Adapting the Vee Model to Accomplish Systems Engineering on Change Projects

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Abstract

- Most systems engineering standards and textbooks describe how to create a new system from a "blank slate," that is, from scratch. System modifications are not normally treated in depth, if at all. In industry, modifications can often be the major focus of the development effort. So the question is: how does one apply systems engineering principles in the change process. There are two ways to answer this question, one through the traditional Vee model and the other through a phased development model. The traditional Vee model shows how requirements are developed through the tiers of the system architecture, say, for an aircraft, on the left side of the Vee. The process always starts at the upper left side of the Vee. The right side depicts the verification of the system elements in the reverse order, that is, from bottom (components) to the top (total system). In the change process it is necessary to begin in the middle, at the architectural tier where the change is actually taking place. The process then goes up the left hand side so that the change requirements can be bounced off the original total system requirements. So either the change requirements or the system requirements have to be altered to resolve any conflicts. The process can then proceed down the left side as usual. The phased development model is then used to track the changes through the development cycle of the change, in the same way that a new system would be developed. So, in the end, the net result of combined approach using the modified Vee and phased models achieves the desired result of, first, achieving the objectives of the change, and secondly, assuring that the top-level requirements of the entire aircraft are maintained.

Topics

- Background
- The Change Projects Environment
- Implementing Systems Engineering on Change Projects
- The Evolution Development Model
- Adapting the Evolution Development Model
- The " Vee" Model
- Adapting the "Vee" Model
- The Phased Development Model
- Adapting the Phased Development Model
- Combine Approach
- Conclusion

Background

- Most textbooks show how to apply Systems Engineering to a project from the beginning
- A large percentage of projects are changes to the current system (improvement/modification of existing systems)
- There are few resources for performing Systems Engineering on change projects

The Change Projects Environment

- Multiple and concurrent change projects
- Vertical Integration (SE Principles) Required
  - The change projects must integrate with the existing system
    - Must achieve the change needs (reduce cost, add new capability, etc..) while still meet system level requirements (weight, reliability, etc..)
- Horizontal Integration Required
  - The change projects might impact each other
    - Beneficially
    - Adversely

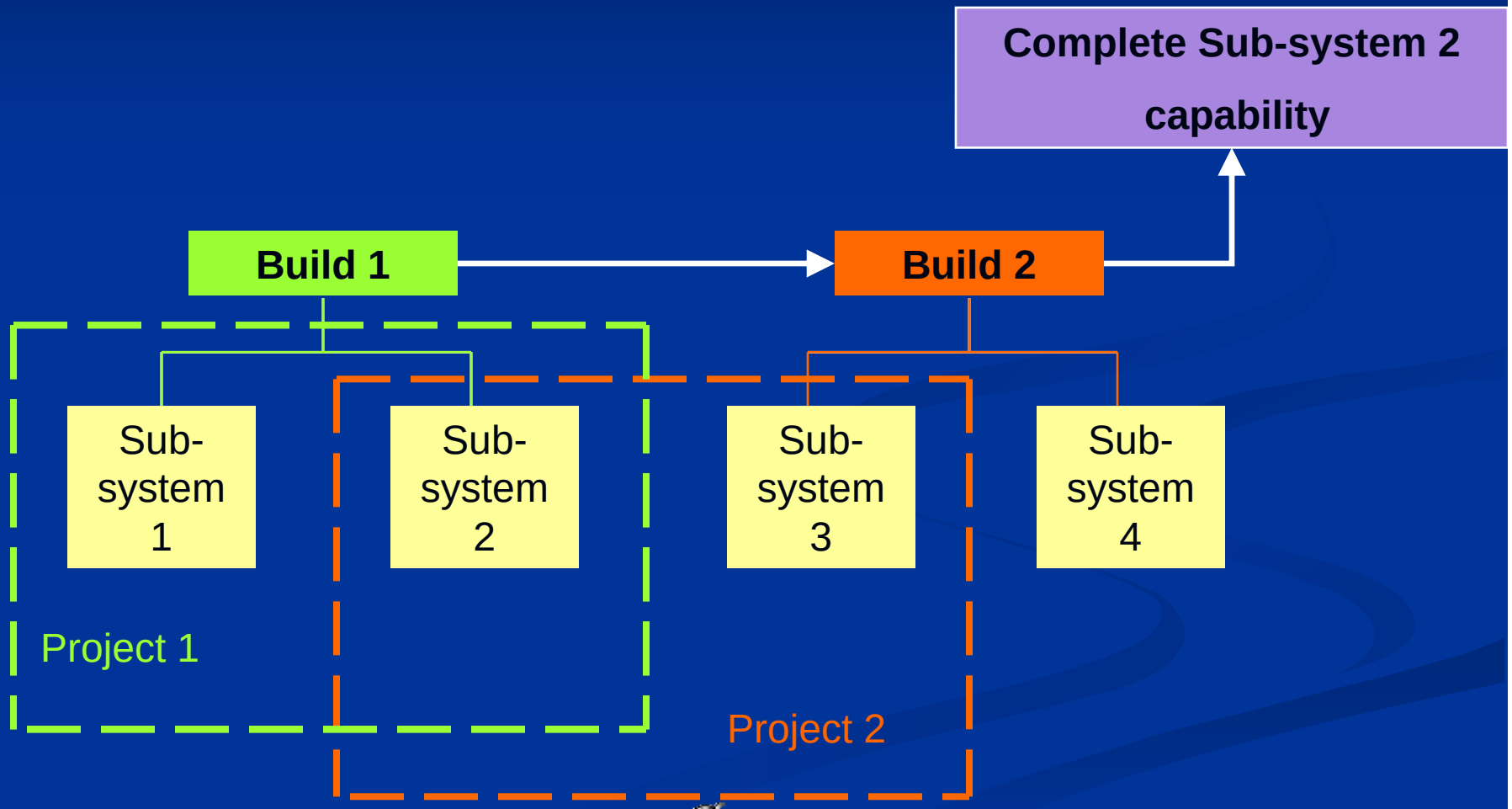
Implementing Systems Engineering on Change Projects

- Adapting the Evolution Development Model
- Adapting the "Vee" Model
- Adapting the Phases Development Model

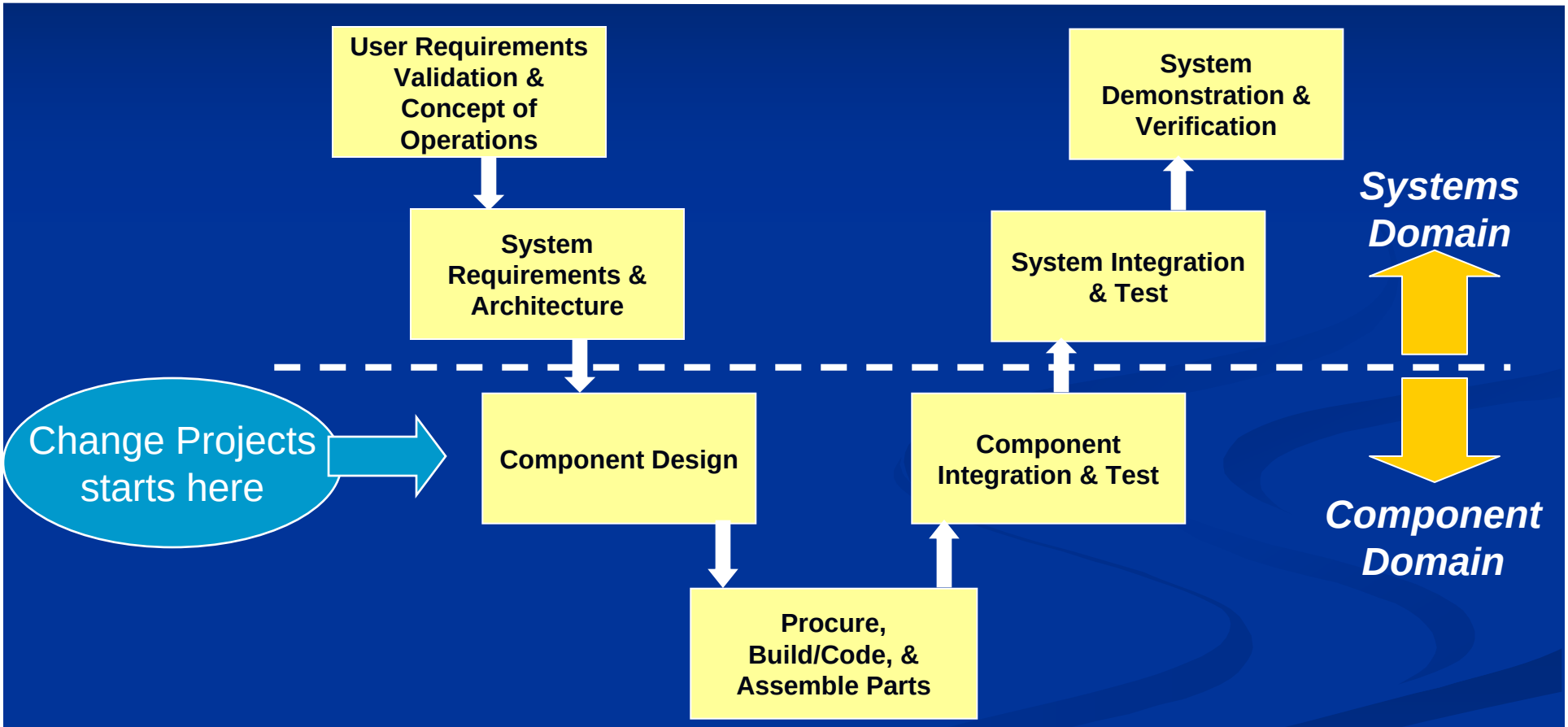
The Evolution Development Model

- Iterative Builds
- Each Build meets a subset of the total system requirements

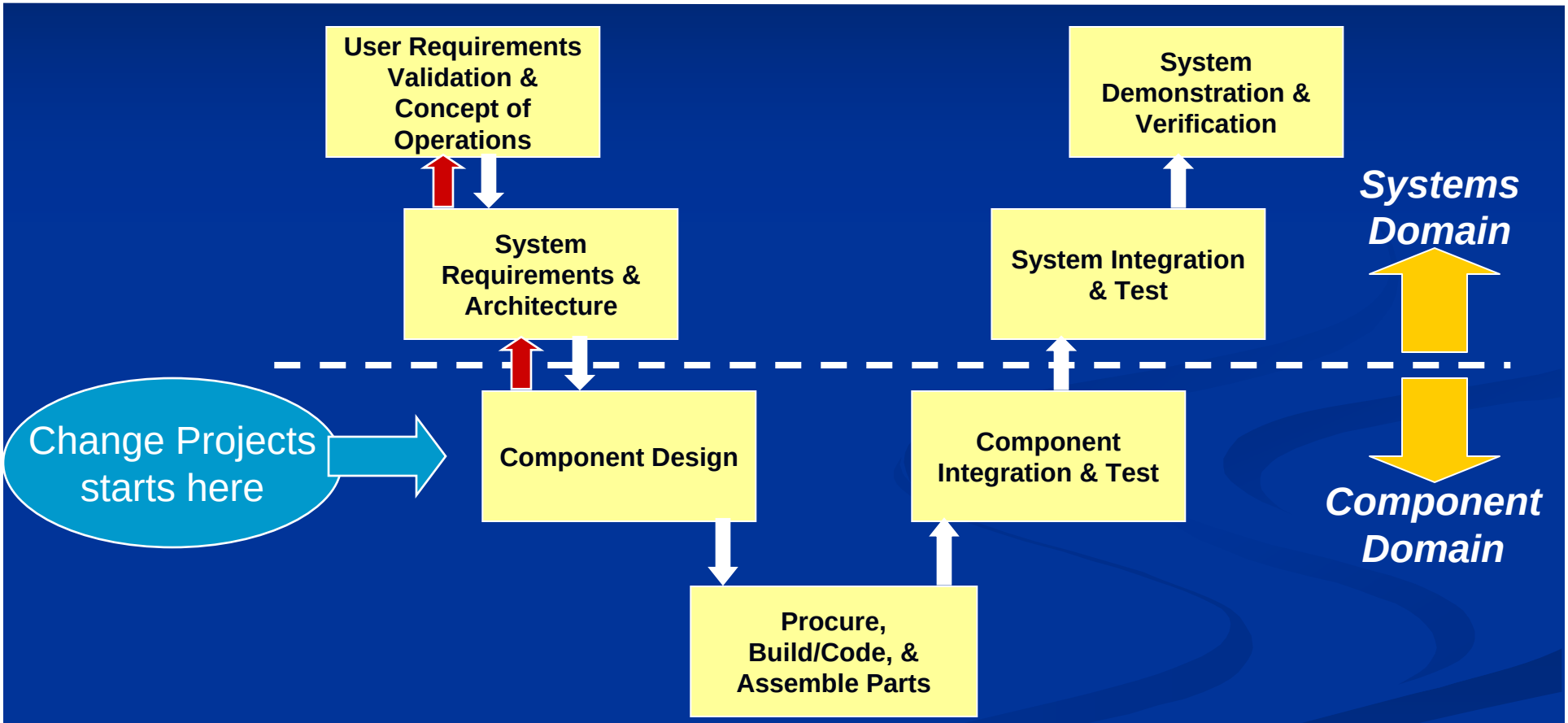
Adapting the Evolution Development Model



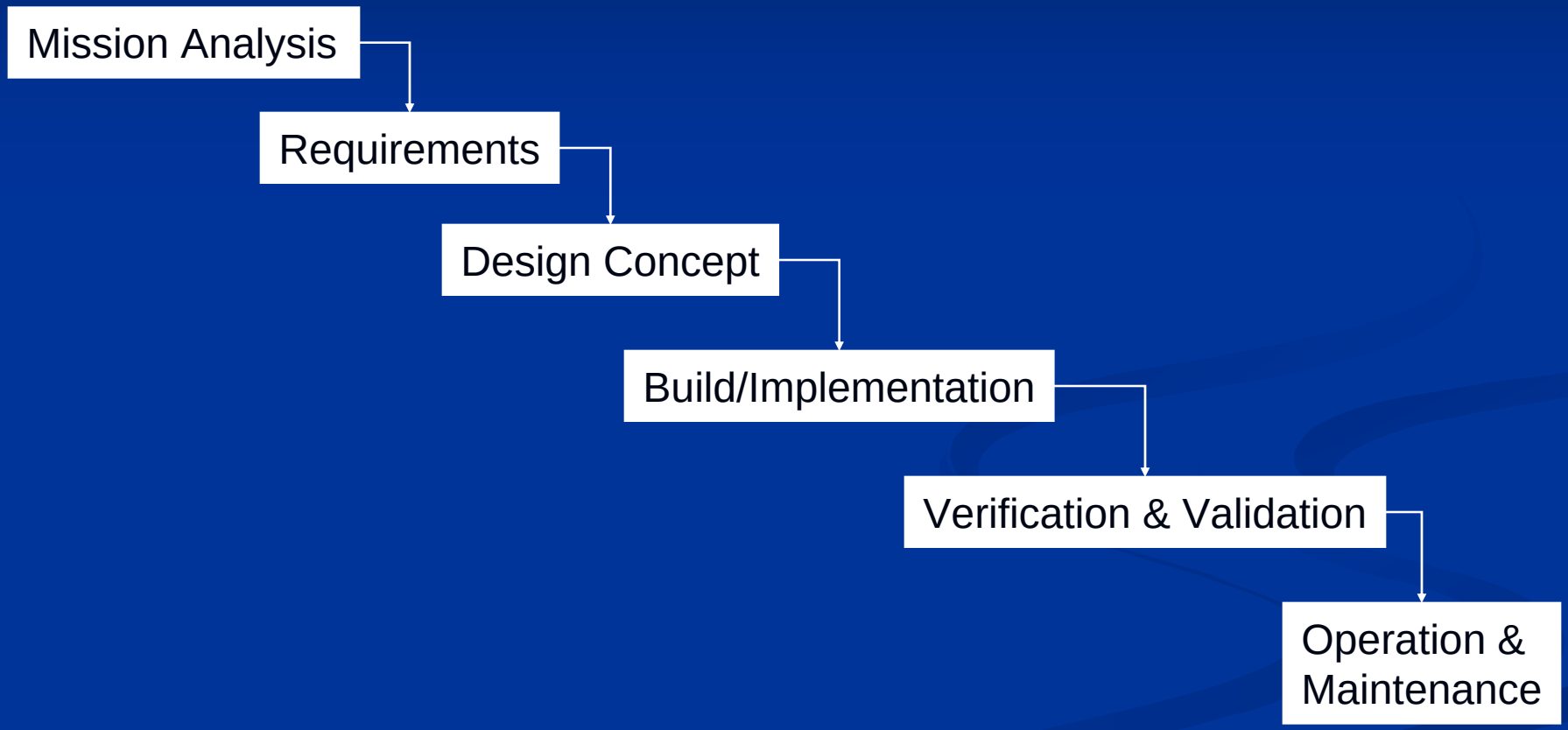
The "Vee" Model



Adapting the "Vee" Model



The Phased Development Model



Adapting the Phased Development Model

- Changes are tracked in Phases
- Phases are adapted to check compliance to:
  - Existing requirements
  - Impact to other projects

NEED FOR CHANGE	AUTH. TO DEVELOP	RQMT (High Level)	INITIAL CONCEPT	CONCEPT SELECT	AUTH. TO IMPLEM.	PRELIM DEFIN.	DETAIL DEFIN.	PRODUCE TO DELIVER	OPS SUPPORT
PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6	PHASE 7	PHASE 8	PHASE 9	

Combined Approach

NEED FOR CHANGE	AUTH. TO DEVELOP	RQMT (High Level)	INITIAL CONCEPT	CONCEPT SELECT	AUTH. TO IMPLEM.	PRELIM DEFIN.	DETAIL DEFIN.	PRODUCE TO DELIVER	OPS SUPPORT
PHASE 1	PHASE 2	PHASE 3	PHASE 4	PHASE 5	PHASE 6	PHASE 7	PHASE 8	PHASE 9	

Go / No-go decision → PLR

SRR

SDR

CCB

Authorize implementation

PDR

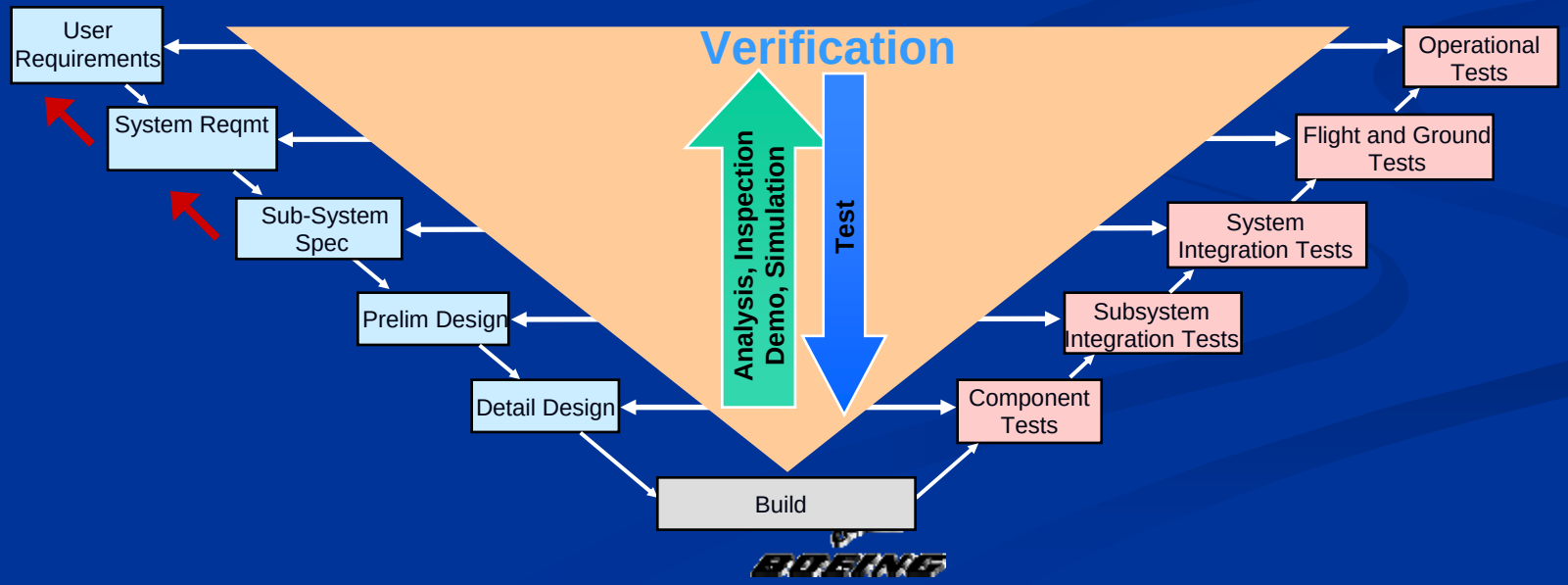
Release drawings

CDR

TRR

PRR

FCA/PCA



Conclusion

- A single model is inadequate for implementing Systems Engineering on a Change Projects environment
- Tailoring various models and combine them achieve a more effective implementation
  - Achieving the objective of the change
  - Assuring that the top-level requirements of the system are maintained