More than the sum of its parts

The case for integrated model based E/E development – *Throughout the product cycle*

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Overview

- The situation
- How can we address the situation?
- What must we achieve?
- What do we need?
- A way forward
- In summary
The situation

Challenges in automotive E/E development

- Engineers must develop complex control functionality:
  - Driver assistance, active safety, hybrid drives, connectivity, ...

- While balancing:
  - Ever-increasing quality requirements
  - Ever-decreasing time to market
  - A drive to minimise costs
The situation

Competing needs, limited time!

Requirement engineering

Architecture design

Electrical design

Product lines

Network design

AUTOSAR

Diagnostics

Function development

Safety management

Test management
The situation

The risks

The situation
Needs in automotive E/E development

- Comprehensive evaluation of alternative approaches
- Requirements management integrated into development process
- Function-driven development
- Improved and systematic re-use of design elements
- Seamless tool support throughout development process
How can we address the situation?

**Optimisation of the process**

- Optimise the complete systems engineering process
  - Dramatically reduce effort and complexity
- Prerequisite
  - A data model that covers all SE process phases
What must we achieve?

The promise

- Improved work processes
  - Better collaboration
  - Consistent, extensive automated tool-support
  - Consistent, shared model
  - Reduced work duplication
  - Only one tool to learn and maintain

- Better product
  - Front-loaded development process
    - Spot problems early
    - ‘What-if’ scenarios
  - Cross-layer optimisation
    - Reduced weight, material, cost, complexity
  - Higher quality
    - Consistency, traceability, documentation
What do we need?

Cross-layer links

- Linking elements between all layers
- Mapping work flows, dependencies, realisation, etc., ...
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Components

Safety analysis
What do we need?

Cross-layer links

- Linking elements between all layers
- Mapping work flows, dependencies, realisation, etc., ...

Components
Tickets
Work packages
Responsible person
What do we need?

Cross-layer links

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What do we need?

Cross-layer links

- Linking elements between all layers
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What do we need?

Platform engineering capability

- **Product lines**
  - Share common elements, vary the rest
  - Re-use, part libraries, branching

- **Variant models**
  - Allow for wide range of variants within a product line
  - Rapid prototyping

- **Variant conditions**
  - Model, document and check dependencies, constraints
  - Automatically create valid configurations

- **Product lines and variant models shared by all users**
What do we need?

Collaboration support

- Ensure consistency in our shared model
  - Lock/commit mechanisms
  - Branching
  - Traceability, history, rewind
  - Rights management

- User- and task-specific views
  - Focus on task-relevant elements
  - Better learning curve
What do we need?

Tool automation

- Interrogate, check and document our model
  - Reports, consistency checks, metrics

- Support model editing
  - Refactoring

- Automatically generate parts of our model
  - Signal router, wire router

- Automatically optimise our design

- Communicate with other tools
  - Broad, open standards based import/export
What do we need?

Project management tools

- Project management elements linked to model
  - Tickets (development issues, bug reports)
  - Change management (status of formal reviews, ...)
  - Project control (resources, deadlines, tasks, ...)

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What do we need?

Freedom

- No two users are the same
  - Flexible
  - Configurable
  - Powerful data model
  - Enterprise reliability

- A scalable tool and workflow
  - Start small
  - Gradually add
    - Users (potentially hundreds)
    - Model elements (potentially millions)
  - Increasing model complexity
What do we need?

Good relationships

- Support
  - In-field application assistance
  - Back office/IT services

- Services
  - Training
  - Customisation
  - Consultancy
What do we need?

A single model with multiple tools?

- Combine single model with ‘best-in-class’ tools?
  - Superficially attractive approach
  - e.g. Use ‘Open Services for Lifecycle Collaboration’
    > Requirements interchange with PTC/MKS Integrity
- Must be initiated and supported (£) by customer
  - The tool combination(s) will be unique
What about...

Requirements?
- Simple, few attributes, few connections
- OSLC standard

AUTOSAR Components (e.g. SWC)?
- Complex
- Many connections to other parts
- Partly covered by standard

Variants?
- Highly complex
- Highly connected
- No standard
For every technology increment, with every vendor:

- Upgrade nightmare
  - End effect: Tools frozen, no enhancements possible
  - No longer ‘best-in-class’!

- We enhance our model every 6 months
What do we need?
Integrated model-based E/E development tools
**A way forward**

**Use Case: Product line engineering**

- **Task:** Define feature models, dependencies, configurations
- **Benefit from:** Variant conditions, constraint solver, re-use, ...
A way forward

Use Case: **Requirements engineering**

- **Task:** Define system, software, hardware requirements
- **Benefit from:** Change management, project management, reporting, ...
A way forward

Use Case: *Function development*

- **Task:** Develop new functionality top-down
- **Benefit from:** Re-use, consistency checks, change management, …
A way forward

Use Case: *Architecture design*

- **Task:** Link customer functions to signals, hardware, optimise allocation of logic to ECUs
- **Benefit from:** Signal router, metrics, reports, variants, ...
A way forward

Use Case: *AUTOSAR software design*

- **Task:** Develop AUTOSAR system specifications
- **Benefit from:** Signal router, variant management, ...
A way forward

Use Case: **Network design**

- **Task:** Define frames, PDU, timing, partial networking, ...
- **For CAN, LIN, FlexRay, ...**
- **Benefit from:** Signal router, metrics, consistency checks, ...
A way forward

Use Case: *Diagnostics*

- **Task:** Define diagnostics configuration
- **Benefit from:** Variant management, consistency checks, ...
A way forward

Use Case: Electrical design

- **Task:** Plan wiring, power supply (grounding, fusing)
- **Benefit from:** Harness router, automated metrics, variants, ...
A way forward

Use Case: Test management

- **Task:** Manage test/validation and test data, track execution and results

- **Benefit from:** Ticket system, change management, re-use, reporting, ...
A way forward

Use Case: Safety management

- **Task:** Create safety analysis (ISO26262, FMEA, FTA, ...)

- **Benefit from:** Full traceability, reporting, automation, consistency checks, change management, ...
A way forward

PREEvision
In summary
Integrated model-based E/E development tools

- Much more than the sum of their parts
  - Enable workflows, not constrain them
    - Allow small teams to develop systems consistently
    - Allow global teams to develop highly connected systems
    - Extraordinary demands on your tools
  - Huge benefits
    - In terms of daily work
    - In terms of the bottom line
  - Ask us to demonstrate PREEvision...
In summary

Don’t just take our word for it...
Thank you for your attention.

For detailed information about Vector and our products please visit

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Vector Informatik GmbH
Our integrated model-based E/E development tool

**One** data model, **one** GUI, **full** traceability

Multiple **users**, **multiple** sites, **one** data source, **one** process