Software Engineering Theory and Practice

School of Computing	
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U30819: Software Engineering Theory and Practice

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Software engineering in the car industry

- Requirements engineering
- Design
- Coding
- Software and system integration
- Maintenance

Requirements Engineering

- Who are the users?
  - Drivers – anyone over 16 with a driving license
  - Passengers
  - Car maintainers
- Safety critical functions
- Context of operation of the systems

Requirements Engineering

- Diversity of functions
  - Embedded real time control
  - Infotainment
  - Comfort functions
  - Driver assistance
  - Energy management
  - Air bags
  - On board diagnosis and error logging

Requirements Engineering

- “The complexity and spectrum of requirements for on board software is enormous” (Broy)

Requirements Engineering @ DaimlerChrysler

- Textual requirements are not enough
  - Illustrative pictures, tables, recommendations, explanations about design rationale or decisions taken, test information, parameters, background information
- Define a company wide metadata model for managing requirements and the relationships between them

Requirements Engineering @ DaimlerChrysler

- Manufacturer requirements specs vs. supplier system specs
- Manufacturer needs to make sure that parts provided by suppliers work together
- For every component, need to specify both hardware and software requirements
- Demand to keep competitive expertise in house leads to black-box requirements specs

Requirements Engineering @ DaimlerChrysler

- Redundancy in requirements specs
  - Several hundred large specification and related documents are elaborated in parallel on a tight schedule
  - Results in inconsistencies and double work
  - Dependencies between document are complex and partially non-transparent

Requirements Engineering @ DaimlerChrysler

- Systems are built in small increments
  - No formal elicitation or negotiation phase
  - The reuse of old specs takes place in an ad-hoc manner
  - The systematic recycling of existing specifications is an explicit step in requirements engineering

Requirements Engineering @ DaimlerChrysler

- Managing non-functional requirements and acceptance criteria
- Provide concrete examples of acceptance criteria for functional requirements and re-use these examples
- Non-functional requirements are refined until they are implemented as a set of functional ones

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- Changes in requirements are typical daily work
  - Requirements management level oriented change management – refinements and clarifications
  - Official change management between manufacturer and supplier – large changes

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- Well organised specification reviews are essential for a successful manufacturer-supplier relationship
- Effective requirements management practices
- Appropriate tool support

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- Distributed requirements engineering
  - Internal distribution – departments, business units, business divisions, corporate brands
  - External distribution – DaimlerChrysler and suppliers
  - Ensure information remains top secret – multi server concept
  - Allow offline work on requirements

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- Manage requirements traceability
  - Design guidelines on which links to establish, how to create links, and when to update them

Requirements Engineering @ DaimlerChrysler

- The need for tools in requirements engineering
  - Provide basic means for workflow support
  - Easily adaptable, quickly include new functionality to the tools
  - Tools should be controllable offline

Design

- Hardware architecture design
  - Electronic Control Units (ECUs), bus systems,communication devices, sensors, actuators
- Software infrastructure design
  - Operating system, bus drivers, additional services
- Application software design

Coding

- Most of the coding is carried out by suppliers, not manufacturers

Software and Systems Integration

- Major challenges
  - Virtual integration and architecture verification not possible
  - Sub-systems delivered by suppliers not working together
  - Error correction impossible due to missing guidelines of architecture

Maintenance

- Software compatibility problems
  - Replacing software of an ECU must consider interoperability with older versions
- Defect diagnosis and repair
  - New skills and training required for servicing cars
- Replacing hardware with newer types a re-implement software

Questions?

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