline