Project Life Cycle – The “V” Model within Construction

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Introduction

- Developed by NASA (60s)
  - Aerospace Projects
  - Performance and Reliability Problems
- Used for Software development
- Few applications in Construction

“V” Model - Concept

“This depiction is requirements-driven, and starts with identification of user requirements. When these are understood and agreed-to, they are then placed under project control, and through decomposition the system concepts and system specification are developed. The decomposition and definition process is repeated over and over until, ultimately, lines of code and piece parts are identified. Agreement is reached at each level, and the decisions are placed under project configuration management before proceeding to the next level. When the lowest level is defined, we move upward through the integration and verification process on the right leg of the Vee to ultimately arrive at the complete verified and validated system. At each level there is a direct correlation between activities on the left and right sides of the Vee – the rationale for the shape. Everything on the left and right legs of the Vee are sequentially placed under configuration control, and hence this has been designated the “core” of the Vee.” (Forsberg and Moez, 1998)

Principles and Objectives

- Iteration among disciplines and
- Decision gates
- High level of detail at the beginning
- Early involvement of the team
- Continuous improvement
- Change Control regimen
- Analysis (on the right) Synthesis (on the left)
- To reduce risk within the project
- Reduce Cycle Time
- To reduce uncertainty (may establish meaning for reduce waste in lean design)

The “V” Model

Source: Forsberg and Moez (1998)
The “V” Model

Decomposition

Validation

Definition

Verification

Integration

Concepts

- **Decomposition**: the hierarchical functional and physical partitioning of the system (Forsberg et al., 1996)

- **Definition**: documentation that defines the functional and physical content of each entity (Forsberg et al., 1996)

Development Approaches

- **Evolutionary Development**

  ![Evolutionary Development Diagram](image)

  Source: Forsberg and Mooz (1998)

- **Incremental Development (One product in the end)**

  Source: Forsberg and Mooz (1998)

- **Incremental Development (multiple products in the end)**

  Source: Forsberg and Mooz (1998)
The Ancient Method of Analysis and Synthesis

- Six features within the ancient method of Analysis and Synthesis
  - The starting and end points of analysis qualitatively different
  - Unity of two directions of inferences: backwards for solution and forwards for proof to longer
  - Inferences forwards: synthesis (composition)
  - Does not ensure that the solution can be found: iterative
  - Two types of analysis: theoretical and problematical
  - Decompositional (configurational) analysis
  - Transformative (interpretive) analysis

Analysis and Synthesis within the “V” Model

- This depiction is requirements-driven, and starts with identification of user requirements. When these are understood and agreed-to, they are then placed under project control, and through decomposition the system concepts and system specification are developed. The decomposition and definition process is repeated over and over until, ultimately, lines of code and piece parts are identified. Agreement is reached at each level, and the decisions are placed under project configuration management before proceeding to the next level. When the lowest level is defined, we move upward through the integration and verification process on the right leg of the Vee to ultimately arrive at the complete verified and validated system. At each level there is a direct correlation between activities on the left and right sides of the Vee – the rationale for the shape. Everything on the left and right legs of the Vee are sequentially placed under configuration control, and hence this has been designated the “core” of the Vee. (Forsberg and Moz, 1998)

Project Life Cycle Models

- Set-Based Concurrent Engineering – Toyota’s “V"
  - 1. Map the design space
    - Define feasible regions
    - Explore trade-offs by designing alternatives
    - Communicate sets of possibilities
  - 2. Integrate by Intersection
    - Look for intersections of feasible sets
    - Impose minimum constraint
    - Seek conceptual robustness
  - 3. Establish feasibility before commitment
    - Narrow sets gradually while increasing detail
    - Stay within sets once committed
    - Control by managing uncertainty at process gates

Set-Based Concurrent Engineering

Source: Sobek et. all (1999)

Process Protocol – “Left leg of the V”

Source: www.processprotocol.com

Avis Technique – “Right leg of the V”

Source: www.cstb.fr
### Lessons

- The application of the “V” model should be investigated in Construction;
- Testing should be considered more systematically in Construction Project Life Cycle
- To reduce uncertainty may establish meaning for waste reduction in Lean Design

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**Q & A**  
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Thank you!!!