The V-Model is Dead. 
Long Live the V-Model

Colin Hood Systems Engineering GmbH
Munich Office
Dorfstr. 12
85253 Erdweg
Tel: +49 8138 66 98 620
info@colinhood-se.com
Aims

- To explain that a V-model documents relationships between information, and does not restrict the sequence of creation of information.
- To explain that a V-model shows that larger systems can be considered to be a number of sub-systems to aid specification, and that sub-systems can be further considered to consist of a number of components to aid specification.
- A V-model also shows that components can be integrated to create sub-systems, and that sub-systems can be integrated to create systems.
A Simple Information Model

- Customer Requirements
- System Requirements
- System Architecture
- Sub-System Requirements
- Sub-System Architecture
- Sub-System Detailed Design
- Implementation

What the Customer says they want

What the Supplier promises to supply

Split system into parts for easier specification

What the parts have to do

Split the parts into components for easier specification

How to build the components

Build the components
Architecture consists of…

- **Structure**: How the parts are arranged
- **Interfaces**: How the parts talk to each other
- **Interaction**: How the parts work together
- **Requirements Allocated to Parts**: What the parts have to do

**System Architecture**

**Sub-System Architecture**

INCOSE have collected more than 150 correct but different definitions of architecture
Roles responsible for specification

Customer Requirements

System Requirements

System Architecture

Sub-System Requirements

Sub-System Architecture

Sub-System Detailed Design

What the Customer says they want

What the Supplier promises to supply

Split system into parts for easier specification

What the parts have to do

Split the parts into components for easier specification

How to build the components
Possible Team Communication

Customer Requirements

System Requirements

System Architecture

Sub-System Requirements

Sub-System Architecture

Sub-System Detailed Design

Customer

System Analyst

Software Analyst

System Architect

SW Architect

SW Developer

Collaboration is supported by the V-model
Possible Team Communication

Collaboration is supported by the V-model
The following slides show how the team might work together to consider how best to design the best solution.

The scenario shows that all processes are concurrent and affect each other.

The scenario shows that the processes do not have a strict sequential dependency.

Note:

- Some people may perform more than one role
- Some roles may be performed by more than one person
A Simple Example

Customer Requirements

System Requirements

Remember temperature settings

System Architecture

Sub-System Requirements

Sub-System Architecture

Sub-System Detailed Design

Aims

Implementation

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A Simple Example

Customer Requirements

System Requirements

System Architecture

Sub-System Requirements

Sub-System Architecture

Sub-System Detailed Design

Aims

Implementation

Remember temperature settings

Remember temperature settings

Remember temperature settings in SW?

Remember temperature settings in SW?

We will perhaps need some SW.

We will perhaps need some HW. We could use:

a. Battery back-up
b. Constant power supply
c. NVRAM

Design HW Components
A Simple Example

Customer Requirements

System Requirements

System Architecture

Sub-System Requirements

Sub-System Architecture

Sub-System Detailed Design

Aims

Implementation

Commitments

Remember temperature settings

Remember temperature settings

Remember temperature settings in SW

Remember temperature settings in SW

Remember temperature settings

We will need some SW if we Use NVRAM.

Provide NVRAM HW

Provide NVRAM HW

Design HW components

I advise to use NVRAM

Commitments

Aims

Implementation

Sub-System Detailed Design

Sub-System Architecture

Sub-System Requirements

System Architecture

System Requirements

Customer Requirements

A Simple Example

Remember temperature settings

Remember temperature settings

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Sub-System Detailed Design

Sub-System Architecture

Sub-System Requirements

System Architecture

System Requirements

Customer Requirements

A Simple Example

Remember temperature settings

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Design HW components

I advise to use NVRAM

Commitments

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Implementation

Sub-System Detailed Design

Sub-System Architecture

Sub-System Requirements

System Architecture

System Requirements

Customer Requirements
A Simple Example

Customer Requirements

System Requirements

System Architecture

Sub-System Requirements

Sub-System Architecture

Sub-System Detailed Design

Implementation

Remember temperature settings

Remember temperature settings in NVRAM

Remember temperature settings in SW

Remember temperature settings in SW

Remember temperature settings in SW

Remember temperature settings in SW

Remember temperature settings in SW

It's decided. Let's use NVRAM

Provide NVRAM HW

Provide NVRAM HW

Design HW Components

Aims

Commitments

SWISSED 2016 – 12 September 2016
A Simple Example

Customer Requirements

System Requirements

System Architecture

Sub-System Requirements

Sub-System Architecture

Sub-System Detailed Design

Aims

Commitments

Implementation

Remember temperature settings

Remember temperature settings in NVRAM

Remember temperature settings in SW

Remember temperature settings in SW

Remember temperature settings in SW

Remember temperature settings in SW

We are now sure enough of the design to commit to the customer within available resources to remember temperature settings

Provide NVRAM HW

Provide NVRAM HW

Design HW Components

We are now sure enough of the design to commit to the customer within available resources to remember temperature settings

Aims

Commitments

Implementation

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A Simple Example

Customer Requirements

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Remember temperature settings

Remember temperature settings

Remember temperature settings in NVRAM

Remember temperature settings in SW

Remember temperature settings in SW

Remember temperature settings in SW

Design HW Components

NVRAM chip is selected

Provide NVRAM HW
Specific NVRAM Chip

Provide NVRAM HW
Specific NVRAM Chip

NVRAM chip is selected

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A Simple Example

Customer Requirements

System Requirements

System Architecture

Sub-System Requirements

Sub-System Architecture

Sub-System Detailed Design

Implementation

Remember temperature settings

Remember temperature settings in NVRAM

Remember temperature settings in SW

Manage NVRAM SW

Provide HW Drivers in SW

Design SW Components

This HW needs HW specific SW

This choice of HW affects other domains

Electrical needs

Cooling needs

Provide NVRAM HW

Specific NVRAM Chip

Electrical needs

Cooling needs

Provide NVRAM HW

Specific NVRAM Chip

Design HW Components

Each level is affected by the other levels above and below

Aims

Commitments

Enough information available now to design SW components

Commitments
The V model represents ownership of and relationships between information.
Each level identifier represents 3 pieces of information

No sequence is implied

<table>
<thead>
<tr>
<th>Level identifier</th>
<th>The role defines responsibility and level of skills needed for this level</th>
<th>The process defines tasks to be done or aims to be achieved for this level</th>
<th>The definition of work-product defines how something is to be constructed and where it is to be stored for this level</th>
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Each level identifier represents 3 pieces of information

The V model represents graphically; ownership of and relationships between information.

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| 3                | System Architect                                                      | Create and verify System Architecture                                     | To specify:  
i. Structure of decomposition of system into parts  
ii. Requirements allocated to system parts  
iii. Interfaces  
iv. How the parts interact |
The First Waterfall Model (Royce 1970)

Warning: This can only work on very small projects (Royce)
The First Waterfall Model (Royce 1970)

Warning: Iterations and increments are necessary (Royce)
The V-Model was invented twice in the late 1980’s by NASA and by Kevin Forsberg and Hal Mooz 1991
Source: Forsberg and Mooz
A V-Model was created by Colin Hood in 1986 based on work by Royce.
All levels may be worked upon at the same time

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What the Customer says they want
What the Supplier promises to supply
Split system into parts for easier specification
Split the parts into components for easier specification
How to build the components

The V model is a static model and does not restrict sequence of creation of artefacts.
All levels may be worked upon at the same time

Per release the emphasis of effort changes over time
All levels may be worked upon at the same time.

Customer Requirements

System Requirements

System Architecture

Sub-System Requirements

Sub-System Architecture

Sub-System Detailed Design

Lower levels may not finish before the next higher level.
The Feature Owner might also fulfill any role including the role of the customer in some feature team discussions.
Conclusions

- The V model represents graphically; ownership of and relationships between information.
- The V model is a static model and does not restrict sequence of creation of artefacts.
- The V model is state-of-the-art.
Founding Board Member of IREB 2006
(International Requirements Engineering Board)

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INCOSE Member since 1999