SOFTWARE TRENDS IN DER AUTOMOBILINDUSTRIE

GESELLSCHAFT FÜR INFORMATIK AUTOMOTIVE – IT IM AUTOMOBIL

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Frank Kirschke-Biller
Manager Global Software Core Processes
<table>
<thead>
<tr>
<th><strong>Ford – Global Brand</strong></th>
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<tbody>
<tr>
<td><strong>Name</strong></td>
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<tr>
<td><strong>Headquarter</strong></td>
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<tr>
<td><strong>Included Brands</strong></td>
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<tr>
<td><strong>Number of Employees</strong></td>
</tr>
<tr>
<td><strong>Global Presence:</strong></td>
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<tr>
<td><strong>Sales (2012)</strong></td>
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<tr>
<td><strong>Production:</strong></td>
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<td><strong>Other services</strong></td>
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Ford – Global Brand

50 carlines world wide – From Subcompact to Heavy Duty Truck
Modern Vehicles are Computer Networks on Wheels

- Modern Vehicles
  - incorporate high-tech functionalities
  - have a high number of Electronic Control Units
  - have all ECUs connected by different bus systems
  - are computer networks on wheels
Feature Highlights

Three main Areas of Feature Growth

Drive Safe
- Best in class offering of active safety systems

Drive Green
- Wide range of technology – from efficient combustion engines up to battery electric vehicles

Drive Smart
- Advanced infotainment systems with intelligent off- and onboard services
Drive Safe - Active Assist Systems

- Adaptive Cruise Control
- Blind Spot Assist
- Lane Departure Warning
- Lane Keeping Aid
- Auto Park Assist
- Driver Alert System
Drive Smart – HMI Concept

- Premise
  Hands on the wheel
  Eyes on the road
- Ingeniously simple and always under control
- Using known stereotypes
- SYNC makes the difference
- Be entertained, connected and productive
- Designed for global markets, supporting various languages
Drive Smart – New technologies find their way in the Vehicle - SYNC

Vehicle
- Display Unit
- Instrument Cluster
- Infotainment ECU
- Body ECU
- Powertrain ECU

Mobile Device
- Apps
- Navigation App

Data
Control

Vehicle
- Mobile Device
- Data
- Control

Sync

Navigation App

Ford
Go Further
Continuous Feature Growth – enabled by Software

- **E/E Functionality**
  - Features
  - Components based development with local functionality
  - Function based development with distributed functions

- **E/E System design**
  - With the focus on the requirement and interactions and complex Software Interface

- **Remote Diagnostics**
  - Hybrids
  - In Car PC
  - Brake-by-Wire
  - ISG
  - Semi-auto parking
  - Blind Spot Detection
  - Infotainment
  - EPAS

- **Displays**
  - PTC Heater
  - IVDC
  - E-Connectivity
  - 4WD
  - Start/Stop
  - Regen Breaking

- **Advanced Restraints**
  - Adaptive Headlamps
  - Keyless Vehicle
  - ASM

- **X-by-Wire**
  - Fuell Cell

- **Year**
  - 1980
  - 1990
  - 2000
  - 2010

Go Further
These new features are mainly implemented using Software

1. **Innovation**
   Innovation is growing at highest rate. It is mainly driven by market demand for electronic devices on the vehicles and driver assistance systems.

2. **Electronic Equipments**
   Electronics play an increasingly important role to realize the rise of innovations in the automotive industry. Electronic equipments are more and more complex and connected by CANs (Control Area Network) which control more than 85% of the cars functionalities.

3. **Software**
   Increased Interaction between Systems and Software which helps to initiate the coordination of information between the system components.

Software Engineering in the European Automotive Industry
Fabrizio Fabbrini et al. IEEE 2009
The new features required an increasing number of ECUs and LOC

- 90% of innovation in the vehicle is driven by electronics / software
- > 75% of mechanical / electronical functionality is controlled by software

The rise of competition between vehicle manufacturer as well as the innovation-driven automotive market has resulted in deploying a continuous increasing number of Electronic Control Units.

Drastic increase in the number of Lines of Code involved in the support of interaction between ECUs.

Source: ADL Improving Efficiency of Automotive SW Development 2005
The vehicle value share’s for Software is increasing

- Software is getting more and more important for a vehicle manufacturer to further differentiate to other vehicle manufacturers

<table>
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<tr>
<th>Year</th>
<th>Mechanics</th>
<th>Electronics</th>
<th>Software</th>
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<tbody>
<tr>
<td>1975</td>
<td>90%</td>
<td>10%</td>
<td></td>
</tr>
<tr>
<td>2000</td>
<td>76%</td>
<td>22%</td>
<td>2%</td>
</tr>
<tr>
<td>2010</td>
<td>55%</td>
<td>32%</td>
<td>13%</td>
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Source: Global Industry Analysis
Efficient and effective Software Development can be grouped in three areas

**PROCESS-ORIENTED DEVELOPMENT**
Providing a process-oriented environment to cope with the challenging and complex Software development phase

- Project Management
- AutomotiveSPICE
- Agile Development Methods
- SW-Quality Management
- Function-orientation
- Test Strategies
- Model-Based Systems Engineering

**TECHNOLOGY LEADERSHIP**
Ford has already established itself as the mass-market leader for in-car technology

- Consumer Electronics as a driver
- Interaction with the environment
- SW-Security
- Software Ownership
- HW Trends and their impact

**STANDARDIZATION**
Helping to provide standardized effective techniques and approaches to support the software life-cycle

- AutoSAR
- Functional Safety ISO 26262
Process-oriented development – cope the increasing complexity

- SW Development processes are needed for high quality SW
- AutomotiveSPICE as Process Model
- Agile methods for SW development
- Model Based Systems Engineering
- Function-orientation instead of module orientation
- Test strategies for complete test coverage
- SW-Quality Assurance
Technology Leadership – Consumer Electronics is a driver

- Consumer Electronics have high innovation speed
- Consumer expect the devices they use at home to interact with the vehicle
- New Ford SYNC Applink makes Apps available in the vehicle
Technology Leadership – European market specific Apps introduced

- **Spotify** - integrates the Spotify music streaming service. Users will have access to their favourite music, playlists and Spotify Radio.

- **Kaliki Audio Newsstand** – audible playback of newspaper and magazine articles from different sources.

- **Glympse** – location and estimated time of arrival sharing with friends and family directly from the vehicle, all in real-time on a dynamic map.

- **aha** – more than 30,000 stations of audio entertainment and information delivered to the car; access to web-based music, news, Facebook and Twitter feeds, personalised restaurant recommendations and hotels, weather and more.
Technology Leadership – the vehicle interacts with the environment

- Car2Car Communication and Car to Infrastructure Communication for traffic safety
- Cloud based Services for greater flexibility
- FORD Applink to use a multitude of functions in and outside vehicles by users with different preferences
Technology Leadership – State of the Art SW Security implemented

**Accountability**
Attributing interactions to particular instances or persons.

**Confidentiality**
Only authorized user or authorized devices should have access to specific data.

**Integrity**
No unauthorized changes are allowed.

**Availability**
Usability of services, information and communication connections.

**Authenticity**
Verify User identity as well as Identity of other devices communicating with.

**Privacy**
only store specific data

**Protection Goals**
Some time ago, ECUs with SW were delivered by a specific supplier.
To more differentiate, nowadays the OEM also create specific parts of the SW on the HW to bring in a brand specific “Brand DNA”.
In the future Software and Hardware will be developed separately.
Software will be acquired from different vendors and should be integrated on specific HW.
Technology Leadership – HW Trends have an impact on SW development

- Innovative features demand higher performance of ECUs
  - The performance of a single-core processors is limited
  - Multicore processors viewed as most viable approach to achieve required performance gains within power budgets
  - Software for multi-core processors are a challenge

- New network / BUS technology
  - CAN-FD
    - Flexible Data-Rate for higher data-rate
  - Ethernet
    - preparing for new and more data-heavy applications for tomorrow’s vehicles

Changes in Hardware have a high impact on SW-Architecture and SW Itself
• **AUTOSAR** with its SW architecture and methodology has several advantages for Ford
  
  – Introduction of a top-down / feature-driven development approach based on a layered system / SW architecture to cope with the increasing system / SW complexity
  
  – Leverage Model-based System / SW Engineering for early / virtual integration / testing, auto-coding and data exchange between OEM and Tier 1
  
  – Improved quality for basic and application SW through SW reuse
  
  – Built-in support for important automotive technologies and standards (Multicore, Ethernet, CAN-FD, Partial / Pretended Networking, Functional Safety – ISO26262)

• Functional Safety is paramount for a vehicle manufacturer
  
  – **ISO 26262** is a risk based safety standard, to
    - qualitatively assess the risks of hazardous operational situations
    - define safety measures to avoid or control systematic failures
    - detect or control random hardware failures, or mitigate their effects