Model Based Development Approach – AUTOSAR + Functional Safety + Aspice

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KPIT Industry Focused Solutions

Automotive & Transportation

Manufacturing

Energy & Utilities

KPIT = Product Engineering & Enterprise IT

Embedded Software | Product & Engineering Design | IT Platforms & Solutions
Process modernization using IT | Cloud & Big Data Analytics | PLM | Digital Transformation | Infrastructure Management Solutions
Automotive and Allied Engineering - Snapshot

Product Engineering to make mobility **Smarter, greener, safer & affordable**

**Product Engineering Solutions Across**

- AUTOSAR & In Vehicle Networks
- Body Electronics
- Chassis, Autonomous and Driver Assistance
- Engineering Design
- Functional Safety ISO 26262
- Infotainment
- Instrument Clusters
- Powertrain
- Vehicle Diagnostics

**Products Business Portfolio**

- **K-SAR** AUTOSAR Suite
  - Worlds’ FIRST AUTOSAR R 4.0.3 Solution
  - RTE | Basic Software Stack | MCAL

- **In2Soft** Diagnostic Tools
  - ODX Designer | OTX Suite | Diagnostic IDE/RTE

- **BMS**
  - Battery Management Systems
  - Automotive | Stationary Applications

- **KIVI**
  - KPIT In Vehicle Infotainment Platform

- **REVOLO**
  - Plug In Parallel Hybrid Solution

**People with passion for Technology**

- 4500+

**OEMs & Tier 1s who benefit from our technology**

- 85+

**Vehicle Production Programs impacted by us**

- 350+

**Total number of projects executed**

- 2000+
The Global Automotive Industry is in a Transformational phase....

**Electrification & Fuel Efficiency**

Electric vehicles to be **35%** of global new car sales by 2040. Various Geos offers imperatives and constraints for Electric vehicle adoptions.

**Connectivity**

**89%** of new cars sold worldwide will have embedded connectivity by 2024.

**Autonomous Driving**

**10 Million** Self-Driving Cars Will Be On The Road By 2020.

**Consumer Experience**

Vehicle **customization, ride sharing, personalization, multi modal transport** considered game changers by Automotive industry.

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We are moving towards the world of Autonomous, Connected, Fuel Efficient, Lightweight vehicles with personalized Consumer Experience.
Future trends imposing technical need of standard compliance and change in development workflow

Technical Needs
- ISO
- Functional Safety

Development Needs
- Model based system and software engineering
- Autosar Platform approach
- Integrated model based development environment

Increase in Automotive Controls System Complexity

Platform strategies
KPIT’ Feature Development MBD workflow: Focus on ‘Continuous Verification’
Compliant to ISO26262, ASPICE and Autosar standards

Key Differentiators:
- System Engineering Best Practices
- Functional Safety Assessments
- Use Case Scenarios
- Requirements Management
- Rapid Prototyping
- Extensive tool suite experience in Rhapsody & Matlab/Simulink
- Leader in AUTOSAR
- Completely automated verification of Matlab models to comply with leading industry standards

1. Feature Requirements
2. System Requirements Development/Modeling
3. Concept Development
   - V1
   - RCP (MIL/PIL/HIL/Real Plant)
4. Executable Specification Development
5. Software Architecture Design
6. Auto code Generation
7. MIL/SIL Testing
8. Software Integration Testing
9. HIL Testing / Plant Model Development
10. Acceptance Testing/Calibration Tuning

Production
- Extensive tool suite experience in Industry tools
- An adaptive & integrated solution for Model Based Engineering
- Extensive tool suite experience Using Real Time Workshop & TargetLink auto-coder

Concept

System Architecture
Model Development
Architecture Guidelines
Modeling Guidelines
4.1. MIL Model Based Calibration
5. Software Architecture Design
6. Auto code Generation
7. MIL/SIL Testing
8. Software Integration Testing
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10. Acceptance Testing/Calibration Tuning

4/24/2017
KPIT involvement spans across the entire Functional Safety Lifecycle. KPIT experiences include:

1. **Concept**
   - In-house System / SW Safety Development
   - Alignment

2. **System / SW Safety Development**
   - Item Definition
     - Part 3
   - Hazard Analysis And Risk Assessment
   - Functional Safety Concept
   - Technical Safety Concept
   - System Architecture
   - Safety requirements

3. **Release for Production**
   - Functional Safety Assessment
   - Safety Validation
   - Item Integration & Testing
   - Safety verification

4. **In-house System / SW Safety Development**
   - Part 5

5. **Part 6 SW development using Model Based workflow**

KPIT experiences are performed by OEM.
**Formal Architecture Design Tools**

1. Design Patterns (sensor – actuator, Diagnostics, Functional safety etc.)
2. Component size
3. Component partition
4. Cohesion and Coupling
5. Variant Management
6. Architecture Views and Report generation
7. Architecture evaluation criteria

**Software Safety Requirement Derivation**

- HARA
- Safety Goal
- FSC
- TSC
- HSIC
- DIA

**ASIL Level Assigned Software Safety Requirements**

**ISO26262: Part 6 : REQUIREMENTS & METHODS**

1. Requirements based testing on target – Reuse MIL test vector
2. Fault injection testing
3. MIL-SIL-HIL
4. Interfaces validation
5. Memory optimization manual analysis

**1. Functional validation – MIL**

2. Back to back testing – Model and Code (MIL – SIL)

3. Coverage testing using Auto test case generated from Design Verifier. Measures for unintended functionality
Motivation & Implications of migrating to AUTOSAR

Main motivation to migrate from the legacy software is to manage the increasing complexity of the increasing electronics and software complexity and at the same time:

• Improve quality
• Reduce cost
• Reduce time to market

Typical challenges when migrating from the legacy software to AUTOSAR

• Software migration & complexity
• Variants management
• Configurator vs. implementer
• New technologies
Software migration & complexity

- Application Migration
- Application integration with BSW
- BSW License – delivered pre-integrated with MCAL
- Diagnostics integration and configuration

- BSW configuration → Most services are available in AUTOSAR
- Project specific complex drivers and I/O abstraction
- Bootloader integration
- SWC unit testing and Rapid Prototyping
Workflow of AUTOSAR Application Migration using MBD

1. System Requirement Development
2. Feature Requirement
3. Software Requirement
4. Architecture & Design
5. Model development
6. Auto code Generation
7. MIL/SIL Testing

AUTOSAR Configuration Tools

• Model SWC/Runnable Interface/DataType

Analysis Document

8. Software Integration and testing

Test Report

9. HIL Testing

Test Cases For Testing
• Functional Test Cases
• Integration Test Cases

10. Vehicle testing and calibration

Communication Matrix Analysis

Application (SWC.arxml)

ECU-Extract/dbc

Service Component IoHwAb Component

BSW Platform & RTE Config

Integration & Test

Interface Test

AUTOSAR I/F

Configuration

.Rte.exe

.c/.h

Compliance

AUTOSAR ACG c/.h

Atomic SW-C.arxml

KPIT Tools

AUTOSAR Suite

Integration & Test

K-SAR AUTOSAR Configuration Tools

KPIT Tools

Embedded Coder AUTOSAR Block set
Round trip approach – AUTOSAR Compliant Development

1. Create AUTOSAR Architecture
2. Import ARXML & Create Frame Model
3. Update Detail logic
4. Perform MIL Validation
5. Generate Code & Preform SIL
6. Generate ARXML
7. Merge ARXML
Automotive Spice – Software Quality Assurance Standard

MAN.3 – Project Management

ENG 1 – Requirement Elicitation
ENG 2 – System Requirement Analysis
ENG 3 – System Architectural Design
ENG 4 – Software Requirement Analysis
ENG 5 – Software Design
ENG 6 – Software Construction
ENG 7 – Software integration test
ENG 8 – Software testing
ENG 9 – System integration test
ENG 10 – System testing

MAN 5 – Risk Management

SUP 1 – Quality Assurance
SUP 8 – Configuration Management
SUP 9 – Problem resolution mgmt
SUP 10 – Change Request management

Need integrated environment to manage requirements
KPIT approach: Integrated tools environment for ASPICE compliant workflow

**Objective:**
- Allows management of product lifecycle development based on PLA principles
- Allows traceability throughout product development lifecycle
- Allows impact analysis across product lines and engineering artifacts
- Allows management visibility of the whole process
- Enable global collaboration
- Process and standards compliance (CMMI, AutoSpice, SAE, ISO 26262)

**Engineering Workflow**

- **Systems**
- **Controls**
- **Software**
- **V&V**

**Integrated Infrastructure**

- **Requirements Management Tool**
- **Architecture Modeling Tool**
- **Systems and Controls Modeling Tool**
- **Auto-code Tool**
- **MIL/SIL/HIL Testing Tool**

**ALM Environment**

- **Configuration Management Tool**
- **Change/Issue Management Tool**
- **Data Dictionary**
- **Workflow Management Tool**
- **Test Management**
- **Build and Release Management**
Summary

• Model based development is way forward to develop Automotive controls software
• Model based development is well suited to develop controls software compliant to Automotive standards
  • ISO26262
  • ASPICE
  • Autosar
• Increasing electronics content in Automotive is increasing system complexity, needs many engineers with expertise in Model based development.
Our approach to meet demand - ECoDe – developing right talent to cater to customer demands

**K PIT Learning Model**

<table>
<thead>
<tr>
<th>On going</th>
<th>ECoDe</th>
<th>KAIZEN - Continuous Upgradation and Certifications across all the experience levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fresh Entrants</td>
<td>GENESIS</td>
<td>Fresh Engineers Induction Program Engineering Academies</td>
</tr>
<tr>
<td>Before Joining KPIT</td>
<td>PACE</td>
<td>Initiative to bridge the gap between Academia &amp; Industry needs</td>
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<tr>
<td></td>
<td></td>
<td>• Automotive Electronics Technologies and Domains</td>
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<td></td>
<td></td>
<td>• Competency Framework aligned to Roles &amp; Career Streams</td>
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<td></td>
<td></td>
<td>• Credit Based Framework to Train and Certify employees</td>
</tr>
<tr>
<td>Industry Readiness</td>
<td>Strong Base</td>
<td>Current &amp; Relevant</td>
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</tbody>
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**Collaborations with Internal Stake holders and External Partners**

**ELEVATE | LIFT | ASPIRE | SOFT SKILLS**
Leadership Development Programs to mentor Emerging & Existing Leaders

**40-40-20**
Academy SME + KPIT SME + Vendor Partners Model
Collaborative Education Model

**GENESIS (6-8 weeks)**
Every Campus recruited engineer trained & ready for customer projects

PACE: Program for Academic Collaboration and Engagement
Program for Academic Collaboration & Engagement (PACE) & GENESIS

Unique Initiative of KPIT

Programme objectives

- **Build KPIT Brand** in Universities / Institutions to attract the right talent
- **Hire the Right motivated talent for each practice**
- **Quicker deployment** on projects / reduce internal training time / costs /efforts
- Representation on Academic boards of Institutions **To influence education System**
- **Work to create Industry ready niche resources**
- **SBU Aligned fresher induction and deployment**
- **Faculty Development through collaborations**

1. **“PACE” Programme partnership kit for academic institutions**
2. **MOUs with 20 Partner Institutions aligned to SBU needs**
3. **Standard education artifacts in partnership with SBUs & Academies and repositories**
4. **KPIT created courses approved by Academic boards and taught as part of Curriculum**
5. **Through “Train the Trainer” Faculty enablement programmes & exchange programmes 60+ faculty trained**
6. **Joint partnership for deployment & support institutions**
7. **PACE linked to Campus hire, Internships and prospective employee engagement**
8. **Induction to SBUs and Accounts –additions skill gap trainings as per needs**
Thank You

www.kpit.com