Upgrading to CMMI at Bosch

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Bosch - Distribution of Sales 2001
by Business Sectors

- Automotive Equipment: 23.2 bn EUR (68.3%)
- Industrial Technology: 3.2 bn EUR (9.3%)
- Consumer Goods and Building Technology: 7.6 bn EUR (22.4%)

Total 34.0 bn EUR
Agenda

- Software in the Automotive Industry
- Bosch Initiative for Software-Intensive Systems (BISS)
- Future SPI at Bosch
Quality Management: 0-Defect Strategy

100 % Quality - wouldn’t 99,9% do it also?

- One hour every month of dirty drinking water
- 500 faulty surgeries per week
- 32 000 skipped heart beat per person per year
- 20 000 wrong medical prescriptions per year
- 22 000 checks per hour debit the wrong bank accounts
- 1600 pieces of mail lost per hour
- One car per day with cracks in the steering-gear arm
- 20 loose lug nuts per day
- 80 faulty parts in every car produced
- A parachute doesn’t open once per 1000 jumps

Hence: Zero Defect Strategy !
Software in the Automotive Industry

0-km Failure History of Mechanical Product

Program „100 - 2000“

Factor of 130

start of production

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Paradigms for Automotive Innovation

1880 - 1960
Innovation → Mechanical Systems
Process Focus → Standardization

1960 - 1990
Innovation → Electronics Hardware
Process Focus → Standardization

since 1980
Innovation → Process Focus → Standardization
Software
Characteristics of Automotive Electronics

- Low Cost
- Quality, Reliability, Safety
- Hard Real-Time
- "Explosion" of Functionality
- Temperature Range: -40 °C to +125 °C

80% of all innovations in automobiles are realized with software
(German car manufacturers, September 2001)
Automotive Electronic Systems

- Body Electronics
- Engine Control
- (Adaptive) Transmission Control
- Brake Control
- Dynamic Drive Control
- Driver Assistance Systems
- Telematics
Complexity of Electronic Systems in Vehicles

Signals
Sender/Receiver Interactions
Effort for Calibration and System Integration

System Integration ~ n
Sender/Receiver Interaction ~ n^2
Signals on CAN-Bus = n

Comparison E38/E65

Source: BMW 10/2002

E38  E65  next generation BMW 7 series

~64
~8
1

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“Explosion” of Functionality

Stand-alone systems (interactions by dedicated wires)  In-Vehicle networking  Vehicle linked to environment

Lines of Code*

10^10 10^8 10^6 10^4 10^2 10^0


*All systems in a car (Source: DaimlerChrysler 2002)
SPI Adoption

Bosch within the automotive industry

Automotive industry as a whole

Innovators

Early Adopters

Early Majority

Late Majority

Laggards
Software in the Automotive Industry

Quality Software

Software viewed as Business Opportunity
Improving competitiveness

Software viewed as Cost Factor
Managing risks
Avoiding bugs

Software as a vital component
Software as a necessity
Software as a differentiator

Target: Zero failure

Software Quality
Upgrading to CMMI at Bosch

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Ingredients

- SW-Quality
- SW-Processes
- SW-Architecture
- Product Lines
Roadmap

- Mandatory
  - Process
  - Product Lines

- Voluntary
  - Process
  - Product Lines
  - Systems / Hardware

- 1995: Pre-BISS
- 1999: Launch of BISS
- 2003: Next Phase
- 2005: Systems / Hardware
Why CMM(I)?

Management Skills

Software Development

Auto-motive

Engineering Processes

(Software) Management Processes

Domain Know-How
Why “Product Lines” at Bosch?

- Automotive electronic systems are Product Lines
  - Platform concepts
  - Medium to large number of variants

- Increasing software complexity and quality demands

- “Multi-talented” engineers of automotive electronics are rare

Achieve explicit business goals
in the realm of software intensive systems
based on systematic, strategic reuse
Change Management towards Organizational Maturity

Executive Management
Senior Management
Project Managers
Staff

Change
Improvement

Improvement Organization
(SPI Direction)
(SEPG)
“Breitensport”

**Business Units (19)**
- 1999
- 2002
- 2003

**Plants (37)**
- 06.2002
- 10.2002
- 12.2003

- within BISS
- not yet within BISS
0-km Failures Caused by Software Defects

According to manufacturing date of electronic control units (relative numbers: 2002 = 1)
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Future SPI at Bosch

SW-intensive Systems: Triangle of Excellence

Process

CMMI 5
CMMI 4
CMMI 3
CMMI 2

People

Individual
PSP
TSP
Interdisciplinary Teamwork

Function
Design
Architecture
PLA

Technology

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Transition from CMM to CMMI at Bosch

Appraisals per year

Scale?

Time

CBA IPI

SCAMPI A
Motivators to Upgrade

CMMI is

+ Compliant to our current and future needs for model-based improvement
+ Highly interrelated with the “Product Lines Framework”
+ Applicable to both systems development and hardware development
+ The better model w.r.t. business orientation, terminology and structural consistency

but CMMI requires SCAMPI
Delayers to Upgrade

As for SCAMPI A it seems, that

- There is little experience, instead open questions
- It will take time to have enough Bosch-internal lead appraisers
- SEI’s observation policy may conflict with language constraints
Future SPI at Bosch

Our Expectation to the SEI

CMMI + SCAMPI A

Application of the methods

Methods  Training

Professional Support  Quality Control

UNCOMPROMISED!
Summary

- The automotive industry has recognized to be “software-dependent”
- Software in Automobiles strongly influences innovation, safety, and environmental protection
- Automotive software will be required to be Quality Software

AND WE ALL DEPEND ON THIS MORE AND MORE!
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