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Session CEE-1905

The End of Cloning:
Strategic Reuse and Product Line Engineering With the IBM Rational Platform

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Innovate2014
The IBM Technical Summit

June 1 – 5 | Orlando, Florida

Innovate @ SPEED

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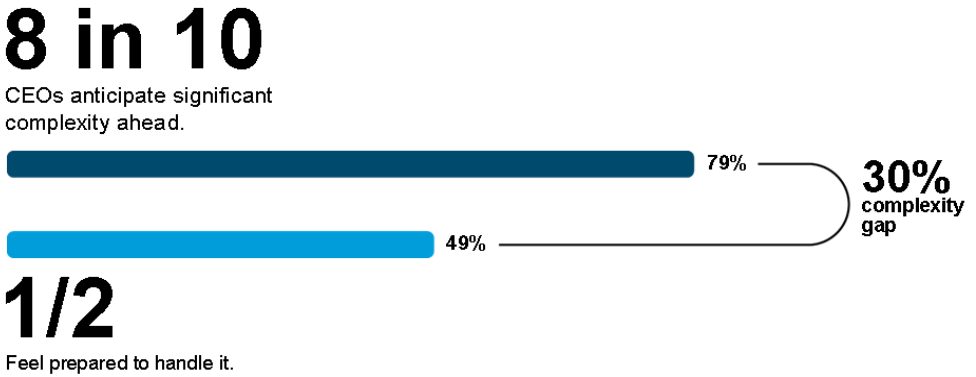
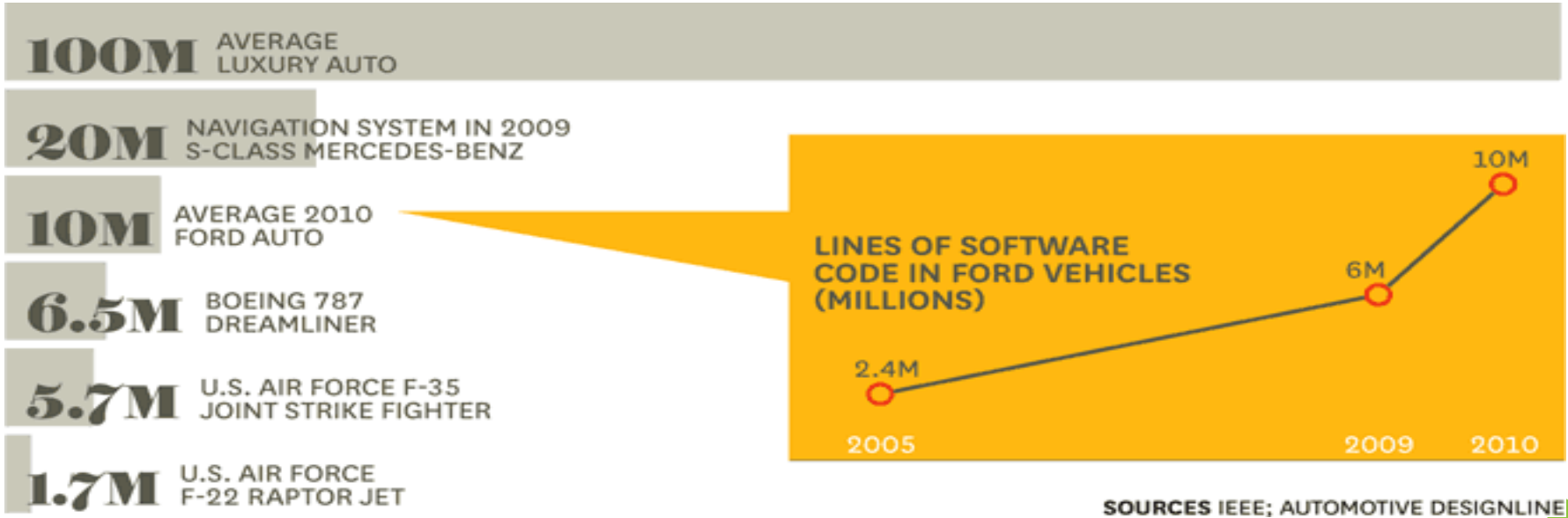
Outline

- Background: The need for Reuse
- Approach: The need for Product Line Engineering
- Concepts of PLE
- Solution: Federated Platform for PLE

As products and systems become more complex, engineering effort multiplies.





More Complex Than a Fighter Jet: Safety regulations and consumer demand for performance and convenience have led to an exponential spike in cars' software complexity.

source, HBR, June 2010

Companies are embracing new techniques and methods to better engineering complex products.

Connect multiple products and services into a *"system of systems"* to deliver exponential value

Leverage *systems engineering* to accelerate time to market, improve quality and reduce costs

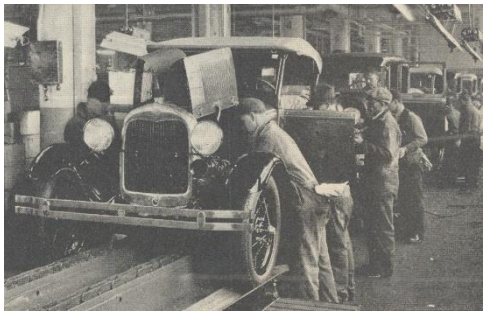
Develop a core competency in *software delivery* to produce products that are differentiated

… but good engineering on its own isn't enough

In the beginning …

…we just made them all **alike**

(efficient, but it didn't meet all customers' needs)



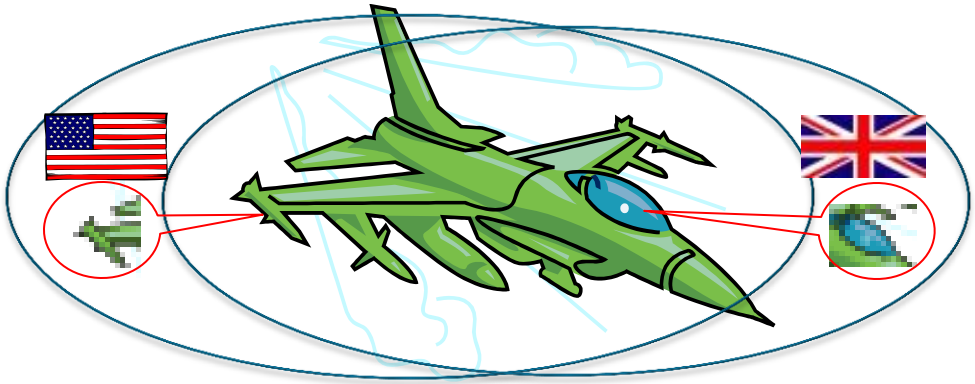
…or we built them **one-by-one** for each new customer

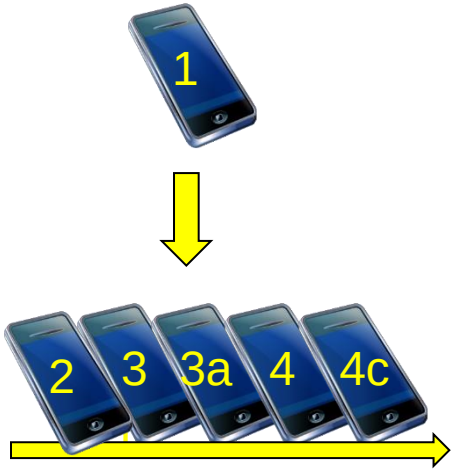
(it met the needs, but was very expensive)

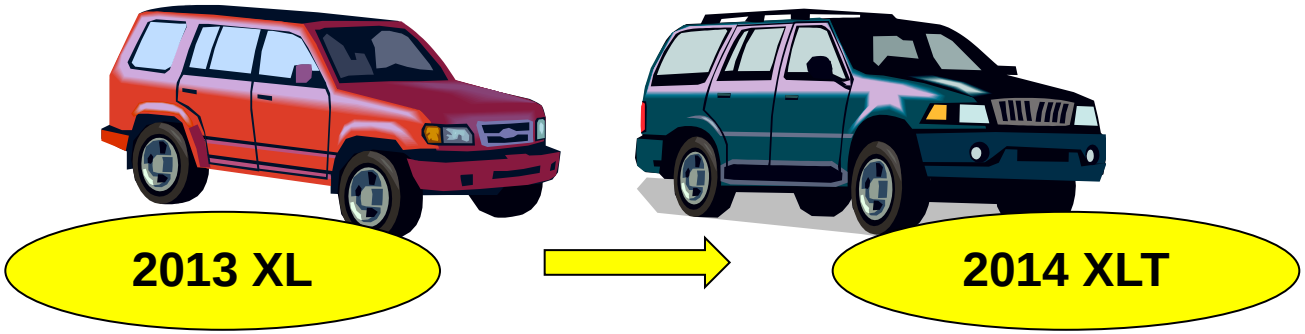
Now customers demand increasingly **specialized** and **customized** products and costs are going through the roof!

In reality …

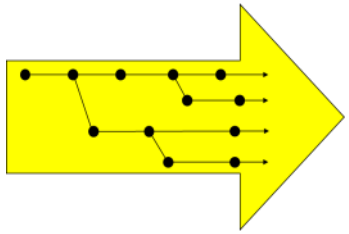
… many products have a high degree of **commonality** with just small **variations**…



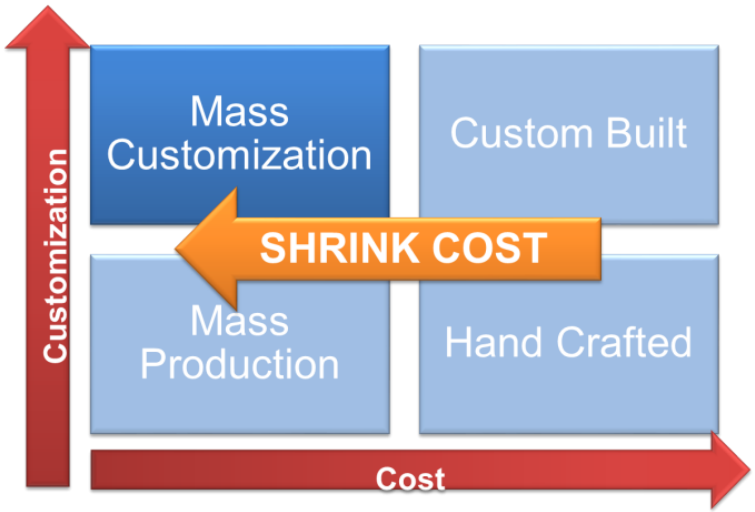




We need a new approach



- **Strategic** reuse of engineering artifacts (without just **copying**)
- Engineering from sets of **features** with dozens, hundreds or even **thousands** of product variants
- Management of product component versions and their **combinations**
- Strategic management of product family **evolution**



Result: More customization and variation to meet customer needs, but at a **lower cost**.

A scenario on the timeline…

A problem is found and change applied

Fix delivered from Program B Base variant, then to other family variants

A

B

Program B identifies and issue and fixes it

C

Parallel development …

Propagation of changes …

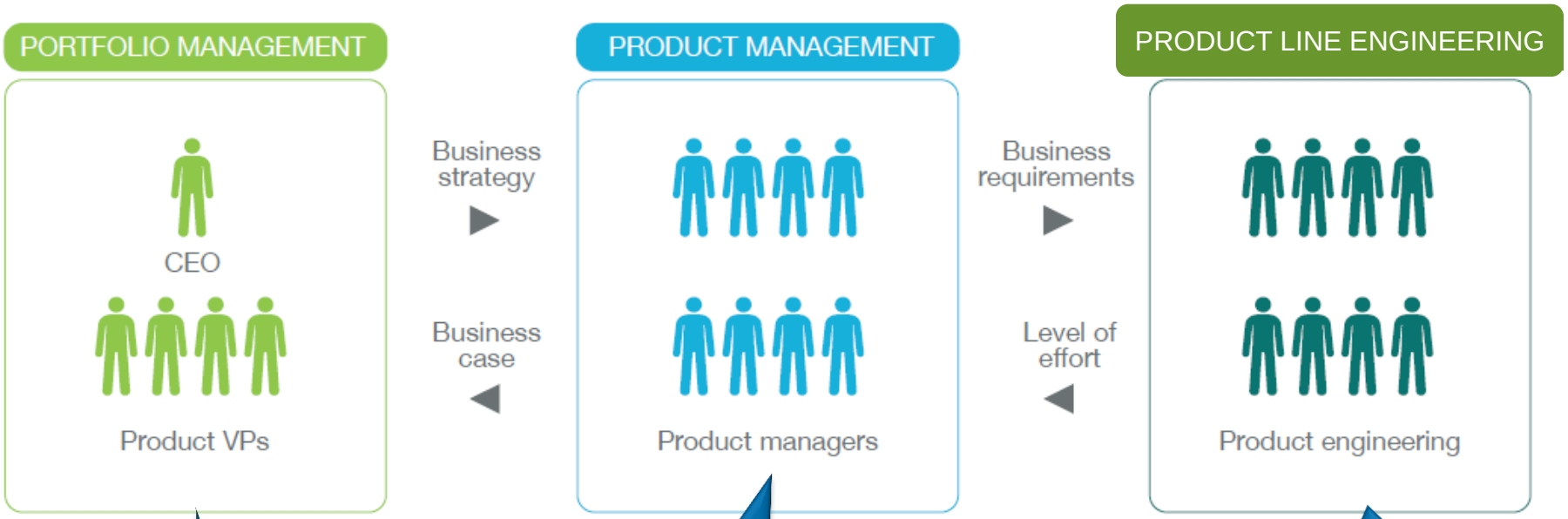
Product Line Engineering (PLE): The Path to Engineering Efficiency

The goal: Product Lines with high degree of reuse

Better reuse & variation management

- Reach more market segments
- Reduce development costs
- Reduce time to market
- Improve engineer productivity

Product Line Engineering is becoming a key component of business strategy, along with portfolio and product management

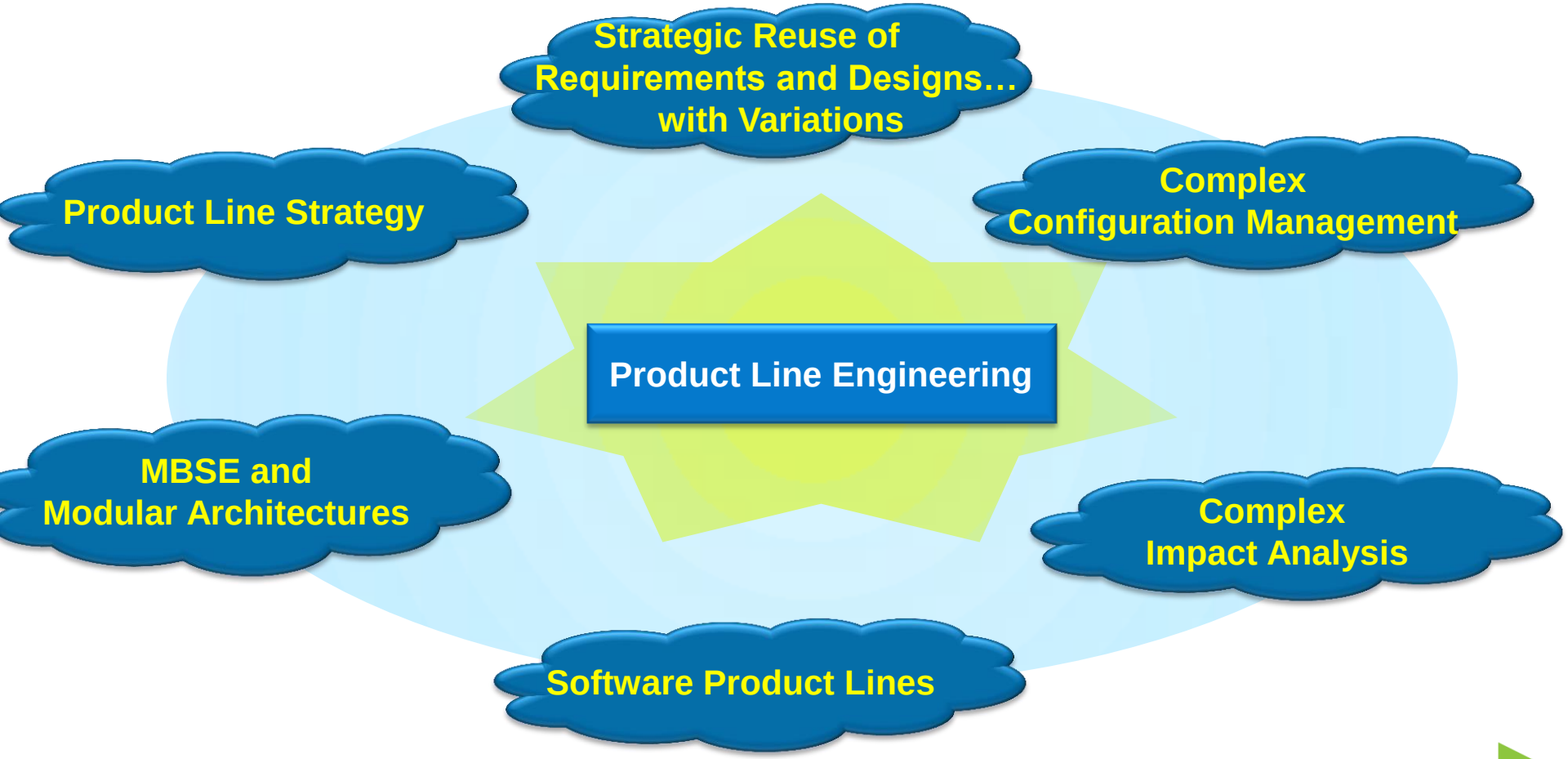


Pick the right products to build

Build those products right

Now build them as product lines
- Lower Cost
- Engineering Efficiency
- Reuse
- Time to Market

Needs Driving Toward a Product Line Engineering Strategy



Needs Driving Toward a Product Line Engineering Strategy

Product Line Strategy

"Our products are presented to the market in product lines already—now we want to better develop and engineer that way"

Needs Driving Toward a Product Line Engineering Strategy

Strategic Reuse of Requirements and Designs… with Variations

"This new system has much in common with the last one we built so we want to reuse requirements, designs, components, etc… without just making copies"

Avoiding "Clone and Own"

Needs Driving Toward a Product Line Engineering Strategy

"We manage versions, variants, branching and configuration at a low level but want to do this at all levels of our product and systems engineering"

Needs Driving Toward a Product Line Engineering Strategy

"Analyzing the impact of change across our complex set of interrelated products and systems is a challenge for us"

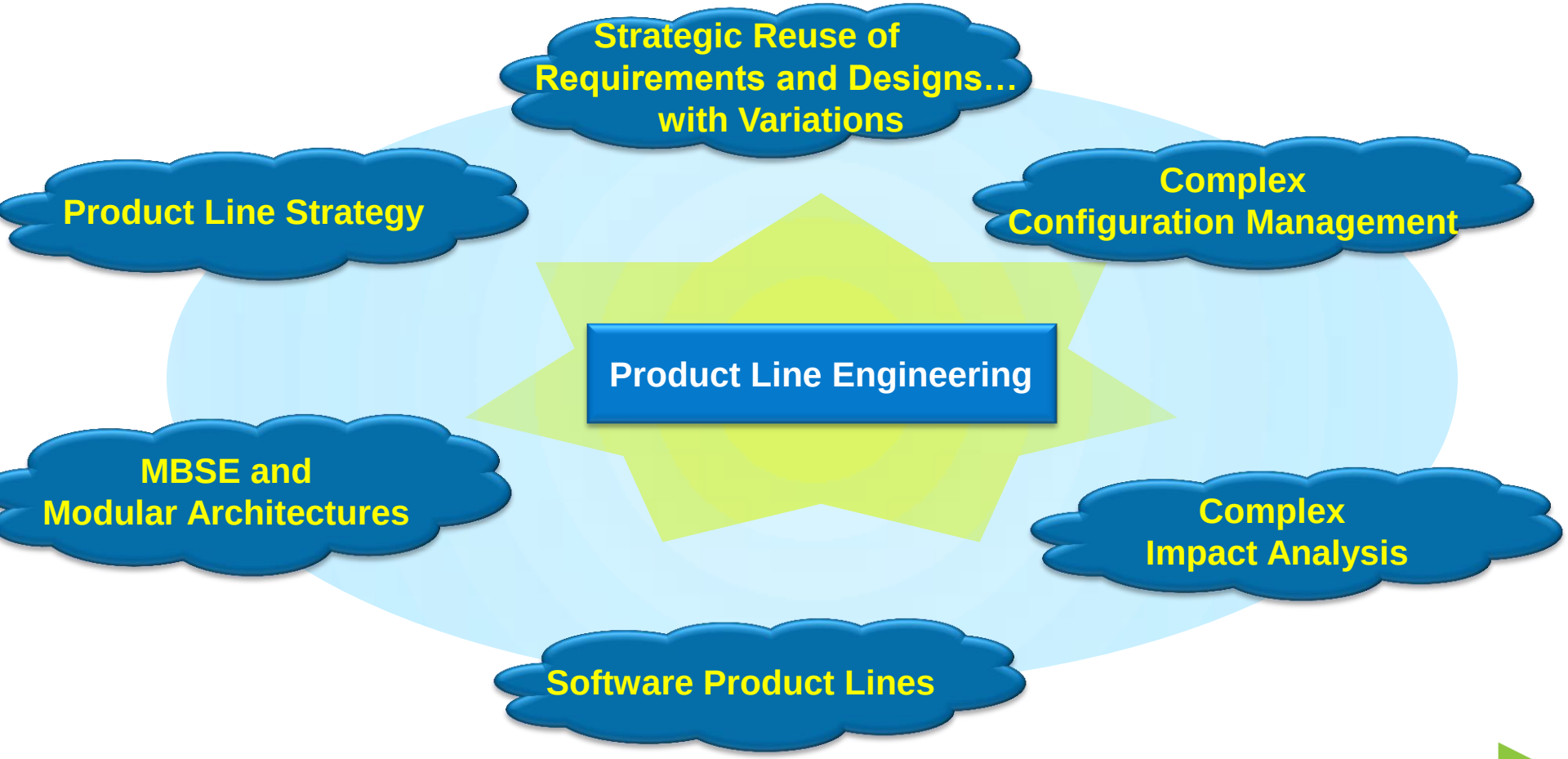
Needs Driving Toward a Product Line Engineering Strategy

"My software is developed in product lines and I want to extend this to my products and systems development"

Needs Driving Toward a Product Line Engineering Strategy

"We are pursuing a model-based systems engineering approach and want to build product line variations into our models"

Needs Driving Toward a Product Line Engineering Strategy



Consider the economic determinants

I cannot afford to engineer for reuse

I cannot afford NOT to engineer for reuse

Consider the economic determinants

I cannot afford to engineer for reuse

- We only reuse the same components a couple of times
- We don't have executive support to create a platform engineering team
- Each program is funded separately. The client won't pay for benefits that others will get
- The 2nd and 3rd programs wanting to reuse something have to bear the cost.
- It's the only practical approach

Consider the economic determinants

- It's the only way we can meet our **development cost** and **time-to-market** challenges
- Our executive team recognizes this and sponsors our strategic reuse transformation
- Our field servicing costs are way down too!

I cannot afford NOT to engineer for reuse

On the road to more **effective** and **pervasive** reuse

Example:
Automotive

3) System-level PLE
- Holistic reuse strategy across engineering domains
- System & feature level modeling
- Reuse of electrical and software with common logical architecture

2) Mechanical Platform and/or Software PLE
- Reuse of mechanical platforms and modular architectures
- Reuse of software through software PLE
- Disjointed reuse initiatives

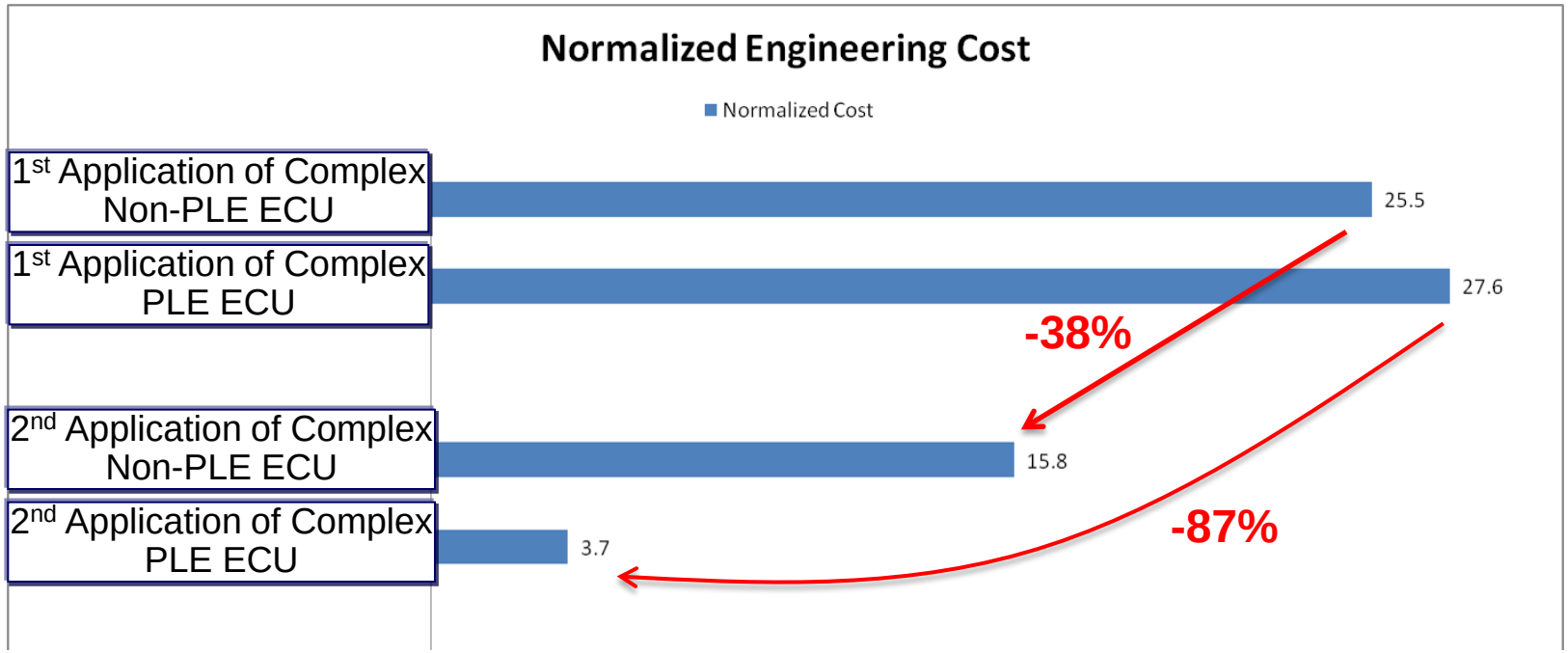
1) Documents and Components
- Copy and paste
- Limited traceability

General Motors – Case Study

GM has one of the most complex systems and software product line engineering challenges in the world

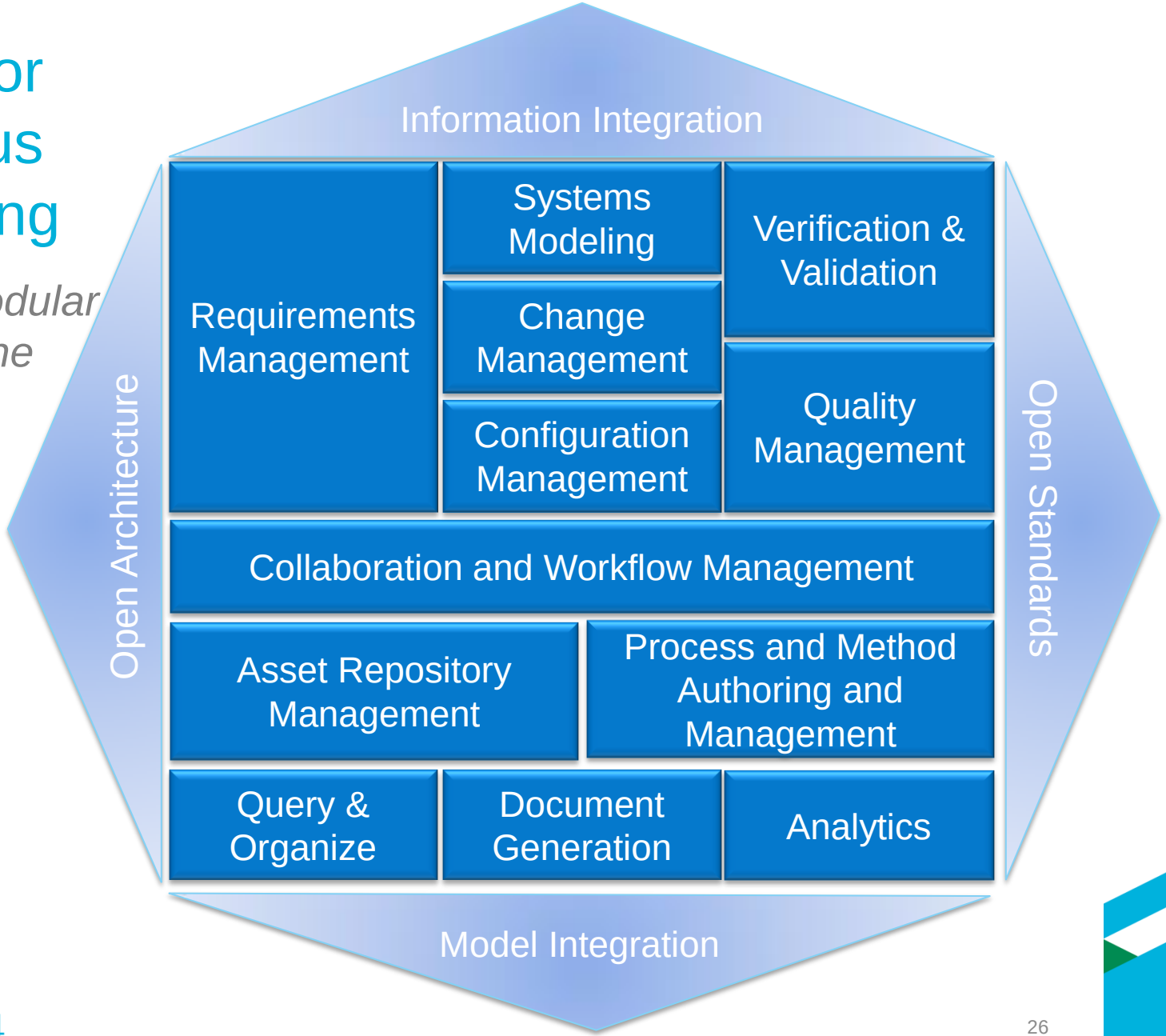
- 300 hierarchical subsystems
- Thousands of variant features
- Millions of product instances
- Tens-of-thousands of unique product variants
- Dramatic increase in product line variation due to emerging alternative propulsion systems
- Global diversity in legislative regulations
- Extreme economic and competitive pressures
- Product line and feature set evolves annually
- 15 concurrent temporal development streams

GM started a reuse approach (PLE) in software engineering with astounding results:

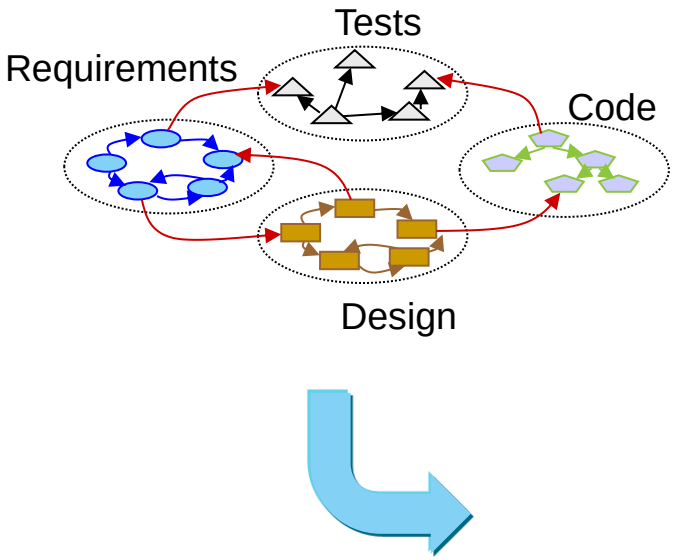


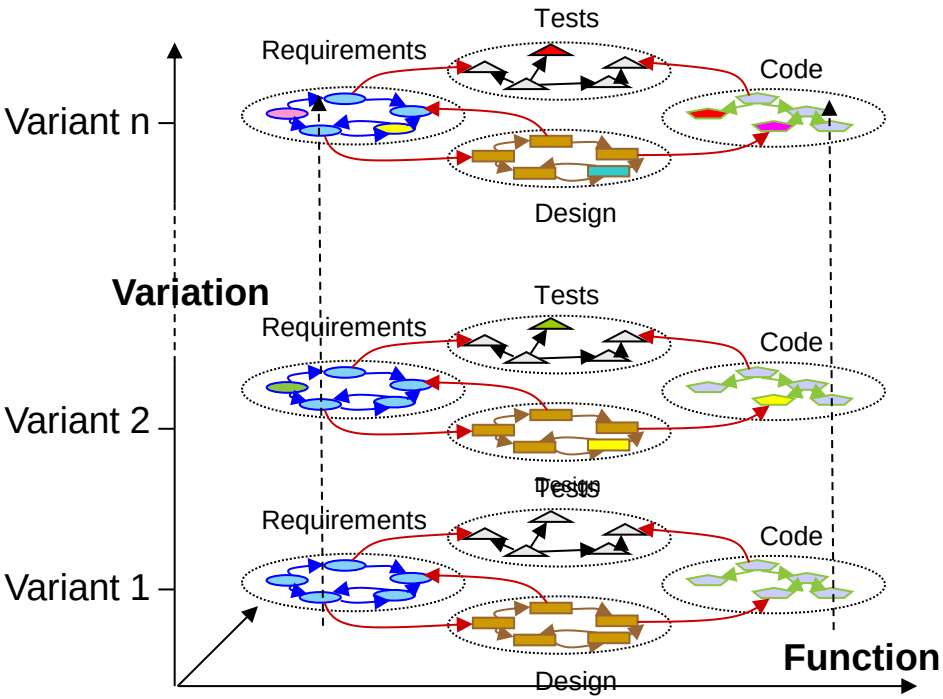
Rational Solution for Continuous Engineering

Integrated modular cross-discipline engineering solution

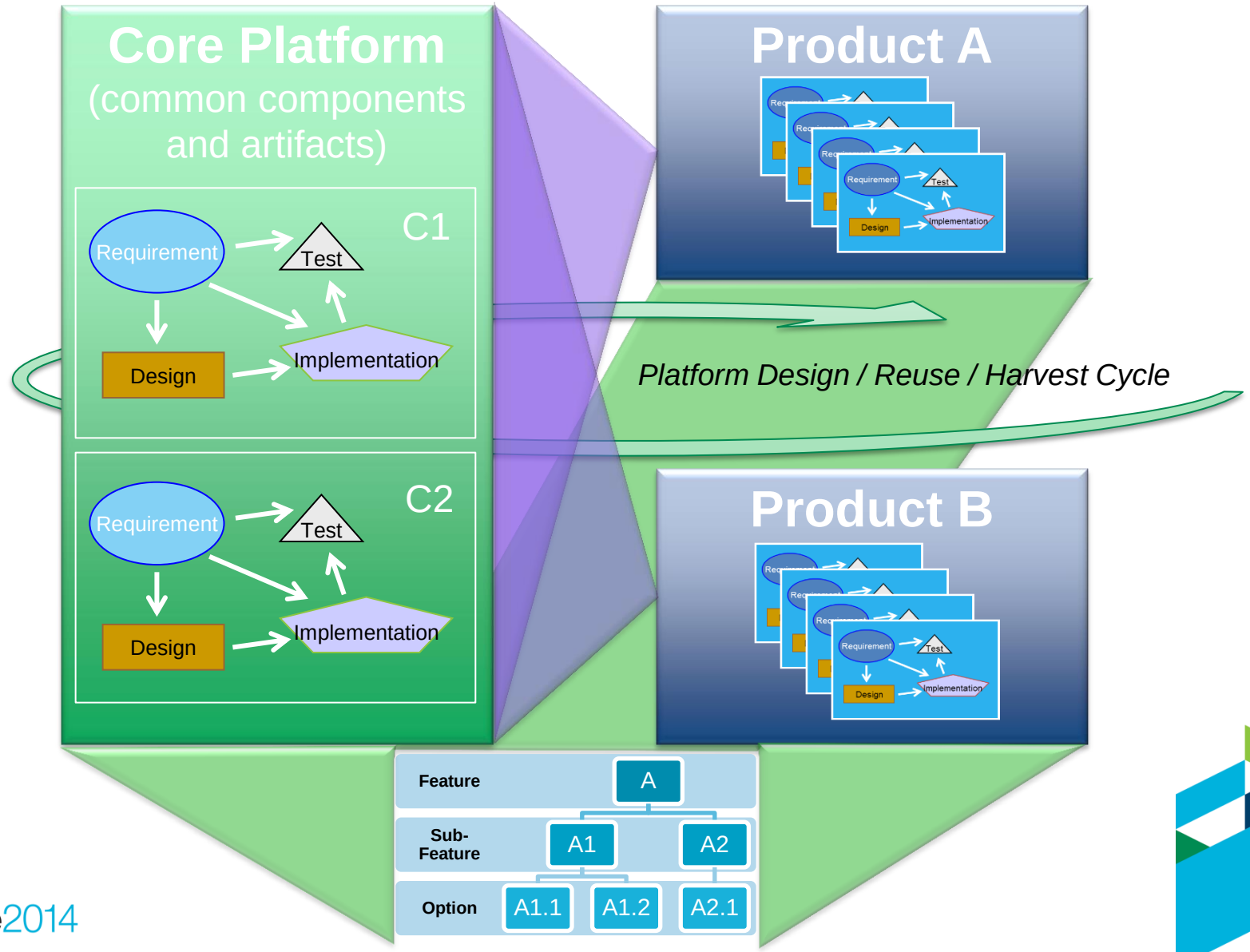


Working with product/component variants

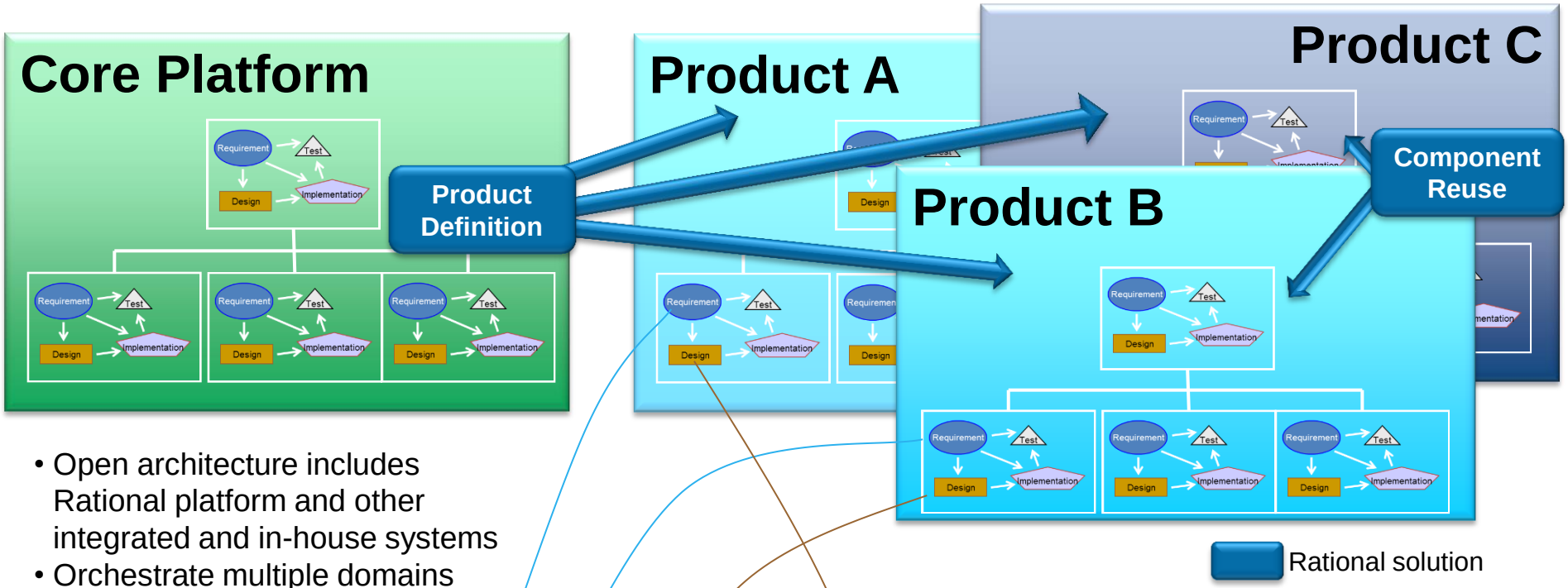




Thinking in Product Lines: Platforms, Reuse, Features



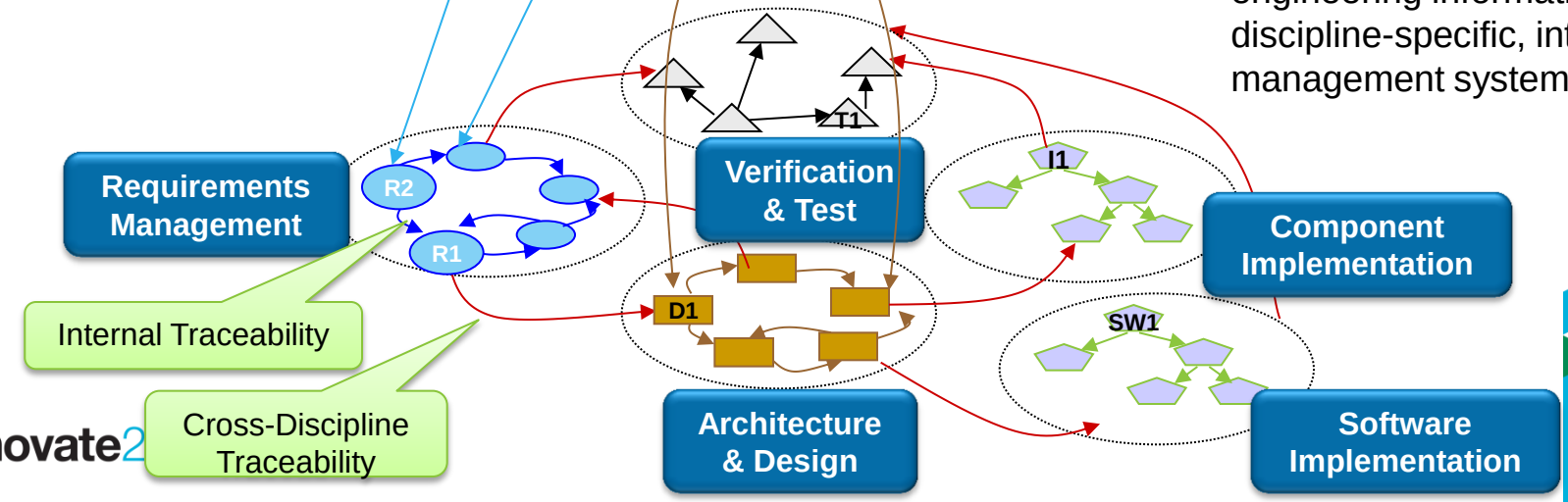
IBM Rational solution with product line



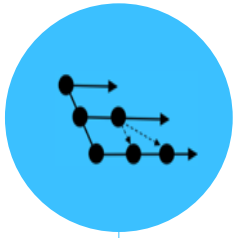
- Open architecture includes Rational platform and other integrated and in-house systems
- Orchestrate multiple domains
- Re-use all kinds of engineering artifacts

Rational solution

- Federated approach keeps engineering information in discipline-specific, integrated management systems

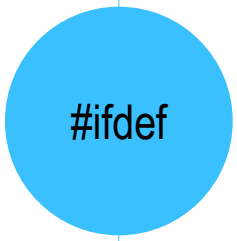


3 Patterns



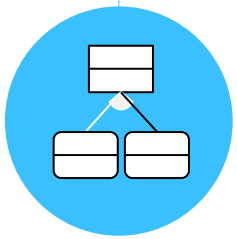
Multi-stream

- Configuration management approach
- Branching as primary pattern
- Reuse without “clone and own”



Parameterized

- Automated derivation
- General artifacts made specific with parameter values
- Simplifies complicated variations



Feature-driven

- Represents “problem space” familiar to business stakeholders
- Easier traceability from business stakeholders to engineering
- Complex feature combinations

Suggested next steps: build on a solid foundation

- Ensure a foundation of integrated methods and tools across engineering disciplines

- Develop comprehensive approach to configuration management and coordinate across product build space.

- If requirements variability is important, ensure that requirements are well-managed today, and traced to downstream work products such as design and test.

Suggested next steps: first steps with PLE

- Identify opportunities for strategic reuse
- Choose your product line approach: incremental or engineered for reuse?
- Define and implement transformation: in organization, development practices, etc.
- Take a measured approach

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Reuse and PLE Sessions at Innovate 2014

> Selected Sessions
> All Reuse/PLE Sessions

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Learn more: selected sessions

CEE-1512	Product Lines Development and Strategic Reuse With the IBM Rational Systems Platform (technical design vision)
CEE-2064	What's New in the Product Definition Tool for IBM Rational Engineering Lifecycle Manager (product)
DRM-1946	Increasing productivity through requirements reuse and variant management with Rational DOORS Next Generation (product)
CEE-2021	Product Line Engineering Meets Product Line Operations (BigLever Software)
CEE-1532	Variant Management for Complex Systems and Software Engineering (pure-systems GmbH)

Learn more: Expo Hall

Pedestals	Innovation Labs: Reuse & variant management
	Continuous Engineering: Strategic Reuse
Partners	BigLever Software
	pure-systems GbmH

Vision, Roadmap, Progress

- CEE-1905: The End of Cloning: Strategic Reuse and Product Line Engineering With the IBM Rational Platform - Barclay Brown & Daniel Moul
- CEE-1512: Product Lines Development and Strategic Reuse With the IBM Rational Systems Platform - Eran Gery, Mats Goethe, Jin Li
- CEE-2064: What's New in the Product Definition Tool for IBM Rational Engineering Lifecycle Manager - Nick Crossley
- CRM-1175: Requirements Configuration Management in IBM Rational DOORS Next Generation - Brian Steele and Richard Watson
- DRM-1946: Increasing productivity through requirements reuse and variant management with Rational DOORS Next Generation - Eran Gery & Daniel Moul
- DRM-1175: Requirements Configuration Management in IBM Rational DOORS Next Generation
- CEE-2309: Strategic Reuse: A Fundamental Approach for Success in Automotive Engineering - Brett Hillhouse

Customer Case Studies & Presen-tations

- CRS-1117: Case Study: Variant Product Design for Eaton Corporation - Joanne Scouler (co-presenting with customer)
- CEE-1181: Distributed Planning of Reusable System Parts With IBM Rational Team Concert for a Global Automotive Supplier - Jiong Xie, Soenke Seifarth, Robert Bosch GmbH
- CCC-1427: Automotive Supplier Automates Distributed Planning With IBM Rational Team Concert and Method Park Stages - Dimitrios Dentsas, Robert Bosch GmbH
- CRS-2478: Collaborative Automotive Software Engineering - Raz Yerushalmi, Christof Hammel, Robert Bosch GmbH
- CSE-1453: It's Electrifying: Leveling Up the Tool Platform to IBM Rational at Bosch Hybrid-Systems - Arne Bister, IBM Deutschland GmbH, Jörg Spranger, Robert Bosch GmbH
- CRM-1795: Model-Based Systems Engineering and Supplier Specification Documents - David Perkins & Doug Babcock, General Motors
- CEE-1796: From Idea to Road: A Vision for Application and Product Lifecycle Management Integration at General Motors - Ben Williams, Len Wozniak, General Motors Company

Business Partners

- CEE-1532: Variant Management for Complex Systems and Software Engineering - Danilo Beuche, pure-systems GmbH
- CEE-2021: Product Line Engineering Meets Product Line Operations - Charles Krueger, BigLever Software

Reuse with current capabilities (pre-PLE)

- DRM-1539: Reusing Requirements: Using Modules to Gain Efficiency While Avoiding Chaos - Ed Gentry
- DQM-1981: IBM Rational Quality Manager: The Basics, Advanced Topics and Best Practices - Paul Tasillo, John Nason, Allison Lynch [this is reuse pre-configuration management]
- CQM-1981: IBM Rational Quality Manager: The Basics, Advanced Topics and Best Practices
- CES-1995: Model-Based Approaches to Designing System Variants - Barclay Brown
- DCM-1027: Case Study: Configuration Lifecycle Management of Applications with ClearQuest at Avaloq - customer session [using existing CQ capabilities]

Relevant keynotes

- KEY-2490: Speeding the Delivery of Increasingly Complex and Connected Products With Continuous Engineering - Bret Greenstein et al.
- CRM-1118: IBM Rational Requirements Management Keynote - Morgan Brown, Richard Watson, George Decandio [will touch on requirements configuration management]
- DRM-1118: IBM Rational Requirements Management Keynote

Pedestals & Exhibits in the Expo

- IBM Continuous Engineering: Strategic reuse
- IBM Innovation Labs: Reuse and product variant management
- BigLever Software
- pure-systems GmbH

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