Machine Software Development Lifecycle – Vision!

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Business Development Strategy
Amazon Web Services

AGENDA

01 What is the future

02 Cloud based SW Development

03 Cloud based Testing

04 Cloud based Post-Production

05 AWS Solutions and Next Steps

The Future of Software Development

Software development is changing dramatically. **We're moving away from separate, step-by-step processes to a fully integrated approach powered by AI.**
Instead of working in isolated phases, your development, testing, and maintenance teams will work together continuously. **AI will be your partner throughout the entire process** - helping write code, catch bugs early, and optimize performance automatically.

What this means for you: Faster delivery, higher quality software, and lower costs through seamless collaboration and intelligent automation.

Software Development: From Coding to Creation

Software Development: From coding to creation

AI and Gen AI are transforming developers from manual coders into creative problem-solvers through intelligent augmentation, native AI methodologies, and invisible development processes.

Testing: From a phase to a continuum

Transforming testing to be more continuous integration and automated and augmenting with AI to be faster and more intelligent.

Post-Production: From reactive to predictive

Automate and make deployment process more intelligent. After deployment, shift the focus to proactively preventing issues using AI and analytics.

SDLC Challenges

Cultural clashes and methodology muddle

Without clear guidelines, teams get confused, fail to follow the process correctly, ‘us vs them’ mentality grows

Complex debugging

Debugging is time-consuming and resource-intensive due to the difficulty of isolating root causes across hardware, software, and their complex interactions.

Documentation balance and KPIs

Finding the right KPIs and the balance of docs to meet agility and regulations can be complex

Real Time Complexity

Embedded systems in heavy machinery face critical risks from delayed responses, making real-time testing extremely difficult and requiring specialized expertise.

HW-SW Synchronization

Many HW and SW synchronization challenges: developers often rely on imperfect emulators, which causes critical bugs to be found late in the development cycle

Safety and Compliance

Constant challenges to ensure the security and safety of the devices.

ECU: Electronic Control Units | HPC: High Performance Computers

Engineering Team Challenges

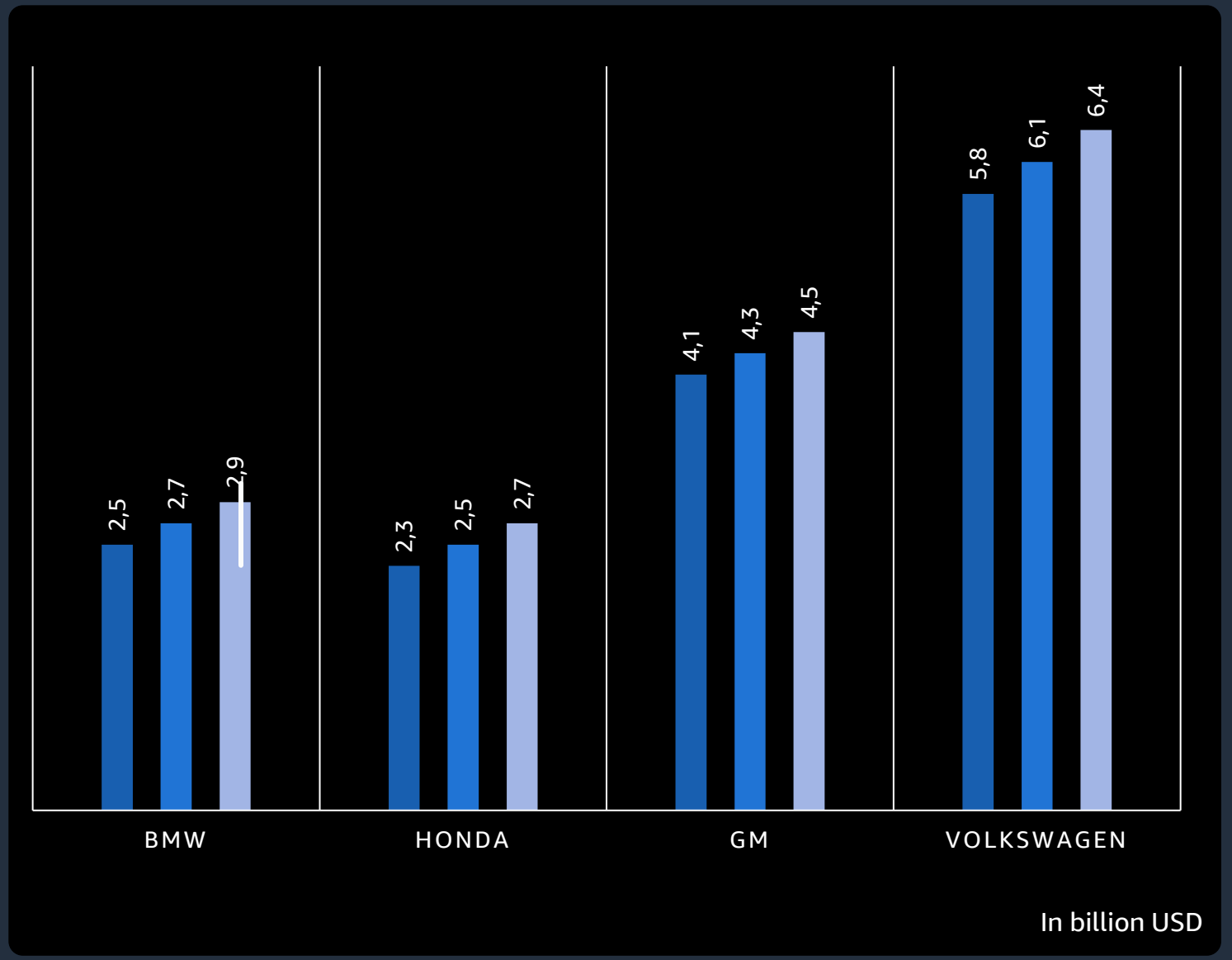
- Current state: Classical testing takes months. DEV/TEST Effort-Ratio: 10/90 – 30/70
- Traditional automation covers only 60-70% of test cases
- Volume of software in vehicles increasing exponentially. Continuous OTA updates becoming industry standard.
- Testing becoming the bottleneck in innovation
- Time to market new KPI for all processes
- Global R&D and product cost pressure

Warranty / R&D ratio

Warranty to R&D Ratio (2023):
- BMW: 38.7%
- GM: 52.9%
- VW: 38.1%
- Honda: 41.5%

Key Trends:
Cost Pressure:
- Warranty costs growing faster than R&D in most cases
- Software-related warranty claims increasing
- Complexity-related issues driving costs

Technology Impact:
- Software issues becoming major warranty driver
- Electronic component failures increasing
- Traditional mechanical issues decreasing



Software Development

AI-Augmented Development

Your development teams will deliver products to market **40% faster** as AI handles routine tasks like code generation, documentation, and refactoring – reducing development costs while accelerating revenue generation from new features.

AI Native Methodology

Your business ideas can now flow directly into working software through AI-Driven Development frameworks that automatically generate requirements, code, and tests – **reducing time-to-market** by months while cutting development costs and enabling faster response to market opportunities.

Invisible SDLC

Your teams will simply describe what they need in plain language, and AI will instantly generate the code and graphics – **reducing** development time **by 50%** and eliminating technical bottlenecks while enabling faster product iterations and competitive advantage.

Real World Customer Use Cases

Requirement and User Story Generation

Using natural language processing (NLP), GenAI can automatically translate plain-language business needs into detailed, formatted user stories and acceptance criteria.

Automated Code Generation and Refactoring

Using GenAI to generate code, code snippets, or even graphics instantly. It can also help optimize or restructure existing legacy code for better performance, maintainability, and security without altering its core functionality.

Rapid Prototyping

Using GenAI to translate abstract business ideas in plain language into a concrete product mock-up, UI/UX generation, underlying code for the front end to accelerate the iterative design process.

Automated documentation

Using GenAI to generate comprehensive and up-to-date documentation by analyzing the codebase, user stories, and other project materials. For example: API documentation, user manuals, code base explanation and release notes.

Transitioning to Active Code Assistant

Making the GenAi code assistant a more active and predictive tool to actively test code, identify subtle code anomalies and generate fixes without intervention.

Testing

Hyper-Automated Testing

AI automates end-to-end testing workflows, delivering 70% reduction in manual effort and faster release cycles—directly reducing costs and accelerating time-to-market.

Predictive and Adaptive Systems

AI predictive analytics prevent customer-impacting defects while self-healing tests automatically adapt to changes—reducing production incidents by 60% and eliminating test maintenance costs.

Enhanced Collaboration and Accessibility

AI-powered low-code/no-code testing platforms enable business users to create and review tests directly, reducing IT bottlenecks by 50% and accelerating testing cycles.

Real World Customer Use Cases

Library for Testing & Verification

1000s of real vehicle configurations with existing continuous testing pipelines. Manage test fleet configurations, baselining telemetry against the right software versions.

Intelligent Generation and Optimization

Generative AI and LLMs, analyzes requirements, user stories, code, and even design mockups to automatically generate comprehensive and diverse test cases, including edge cases and negative scenarios.

Autonomous Sensor Fusion Integrity

Integrate advanced GenXAI for anomaly detection in sensor data, and more sophisticated synthetic data generation that mimics real-world scenarios and sensor imperfections.

Supporting Certification and Compliance

GenAI reviews test results, system logs, and safety data to automatically generate compliance reports and proactively identify safety hazards before they become regulatory issues or costly incidents.

Cross-domain simulation

Using GenXAI models, developers can link sensor data (camera, LiDAR) with text descriptions and audio cues to create rich, multi-modal simulations. For example, virtual pedestrians can be given realistic crossing "intent" that generates complex behaviors beyond simple motion paths.

Post Production

Deployment Process Automation and Intelligence

AI automates deployment by predicting risks, generating error-free configurations, and enabling automatic recovery from failures—eliminating costly production incidents while **accelerating release cycles.**

Predictive Issue Prevention

AI continuously monitors systems to detect anomalies and predict failures before they impact customers, while automatically generating root cause analysis and building knowledge libraries—**preventing costly downtime** and accelerating incident resolution.

Predictive and Autonomous CI/CD

Intelligent CI/CD pipelines automatically identify, diagnose, and fix potential issues before they reach production—**reducing operational costs and risks** while accelerating time-to-market through proactive issue prevention and minimized downtime.

Real World Customer Use Cases

Predictive Deployment Risk Assessment

AI analyzes deployment history and error patterns to predict deployment risks, flagging potential conflicts before production and recommending optimal deployment timing to minimize failure rates and service disruptions.

Automated Configuration Generation

AI analyzes device hardware and software components to automatically generate optimized configuration files, ensuring seamless fleet deployment while eliminating manual errors and accelerating releases.

Intelligent rollbacks and auto-healing

AI monitors applications in real-time and automatically triggers rollbacks or self-healing processes when anomalies are detected, minimizing service disruptions and reducing recovery time to protect revenue and customer satisfaction.

Proactive Documentation

AI automatically generates incident summaries and knowledge base articles after issue resolution, building an institutional knowledge library that accelerates future problem resolution and reduces mean time to recovery.

Anomaly Detection

AI continuously analyzes production monitoring data to detect subtle performance anomalies and predict failures before they impact customers, automatically feeding insights back into the CI pipeline to prevent costly downtime and maintain service reliability.

Let’s brainstorm – what’s next

- “Embrace uncertainty in testing”
- “Trust in AI-driven decisions”
- “Continuous learning mindset”, e.g. Human in the loop
- “Agile testing at scale”; Concurrent AI agents working on design/test/compliance
- “Real-time validation”; 90% virtual validation via digital twins
- “AI-first approach”; AI synthesizes 10M+ scenarios from real-world data. Build Regulatory AI Co-Pilots
- "Stop writing test cases, start teaching AI"
- "Kill the V-Model - embrace continuous evolution"
- "Test engineers must become AI trainers"
- "Either automate 100% or become obsolete“
- AI Ethics as Engineering Discipline.
- Shared Failure Libraries. OEMs must pool anonymized defect data.
- Testing at Exascale. Billions of edge-case scenarios

AI-Driven Validation Framework (WIP)

Human Oversight & Governance

- Framework Evolution
- Regulatory compliance
- Risk Management
- Strategic Control
- QM framework

AI-Driven System Architecture

- Self-monitoring Systems
- Autonomous Validation
- Runtime Verification
- Formal Methods
- Compliance Monitoring

Digital Twin Evolution

- Real-time simulation
- Predictive Modeling
- Automated Regression
- Virtual Homologation
- System Learning

Compositional Safety

- Verifiable Units
- Augmented Functional Safety
- Automated Safety Cases
- Continuous Monitoring
- Dynamic Risk Assessment
- Safety Patterns

Closing

"The question isn't if **AI will transform automotive development and operational lifecycle**, but when. And the **when is now**.

Lead this revolution or follow others who will. “