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

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Aims

To discuss

- 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 supports iterative creation of a feature or capability, and also the incremental introduction of features or capabilities to a system.
- the V-Model supports agile development.
- the V-model is state-of-the-art.
A Simple Information Model

Customer Requirements Specification

System Requirements Specification

System Architecture Specification

Sub-system Requirements Specification

Sub-system Architecture Specification

Sub-system Detailed Design Specification

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

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INCOSE have collected more than 150 correct but different definitions of architecture

<table>
<thead>
<tr>
<th>Structure</th>
<th>How the parts are arranged</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interfaces</td>
<td>How the parts talk to each other</td>
</tr>
<tr>
<td>Collaboration</td>
<td>How the parts work together</td>
</tr>
<tr>
<td>Requirements Allocated to Parts</td>
<td>What the parts have to do</td>
</tr>
</tbody>
</table>

**System Architecture Specification**

**Sub-system Architecture Specification**
Roles responsible for specification

Customer Requirements Specification

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Sub-system Detailed Design Specification

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What the Customer says they want

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SW and HW are examples of sub-systems or parts
Possible Team Communication

- Customer Requirements Specification
- System Requirements Specification
- System Architecture Specification
- Sub-system Requirements Specification
- Sub-system Architecture Specification
- Sub-system Detailed Design Specification

Collaboration is supported by the V-model

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Possible Team Communication

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Collaboration is supported by the V-model
Scenario showing concurrent running of processes

- 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

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Aims

Implementation

Remember temperature settings
A Simple Example

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Aims

Remember temperature settings

Implementation

OK team. How can we do this?
A Simple Example

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Remember temperature settings

Remember temperature settings in SW?

Remember temperature settings in SW?

Aims

Implementation

We will perhaps need some SW.

We will perhaps need some HW. We could use:
- Battery back-up
- Constant power supply
- NVRAM

Design HW Components

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A Simple Example

Customer Requirements Specification

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Aims

Commitments

Implementation

Remember temperature settings

Remember temperature settings

Remember temperature settings

Remember temperature settings in SW

Remember temperature settings in SW

We will need some SW if we Use NVRAM.

Provide NVRAM HW

Provide NVRAM HW

Design HW Components

I advise to use NVRAM
A Simple Example

Customer Requirements Specification

Remember temperature settings

System Requirements Specification

Remember temperature settings in NVRAM

System Architecture Specification

Remember temperature settings in SW

Sub-system Requirements Specification

Remember temperature settings in SW

Sub-system Architecture Specification

Provide NVRAM HW

Sub-system Detailed Design Specification

Provide NVRAM HW

Design HW Components

Aims

Implementation

Commitments

It's decided. Let's use NVRAM

Remember temperature settings in SW
A Simple Example

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Implementation

Commitments

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

Design HW Components

Provide NVRAM HW

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

- Aims
- Commitments

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Implementation

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

Provide NVRAM HW Specific NVRAM Chip

Design HW Components

NVRAM chip is selected

Aims

Commitments

Provide NVRAM HW Specific NVRAM Chip
A Simple Example

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Implementation

Remember temperature settings

Remember temperature settings in NVRAM

Design SW Components

Remember temperature settings in SW
Manage NVRAM SW

Remember temperature settings in SW
Manage NVRAM SW
Provide HW Drivers in SW

Design HW Components

Each level is affected by the other levels above and below

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

Aims
Commitments

This choice of HW affects other domains

Remember temperature settings

This HW needs HW specific SW

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

REConf 2017, 28 March 2017
The V model represents ownership of and relationships between information.
Each level identifier represents 3 pieces of information

<table>
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<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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No sequence is implied
Each level identifier represents 3 pieces of 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 V model represents graphically; ownership of and relationships between information.
The First Waterfall Model (Royce 1970)

Warning: This can only work on very small projects (Royce)
Warning: Iterations and increments are necessary (Royce)
The V-Model was invented twice. Firstly in the late 1980’s by NASA and also 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.
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 supports iterative creation of a feature or capability, and also the incremental introduction of features or capabilities to a system.
- The V-Model supports agile development.
- The V-model is state-of-the-art.
All levels may be worked upon at the same time

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How to build the components

Elicit

Specify

Quality Check

Release

Understand

Chief Requirements Engineer
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

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Chief Requirements Engineer

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.

Collaborative incremental feature based development is supported by the V-model.
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