Welcome

Ford

- 62 plants worldwide
- 200 markets
- 203,000 employees, 53,000 in Europe
- $136 billion revenues, $29 billion in Europe
- 6.3 million vehicle units, 1.4 million in Europe
- $5.5 billion expenses for engineering, research and development
Frank KIRSCHKE-BILLER

Frank Kirschke-Biller is leading global core software processes at Ford.

Since 2000, he has been with Ford on different leadership positions in the area of Infotainment, Electrical Integration incl. Electrical Architecture, Networks, Diagnostics and Software Development.

Before he was leading the department of sensor and system technology at imech, a startup in the area of mechatronics.

Frank Kirschke-Biller graduated in electrical engineering at the University of Duisburg.

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Welcome

Vector Consulting Services

- Your experts for product development, technology strategy, IT, and managing changes
- Interim support, such as virtual security/safety officer project management, line leadership
- Global presence
- Training on Agile, Requirements, Security, Safety, CMMI/SPICE etc.
- Part of Vector Group with over 2000 employees

www.vector.com/consulting

www.vector.com/consulting-career
Christof Ebert is managing director at Vector Consulting Services.

He supports clients to improve product strategy and product development and to manage organizational changes.

Prior to that, he held senior management positions for ten years at Alcatel, with global responsibility for software / systems technology.

A trusted advisor for companies around the world, member of industry boards, and professor at the University of Stuttgart and Sorbonne in Paris, Dr. Ebert authored several books.

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www.vector.com/consulting
Agenda

Welcome

- **Challenges**
  Agile Systems Engineering
  Ford Case Study
  Summary and Outlook
Challenges

Industry Challenges 2018

Quality and Cost are the biggest short-term challenges across industries. Connectivity and Digital Transformation evolved as a major challenge.

Challenges

Challenge: Connectivity

Devices

Systems

Infrastructure

1980 2000 2020

Need: Systematic dependency management
Challenge: Heterogeneity

**Need**: System level cost optimization

**Challenges**
- Components
- Networks
- Signals
- Functions

**Harness**
- Topology
- PowerSupply
- Fusing

**Local Optimization Loop(s)**

**Function & Network Design Process**

**Design Process**

**1000s of Inconsistent Documents**
Challenge: Cyber Security

**Need:** Robust systems engineering for cyber security threats
Challenge: Global Collaboration

Need: Orchestrating distributed engineering across locations and disciplines
Challenge: Interdependencies

**Need:** Agile development and alignment of systems engineering, software/IT/EE and services
Agenda

Welcome
Challenges

- **Agile Systems Engineering**
  Ford Case Study
  Summary and Outlook
Levers for Agile Systems Engineering

**Quality and Efficiency**

- Requirements
- Architecture & Design
- System requirements
- System architecture
- Incremental integration, continuous deployment

**Agile Techniques**

- Collaboration and Cooperation
- Modeling and Simulation
## Lever 1: Agile Techniques

### Agile Software Development in sprints

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<th>September</th>
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<th>December</th>
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### Hardware Development

- Increment 1
- Milestone

### Mechanical Development

- Increment 1
- Milestone

- **n**: Sprint Number
- **Synchronize all domains on defined milestones**
Agile Systems Engineering

Lever 2: Modeling and Simulation

System Requirements

Logical System Architecture

Component Architecture

Simulation Implementation
Agile Systems Engineering

Lever 3: Collaboration and Cooperation

[Diagram showing collaboration and cooperation through Scrum of Scrums with Legend]

Legend:
- Red: Chief Technical Lead
- Blue: SW Lead Team 1
- Purple: SW Lead Team 2
- Black: Technical Lead Testing
- Orange: Hardware Lead
- Brown: Mechanical Lead

Kanban Board:
- ToDo
- Doing
- Done
Lever 4: Quality and Efficiency

Agile Systems Engineering

Requirements

System requirements

Architecture & Design

System architecture

System Level

Technology-specific

HW requirements

HSI spec.

SW requirements

Incremental integration, continuous deployment

Integration and Test

Commonality processes, methods, tools

Organizational & cooperation pattern
Agenda

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Agile Systems Engineering

► Ford Case Study

Summary and Outlook
Ford Case Study

Systems Engineering Throughout the Life-Cycle

SW and System engineering requires comprehensive PLM solution
Information Model

The 3 abstraction layers close the gap between Vehicle Attributes and the Component Specification

Responsible: Feature/Function Owner

**Feature from a customer perspective**

Translating customer wants and market needs to stable, consistent and complete feature requirements

**Use:** Discussion/negotiation with customer representatives (e.g. marketing)

**Logical functions necessary to implement the features**

Translating customer requirements to implementation independent engineering requirements.

**Use:** Enable efficient reuse of specifications across ECUs and carlines (Core)

**Allocated logical functions (platform / ECU)**

- Technical interfaces of components (e.g. ECUs) are determined
- Component behavior is enhanced/refined by technical requirements (implementer)

**Use:**
- Consistency of x-ECU interfaces enable interoperability
- Efficient data exchange with supplier

**Depending Business Model**

- If SW is written by Ford, QPIP scope extends to SW specification details
Ford Case Study

Requirements Structure

Defined structure for gathering individual requirements
(e.g. Feature Document)

Specification
(a container with a defined structure to hold requirements and supporting information)
**Ford Case Study**

**Improving Quality and Collaboration with Good Documentation**

**REQ-199754/A-Opt-In Create Driver Profile**

Enhanced Memory shall require a user to Opt-in before enabling this feature and creating first Driver Profile. *Without the opt-in step the user cannot create any Driver Profiles* and the vehicle will operate as it does normally without separate Driver Profiles for different drivers. *(Example from Feature Document without attributes table)*

**ENMEM-REQ-199754/A-Opt-In Enhanced Memory Feature to Create Driver Profile**

Creation of Driver Profiles is only allowed in state *Create* (refer to *figure 3*). The vehicle will operate as it does normally without separate Driver Profiles for different drivers.
Example: System Level Requirements

**Purpose**: Complete understanding of feature by using scenarios and other modeling techniques

<table>
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<th>Scenario 2</th>
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<td>Reference</td>
<td>.... tbd</td>
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<td>Short Description</td>
<td>Do not intervene if a stationary object is in the path of the host vehicle if the driver is backing toward it carefully (below feature activation speed threshold).</td>
</tr>
<tr>
<td>Condition (location, weather, street conditions, light, obstacles)</td>
<td>No specific conditions</td>
</tr>
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**Flow of Actions**
1. The Driver is actively backing the vehicle.
2. The vehicle is approaching a stationary object behind the vehicle.
3. Driver is attentive moving slowly toward object.
4. The feature RBA does not intervene.
5. Feature RBA sends a message to the driver that the system is inactive.
6. The Driver responds by manually applying the brakes at the appropriate time.
7. Scenario ends.

Driving scenarios technique has been developed in pilot projects.
Ford Case Study

Consistent Documentation and Tool Support

QPIP RE work stream defines 1 template per abstraction level (on component level 2) to
- Master complexity
- Apply consistent RE processes and methods across domains

Feature Document (per feature)

Function Specification

Feature Implementation Specification (per Feature)

Aggregated Feature Specification (AFS, Ex-SRD)

ECU Engineering Specification (per ECU)

Platform specific Concepts

Interface Spec

Ext. Interface Spec

Fnc 1
Fnc 2
Fnc 3
Fnc 4
Fnc 5

Feat 1
Feat 2
Feat 3

F1
F4
F2
F5

Fnc

SW Requirements

HW Requirements

Component Level Requirements

Function Level Requirements

Feature Level Requirements

Attribute Requirements
Benefits – Examples from Ford Projects

- Ownership: Self-organization reduces collaboration effort significantly compared to classic project management approach.
- Transparency of project status is significantly improved.
- Velocity and quality are improved. Management and teams recognize and value improvements and agile team spirit.
- Improved design speed and reuse.
- Product complexity is better managed and controlled.
- Architectural complexity control.
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► **Summary and Outlook**
### Summary and Outlook

#### Agile Systems Engineering

![Diagram showing components of systems engineering](image)

### Source:

Ebert, Requirements Engineering, 2017
Collaboration
- Collaboration effort has been reduced by over 20% with agile systems engineering.

Predictability
- Availability of results
- Project transparency

Velocity and product quality
- Customers, management and teams recognize and value improvements and agile team spirit.

Customer (Component Supplier):
“I simply open the Kanban Board of the Scrum of Scrums meeting. If I see no progress after 3 days, I know the team has a problem. But I do not see this often.”

End Customer (Systems OEM), 2 weeks after start:
“Now we see progress!”

Introduce agile systems engineering before complexity gets overwhelming.
Summary and Outlook

Meet us at Vector Forum 2018 for **Agile in Practice**

**Vector Forum: Agile in Practice**
28. June 2018
at Vector headquarters in Stuttgart

- Practical experiences from ABB, BMW, Bosch, Essence, ZF and Vector
- Enhance your competences
- Grow your networks
- Meet our consultants

Details and free registration...
[www.vector.com/vector-forum](http://www.vector.com/vector-forum)

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Recommended event for those interested in quality talks and contacts with the relevant experts.

Lorenz Slansky, Daimler
Thank you for your attention. 
Contact us – We are glad to support you.


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