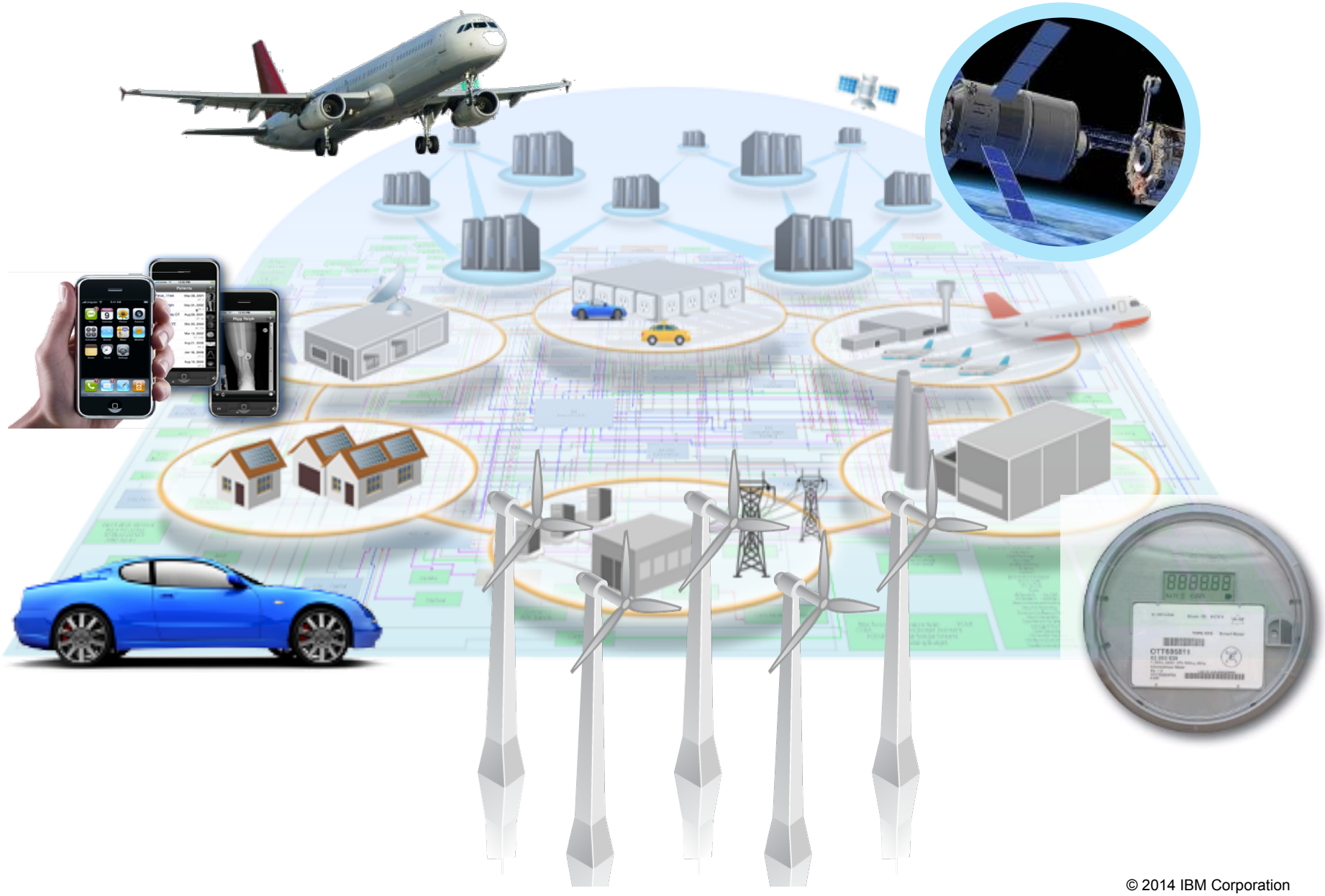
Continuous Engineering Overview

Speed the delivery of sophisticated and connected products

Continuous Engineering. Speed the delivery of sophisticated and connected products



Integrated software development is more important than ever

– Manufacturers are struggling to manage the resulting product sophistication

Aerospace and defense

Today's F35 has 10 million lines of code on board, twice the amount on the F-22, another stealth fighter.

Energy and utilities

Smart meters for water utilities will lead to $29.9 million in sales by 2017 compared with $10.3 million in 2011.

Automotive

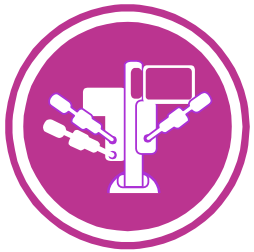
Electronics drives 80 percent of the automotive industry's functional innovation — software is the key to most of it.

Telecom

Between 2012 - 2016, mobile data traffic will multiply tenfold, with video content acting as the biggest driver.

Electronics

By 2014, 230 million Smart TVs will be installed with 57 million homes watching web-based streams over broadband.



Medical devices

The da Vinci S surgical robotic system:

- 1.4 million lines of code
- Computing power of 7 laptops
- 10,000 individual parts

The Product Development Evolution

Market forces the nature of products and systems and the way we develop them

Increasing end user expectation for more specialized and tailored product ranges

Exponential increase in machine to machine and machine to cloud connections

Addressing security and regulatory compliance in a connected world

Development trends

Mechanical Engineering

Electrical Engineering

Systems & Software Engineering

Product development processes and technologies need to evolve

Continuous engineering

New approach to Systems Engineering

Continuous engineering is an enterprise capability that speeds delivery of increasingly sophisticated and connected products by helping businesses to evolve their engineering practices to adapt to the accelerating pace of business change.

"Turn Insight into Outcomes"

Unlocking Engineering Knowledge

Right decisions at the right time

"Measure twice, cut once"

Continuous Verification

Prevent rework & increase time to quality

"Don't reinvent the wheel"

Strategic Reuse

Increase design efficiency

Unlocking Engineering Knowledge

Turn Insight into Outcomes

Access, unlock and understand all engineering information no matter where it resides

I need to **share information** from multiple disciplines with **large groups of stakeholders**.

My data represents a **huge amount of valuable product knowledge**. How can I use this insight to **gain a competitive advantage**?

I need to **show traceability across domains**, even across tools **from different vendors**. Today it takes me weeks of manual effort.

I need a **faster and easier** way of finding the information I need **no matter where it is stored**.

It's about enabling the right decisions at the right times

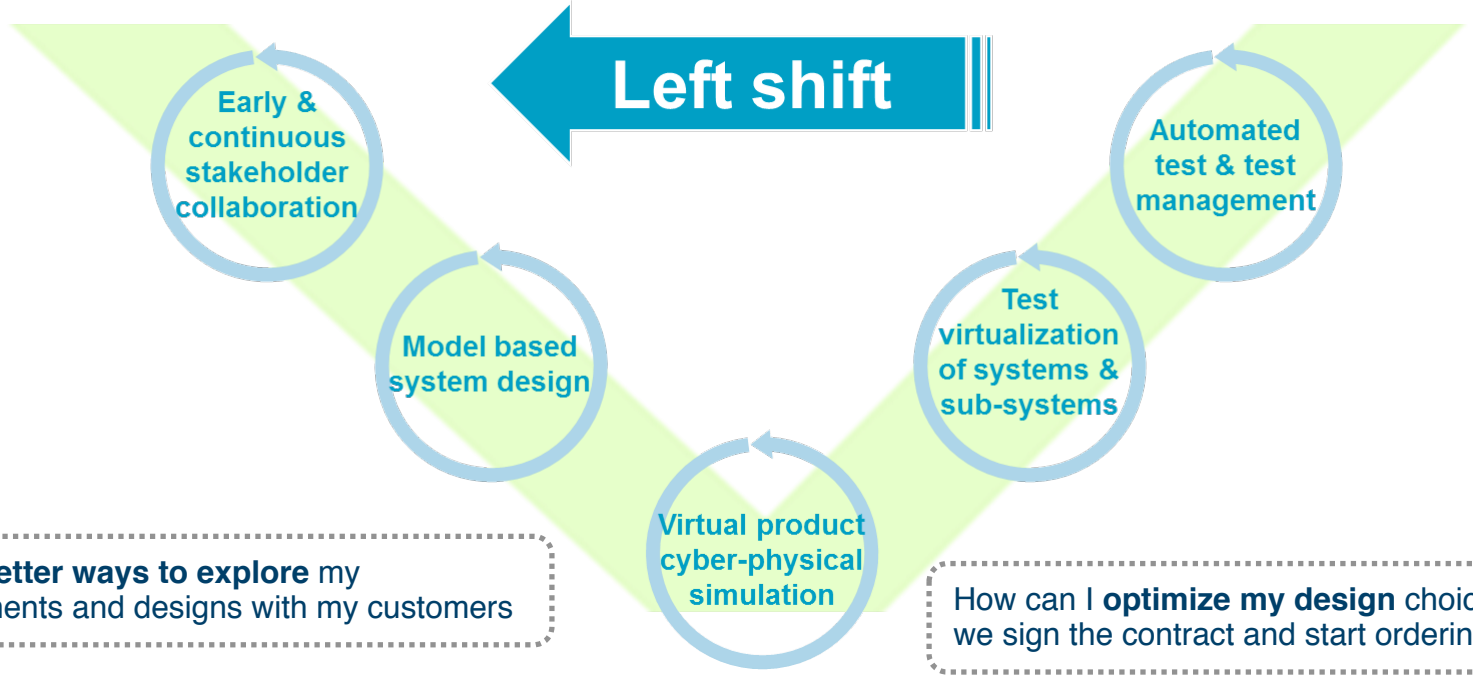
Unlocking Engineering Knowledge

- Make it easier to analyze engineering relationships across the large projects
  - Easily construct new lifecycle views, without programming (RELM v5.0)
  - Work more quickly and easily in larger teams with improved user concurrency (RELM v5.0, DOORS NG v5.0, Rhapsody v8.1)
  - Collaborate more quickly and easily with reduced time to load work item and plans (RTC v5.0)
  - Faster overall RM performance using a new 64-bit client (DOORS v9.6)
- Improve the way engineers communicate through requirements
  - Share traceability perspectives more easily using new dashboard widgets (DOORS NG v5.0)
  - Use Javascript extensions to tailor your RM capabilities or perform custom analytics (DOORS NG v5.0)
  - Capture and manage traceability more easily using drag and drop link editing using DOORS NG (DOORS NG v5.0)
  - Drag and drop link support (DOORS NG v5.0)
- Improve the speed of reporting
  - Reduce time to load data into the data warehouse by up to 10x using the new data collection component

Continuous Verification

Measure Twice, Cut Once

Verify throughout the product lifecycle to reduce rework and achieve faster time to quality



I need **better ways to explore** my requirements and designs with my customers

How can I **optimize my design** choices before we sign the contract and start ordering parts?

My hardware won't be ready for months how can I use **models & simulation** to verify the behavior of the software and hardware together and **reduce my technical risk earlier?**

I have to actually drive the car to run some of my tests. I need **ways of ensuring proper test execution** and to make it easy to capture the results.

It's about achieving evidence based confidence in your design as early and as quickly as possible

Continuous Verification

- Enable greater design confidence early in the lifecycle
  - Design, model, simulate and analyze virtual prototypes of your products using hybrid co-simulation built on industry standards (FMI/FMU) (Rhapsody v8.1)
  - Combine Rhapsody SysML models with ITI SimulationX Modelica models to perform real time simulations of hardware and software integrated together (Rhapsody v8.1)
- Make test management more scalable and more flexible
  - Teams with complex requirements can more easily distribute testing between different test plans using requirement module views (RQM v5.0 DOORS NG v5.0)
  - Engineers that need to execute tests away from the office can now do so using a mobile device (RQM v5.0)
- Build a broader solution for virtual design, simulation, & test in partnership with National Instruments
  - Verify performance early by executing Rational Rhapsody designs in the NI VeriStand real-time framework (RQM v5.0)
  - Automate test management using the enhanced integration between Rational Quality Manager and NI TestStand (National Instruments Test Integration Adapter for RQM v2.0)

Strategic Reuse

Don't Reinvent the Wheel

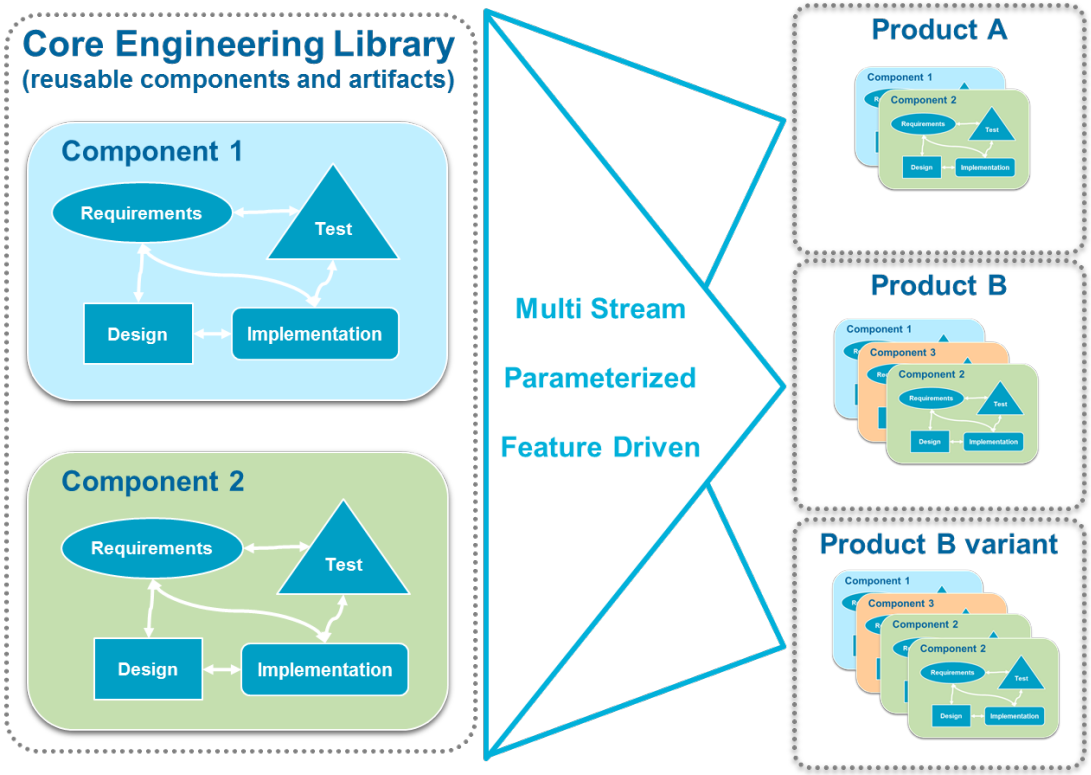
Engineer for continuous reuse in complex product lines or exploit simpler reuse patterns in line with your economic fundamentals

I have several component designs that we know are reliable. I want to **easily re-use the requirements, code and tests in all of my new products**.

I have a serious defect in one of our products, which was copied from another, which was derived from another. We need to know **how far this defect spans across our product range**.

My team has created a set of **reusable components**. How do I select the **right components for each variation of my product**?

The business wants us to offer a broad product line based on a core set of technologies. Help me create a **feature-driven** design based on a top-down architecture.

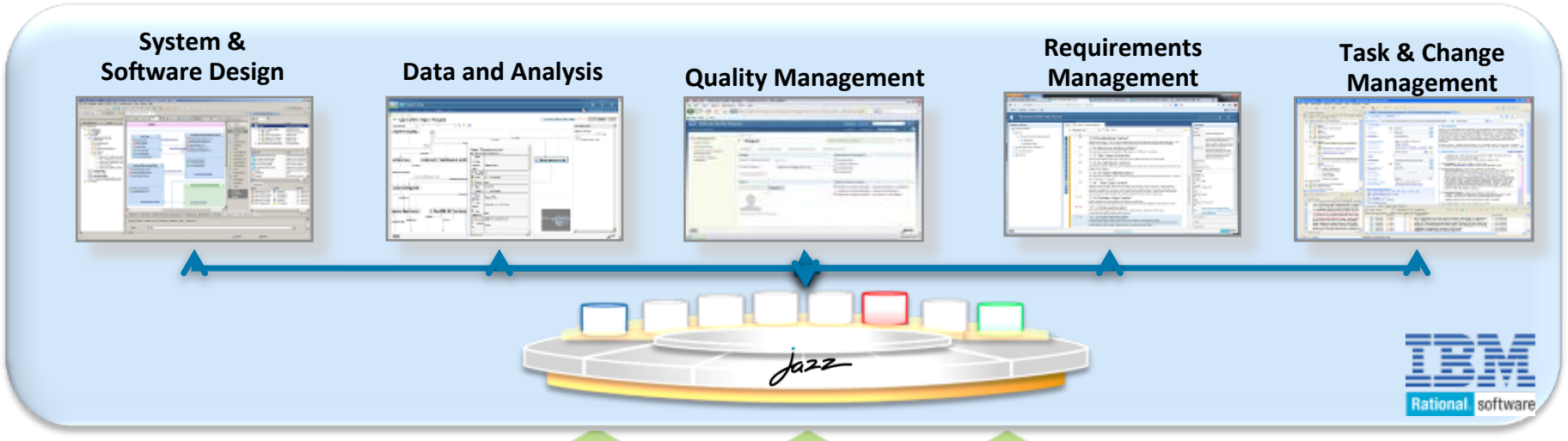


It's about maximizing investment by improving engineering efficiency and productivity

Strategic Reuse

- Specify reuse and variation
  - Enhance the way products and components can be reused by defining products as configurations of hierarchically-related components (RELM v5.0)
- Better planning and working in a reuse environment
  - Better hierarchical planning for managing development of hierarchically-related components (RTC v5.0)
  - Simpler to deliver changes in a multi-steam, multi-variant environment with enhanced merge gap handling (RTC v5.0)
- Requirements Configuration Management
  - Try out your requirements reuse scenarios using Rational DOORS Next Generation with Configuration Management Beta-1 available on Jazz.net

Broaden the solution with an ecosystem of industry integrations



Real-Time Testing

NATIONAL INSTRUMENTS

Electrical Design

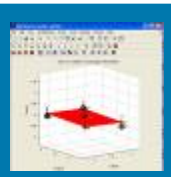
Mentor Graphics

Product Lifecycle Management

SIEMENS PLM SOFTWARE
SIEMENS

Product Line Engineering

BigLever Software, Inc.



Multi-domain Simulation

MathWorks

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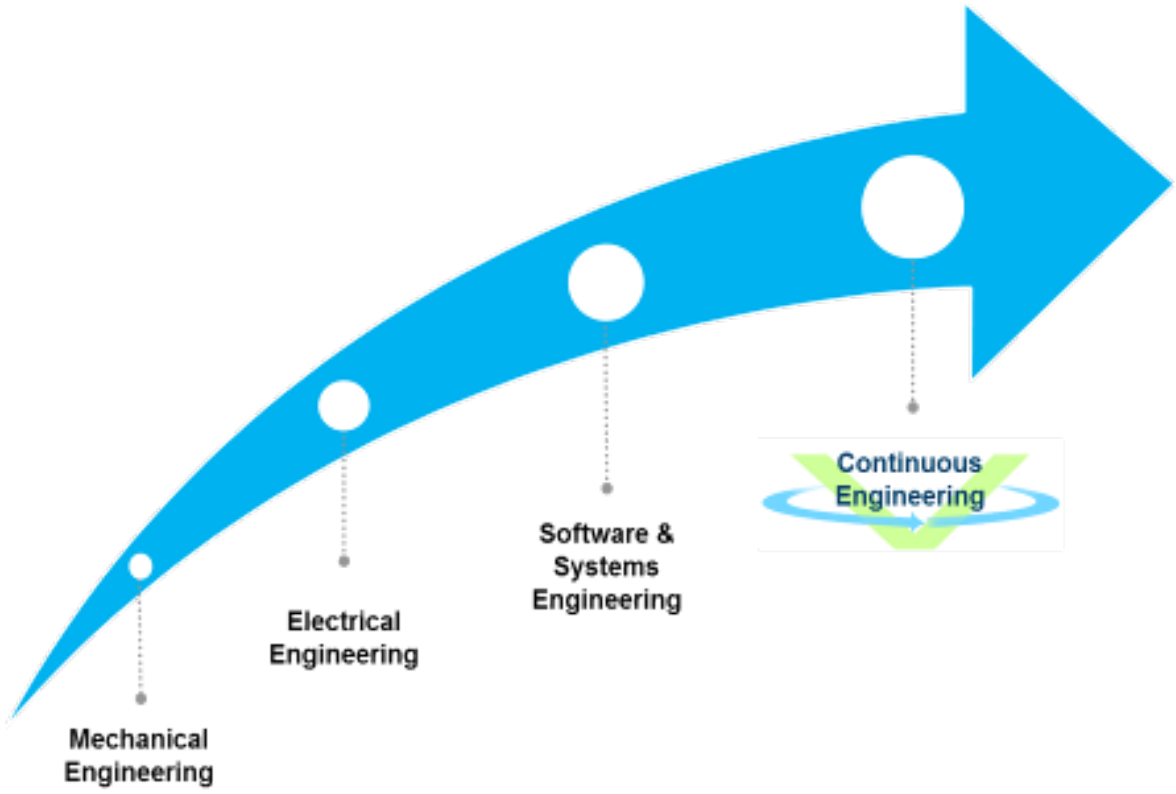
Continuous Engineering

Evolve your engineering practices to turn today's market trends into tomorrow's competitive advantage



Unlock Engineering Knowledge

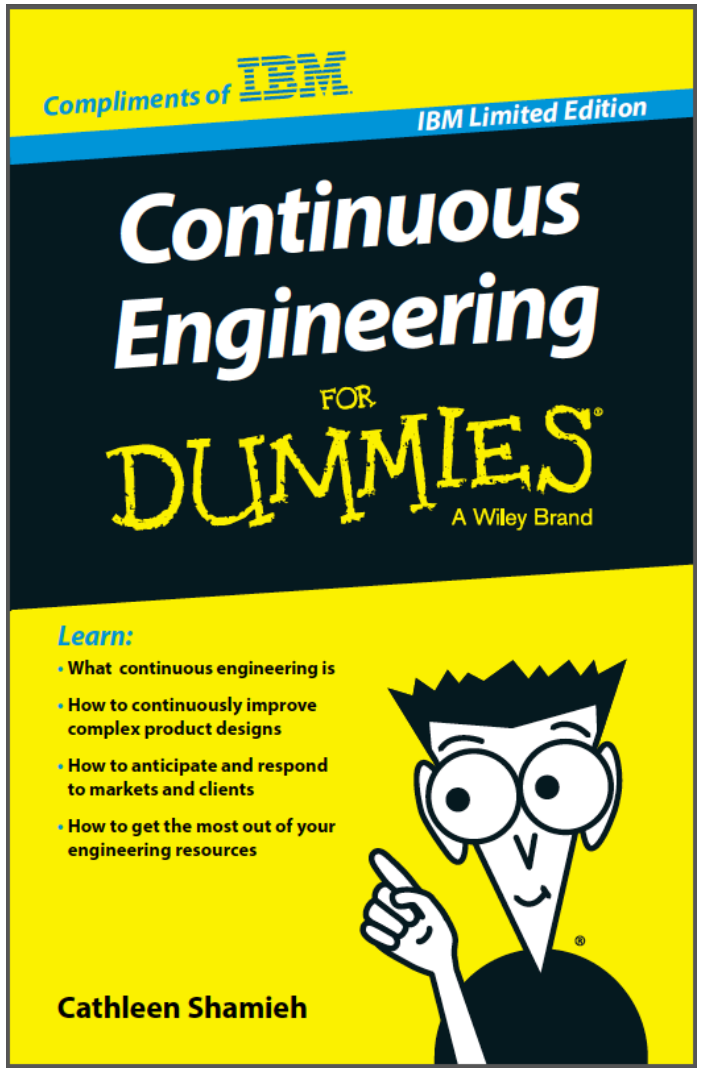
Access, unlock and understand all engineering information, regardless of source – to enable the right decisions at the right times

Continuous Verification

Verify requirements and design at all stages of the product lifecycle – to prevent rework and achieve faster time to quality

Strategic Reuse

Increase design efficiencies, engineer product lines, and tame complexity



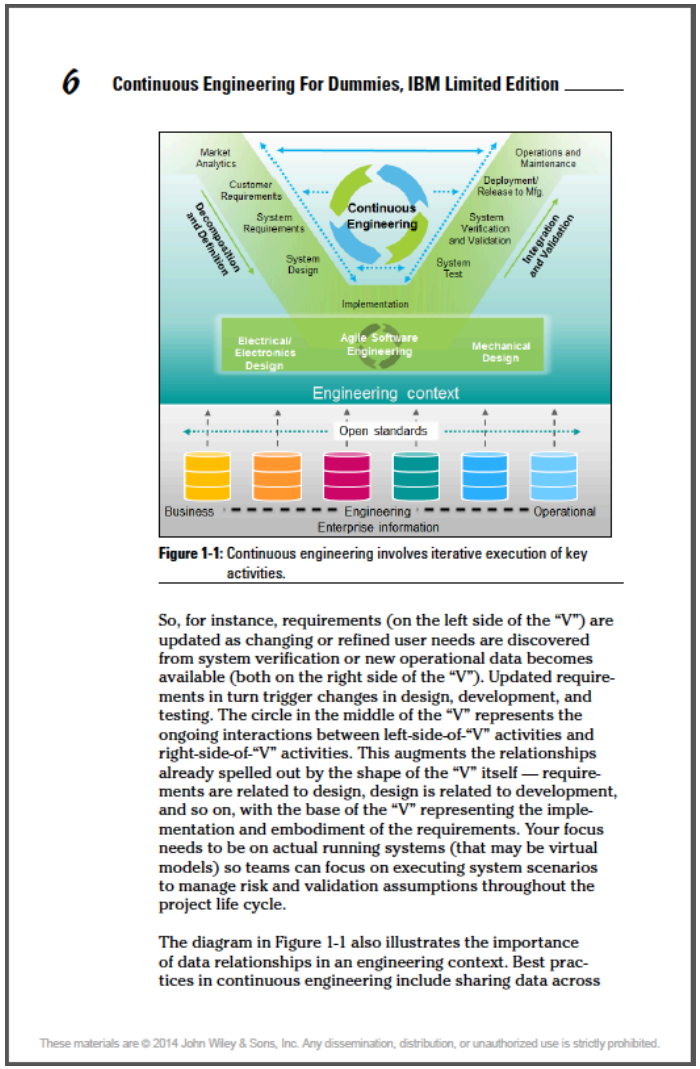


Figure 1-1: Continuous engineering involves iterative execution of key activities.

So, for instance, requirements (on the left side of the "V") are updated as changing or refined user needs are discovered from system verification or new operational data becomes available (both on the right side of the "V"). Updated requirements in turn trigger changes in design, development, and testing. The circle in the middle of the "V" represents the ongoing interactions between left-side-of-"V" activities and right-side-of-"V" activities. This augments the relationships already spelled out by the shape of the "V" itself — requirements are related to design, design is related to development, and so on, with the base of the "V" representing the implementation and embodiment of the requirements. Your focus needs to be on actual running systems (that may be virtual models) so teams can focus on executing system scenarios to manage risk and validation assumptions throughout the project life cycle.

The diagram in Figure 1-1 also illustrates the importance of data relationships in an engineering context. Best practices in continuous engineering include sharing data across

Visit Systems and Software Engineering solution at jazz.net

https://jazz.net/products/sse/

IBM Rational Solution for systems and software engineering

Get started with one or more practices…

- Access and link to any engineering artifact regardless of vendor, tool, version
  - Access engineering data where it resides
  - Utilize best of breed tools on a common integration platform
- Analyze engineering relationships and their impact across the design lifecycle
  - Remove tool boundaries to unlock engineering insight
  - Enable collaboration across engineering domains
- Proactively obtain actionable insight from big data analytics and operational data
  - Exploit patterns found in big data to optimize product engineering

"Turn Insight into Outcomes"

Unlocking Engineering Knowledge

Access, unlock and understand all engineering information, regardless of source – to enable the right decisions at the right times

Get started with one or more practices…

- Demonstrate requirements coverage
  - Ensure every requirement is supported by a test
  - Be alerted when test fails or requirement changes
  - Automate testing and test management
- Employ a model-driven approach for requirements and design
  - Use MBSE for requirements specification
  - Verify architecture using system level modeling (SysML)
- Utilize multi-domain hybrid simulation
  - Integrate multiple platforms/components coming from different companies in the supply chain
  - “Verify by simulation” (software, hardware, cyber-physical)

“Measure twice, cut once”

Continuous Verification

Verify requirements and design at all stages of the product lifecycle – to prevent rework and achieve faster time to quality

Get started with one or more practices…

- Ad-hoc
  - Opportunistically reuse what you can; copy where necessary
- Multi-stream
  - Manage configurations of requirements, designs, tests, and software. Branch an existing product to create a new one, addressing hot spots where reuse will bring significant return.
- Parametric
  - Derive product variants automatically from a product platform based on parameters. Variation is defined as part of the product definition. Parameters enable conditional inclusion of components in product definitions.
- Feature model-driven
  - Use a product feature model as the skeleton for variant management. Products are assembled from features as required.

"Don't reinvent the wheel"

Strategic Reuse

Increase design efficiencies, engineer product lines, and tame complexity

PLM integrations status

Current scope of Lifecycle Integration Adapters for PLM tools

PTC Windchill PLM with an edge. NEW

- Integration with RTC for CM
- Established Design Partner Program validating early implementations of adapter
- Targeting 2014-Q3 availability for CM integration

DASSAULT SYSTEMES ENOVIA

Dassault ENOVIA

- Integration with RTC for CM to begin July 2014
- GA capabilities targeted for 2015-Q1

SIEMENS PLM Software

- Siemens PLM and IBM working together on an integration based on OSLC
- Plans to support Change Management use case between TeamCenter and RTC
- Aligned with TeamCenter Release 11 targeted for 4Q-2014 time frame

SAP PLM

- Exploring DOORS – SAP PLM integration
- Targeting PoC in 2014-Q3

ORACLE AGILE Product Lifecycle Management

- Exploring business development funding options.

aras corp PLM

- Exploring business development funding options