Keynote: Trends and Innovations in Complex Systems Development

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IBM Rational Software Development Conference 2008

WHERE TEAMS ARE R-HEROES

IBM

Rational. software

27 Years Old and 5 Years Young

Individuals → **Local Teams** → **Global Teams**

2008

- **28,000 Customers**
- **2,000 Rational Software Developers**
- **40% Growth Since 2003**

A&D Example – Moving to Network Centric Systems

Previous generations

Isolated systems

- **individual systems on the ship designed independently**
- **threat nature changing, requires more dynamic response**
- **move to ships as collection of assets and capabilities that can be rapidly assembled in support of new missions**

Network Centric System – Zumwalt DDG 1000

- Total Ship Computing Environment (TSCE)
  - IBM Blade servers running RT Linux & IBM WebSphere Real-Time java
- Operates on-board functions (traditional embedded real-time such as radar, weapons control)
  - Design of systems combining IT & Embedded
- Connect to larger net-centric operations for command and control
  - Planning of missions/capabilities

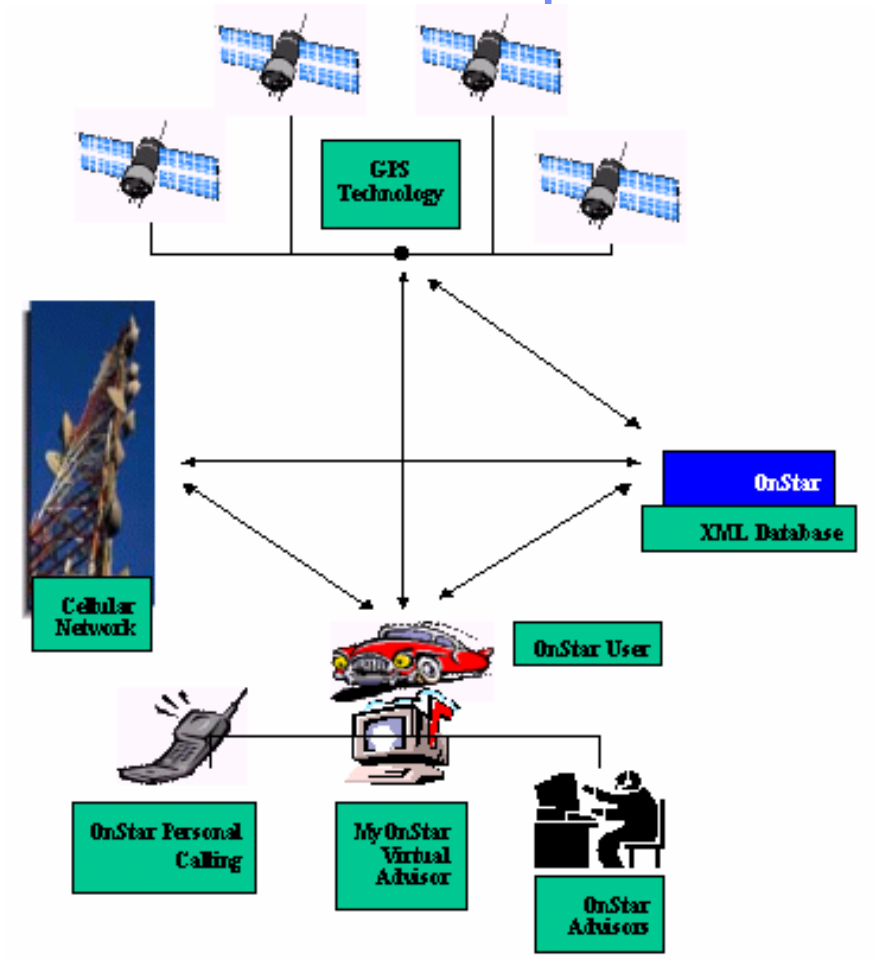
Raytheon

System integrated with IT

Automotive Example – Onstar

Isolated system

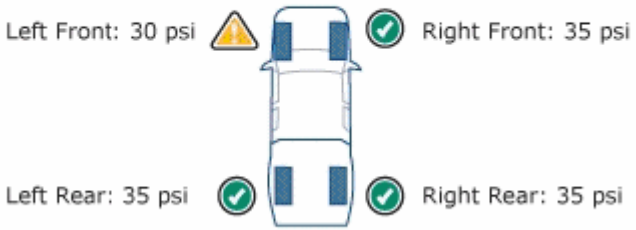
Automotive Example – Onstar



CRASH REPORT	
AIR BAG STATUS	DEPLOYED
MAXIMUM VELOCITY AT IMPACT	24 MPH
DIRECTION OF IMPACT	FRONT
MULTIPLE IMPACTS	NO
ROLLOVER	NO

Tire Pressure Monitoring: Low

- Recommended tire pressure — Front: 35 psi, Rear: 35 psi
- One or more tires may require inflation to optimize performance and fuel economy



More Information

System Integrated with IT

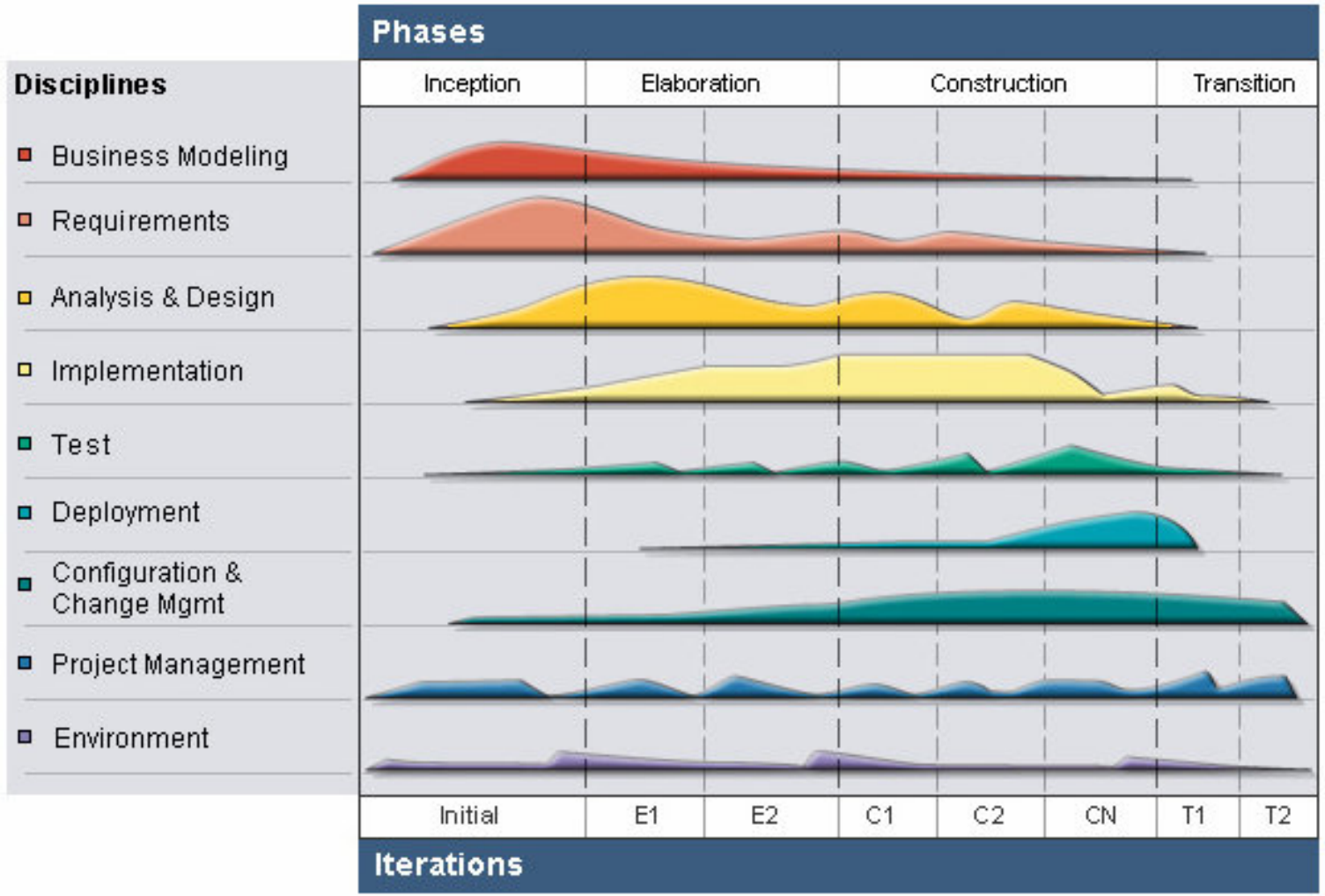
Source: http://faculty.darden.virginia.edu/GBUS885-00/Documents/OnStar_rev0907a.pdf

What do we learn from looking at these examples?

- The System Lifecycle governs your priorities & investments
  - From Concept, Development, Production, Utilization, Support through Retirement
  - This may be months in fierce markets (Mobile devices)
  - Years in A&D systems (B-52 = 50+ years)
- There is a rise in the importance of architecture
  - Architectural standards and principles make it possible to integrate disparate systems in a logical and structured way (e.g. using SOA)
  - Architecture enables a product line approach to maximize return on R&D
- There is a blurring of software and systems development
  - Not so clear where one ends and the other begins
  - Best practices and frameworks being shared across domains

An Experience Report

Rational Unified Process



Systems Development

Initiatives extend beyond a single software development project

Single	Multiple?
Software	Software / hardware / people / information?
Development	Development / operations?
Project	Programme?

Commercial Initiatives

Architecture is key!

- Enterprise architecture
  - Defining an architecture that underpins a number of systems
- Strategic reuse
  - Developing reusable assets that are used within a number of systems
- Systems engineering
  - Developing a system that contains elements of hardware, software, workers and data
- Enterprise Application Integration
  - Developing a solution that includes the integration of a number of legacy systems
- Packaged application development
  - Developing a solution that includes the configuration of a packaged application, such as an ERP or CRM solution
- Outsourced development
  - Defining an architecture that lends itself to the outsourced development of its constituent parts, whilst ensuring the quality and integrity of these parts
- Service-Oriented Architecture
  - Supporting the creating of composite applications whose parts are reusable services

Definitions of Architecture

Architecture is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution. [IEEE 1471]

The software architecture of a program or computing system is the structure or structures of the system, which comprise software elements, the externally visible properties of those elements, and the relationships among them. [Bass]

[Architecture is] the organizational structure and associated behavior of a system. An architecture can be recursively decomposed into parts that interact through interfaces, relationships that connect parts, and constraints for assembling parts. Parts that interact through interfaces include classes, components and subsystems. [UML 1.5]

Characteristics of Architecture

An architecture defines structure

An architecture defines behaviour

An architecture is concerned with significant elements

An architecture meets stakeholder needs

An architecture conforms to an architectural style

An architecture is influenced by its environment

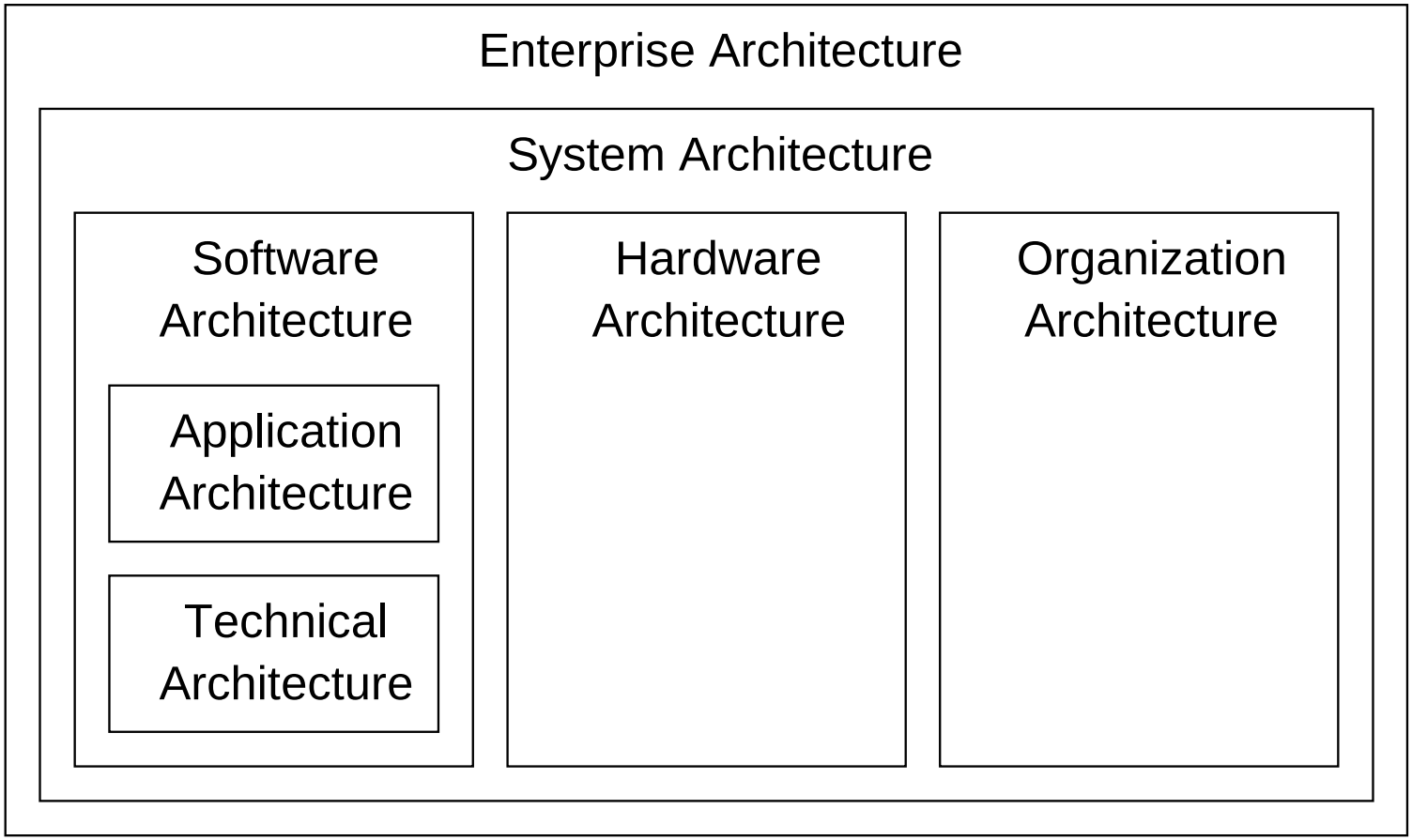
An architecture influences organizational structure

An architecture is present in every system

An architecture embodies decisions based on rationale

"*The life of a software architect is a long and rapid succession of suboptimal design decisions taken partly in the dark.*" [Kruchten]

Architecture Comes in Many Forms



Benefits of Architecting

Architecting helps manage complexity

Architecting ensures architectural integrity

Architecting provides a basis for reuse

Architecting addresses system qualities

Architecting drives consensus

Architecting reduces maintenance costs

Architecting supports impact analysis

Architecting supports the planning process

Enterprise, Business and System

Enterprise

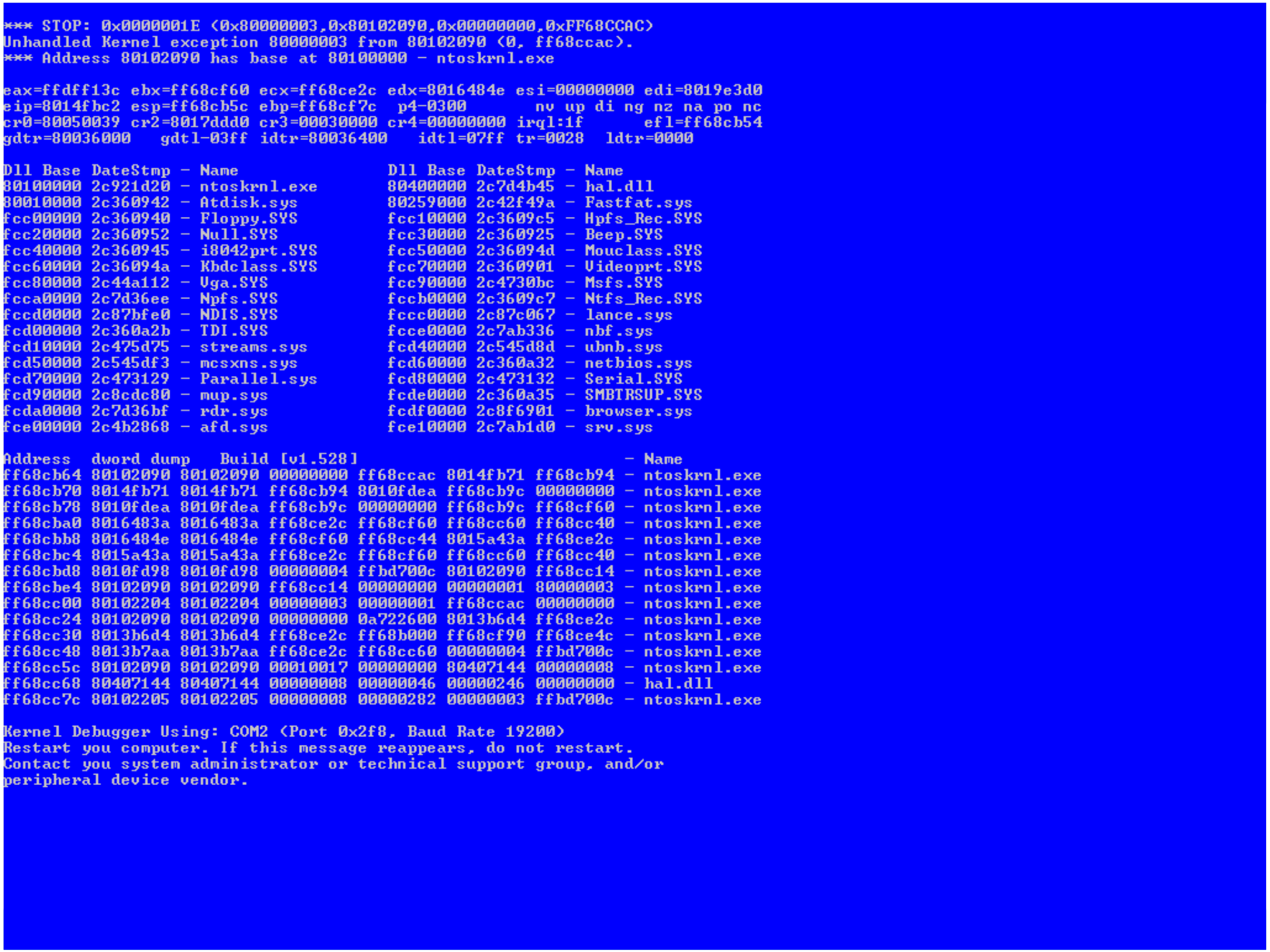
- Set of resources that are used to meet a business need or mission
- Enterprises can cross organization and even business boundaries
- Enterprises provide value to their stakeholders (e.g. stockholders, community, nation, etc.)

Business (Organization)

- A part of an enterprise responsible for one or more business processes (may also be Business Unit, Segment, etc.)

System

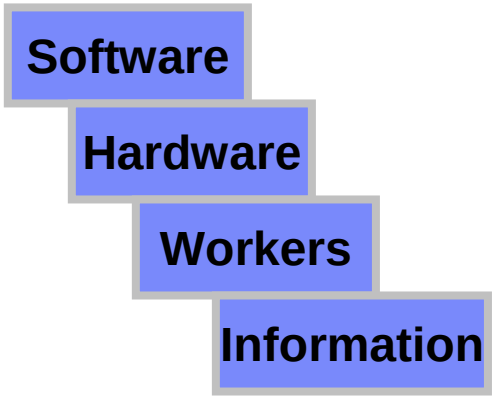
- An entity consisting of hardware, software, workers and information ... that provides services used by an enterprise in meeting its purpose or mission


*** STOP: 0x0000001E (0x80000003,0x80102090,0x00000000,0xFF68CCAC)
Unhandled Kernel exception 80000003 from 80102090 (0, ff68ccac).
*** Address 80102090 has base at 80100000 - ntoskrnl.exe
eax=ffdff13c ebx=ff68cf60 ecx=ff68ce2c edx=8016484e esi=00000000 edi=8019e3d0
eip=8014fbc2 esp=ff68cb5c ebp=ff68cf7c p4-0300 nv up di ng nz na po nc
cr0=80050039 cr2=8017ddd0 cr3=00030000 cr4=00000000 irql:1f efl=ff68cb54
gdtr=80036000 gdtl-03ff idtr=80036400 idtl=07ff tr=0028 ldtr=0000
Dll Base DateStmp - Name Dll Base DateStmp - Name
80100000 2c921d20 - ntoskrnl.exe 80400000 2c7d4b45 - hal.dll
80010000 2c360942 - Atdisk.sys 80259000 2c42f49a - Fastfat.sys
fcc00000 2c360940 - Floppy.SYS fcc10000 2c3609c5 - Hpfs_Rec.SYS
fcc20000 2c360952 - Null.SYS fcc30000 2c360925 - Beep.SYS
fcc40000 2c360945 - i8042prt.SYS fcc50000 2c36094d - Mouclass.SYS
fcc60000 2c36094a - Kbdclass.SYS fcc70000 2c360901 - Videoprt.SYS
fcc80000 2c44a112 - Vga.SYS fcc90000 2c4730bc - Msfs.SYS
fcca0000 2c7d36ee - Npfs.SYS fccb0000 2c3609c7 - Ntfs_Rec.SYS
fccd0000 2c87bfe0 - NDIS.SYS fccc0000 2c87c067 - lance.sys
fcd00000 2c360a2b - TDI.SYS fcce0000 2c7ab336 - nbf.sys
fcd10000 2c475d75 - streams.sys fcd40000 2c545d8d - ubnb.sys
fcd50000 2c545df3 - mcsxns.sys fcd60000 2c360a32 - netbios.sys
fcd70000 2c473129 - Parallel.sys fcd80000 2c473132 - Serial.SYS
fcd90000 2c8cdc80 - mup.sys fcde0000 2c360a35 - SMBTRSUP.SYS
fcda0000 2c7d36bf - rdr.sys fcdf0000 2c8f6901 - browser.sys
fce00000 2c4b2868 - afd.sys fce10000 2c7ab1d0 - srv.sys
Address dword dump Build [v1.528] - Name
ff68cb64 80102090 80102090 00000000 ff68ccac 8014fb71 ff68cb94 - ntoskrnl.exe
ff68cb70 8014fb71 8014fb71 ff68cb94 8010fdea ff68cb9c 00000000 - ntoskrnl.exe
ff68cb78 8010fdea 8010fdea ff68cb9c 00000000 ff68cb9c ff68cf60 - ntoskrnl.exe
ff68cba0 8016483a 8016483a ff68ce2c ff68cf60 ff68cc60 ff68cc40 - ntoskrnl.exe
ff68cbb8 8016484e 8016484e ff68cf60 ff68cc44 8015a43a ff68ce2c - ntoskrnl.exe
ff68cbc4 8015a43a 8015a43a ff68ce2c ff68cf60 ff68cc60 ff68cc40 - ntoskrnl.exe
ff68cbd8 8010fd98 8010fd98 00000004 ffbd700c 80102090 ff68cc14 - ntoskrnl.exe
ff68cbe4 80102090 80102090 ff68cc14 00000000 00000001 80000003 - ntoskrnl.exe
ff68cc00 80102204 80102204 00000003 00000001 ff68ccac 00000000 - ntoskrnl.exe
ff68cc24 80102090 80102090 00000000 0a722600 8013b6d4 ff68ce2c - ntoskrnl.exe
ff68cc30 8013b6d4 8013b6d4 ff68ce2c ff68b000 ff68cf90 ff68ce4c - ntoskrnl.exe
ff68cc48 8013b7aa 8013b7aa ff68ce2c ff68cc60 00000004 ffbd700c - ntoskrnl.exe
ff68cc5c 80102090 80102090 00010017 00000000 80407144 00000008 - ntoskrnl.exe
ff68cc68 80407144 80407144 00000008 00000046 00000246 00000000 - hal.dll
ff68cc7c 80102205 80102205 00000008 00000282 00000003 ffbd700c - ntoskrnl.exe
Kernel Debugger Using: COM2 (Port 0x2f8, Baud Rate 19200)
Restart you computer. If this message reappears, do not restart.
Contact you system administrator or technical support group, and/or
peripheral device vendor.

System

… is made up of

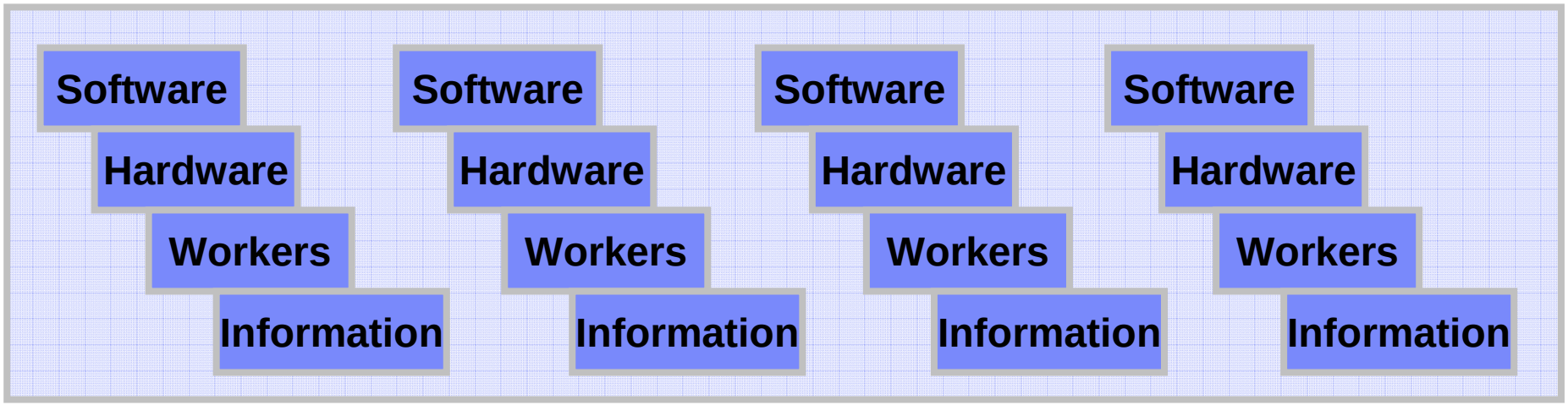
- Software
- Hardware
- Workers (people)
- Information (data)



A System of Systems

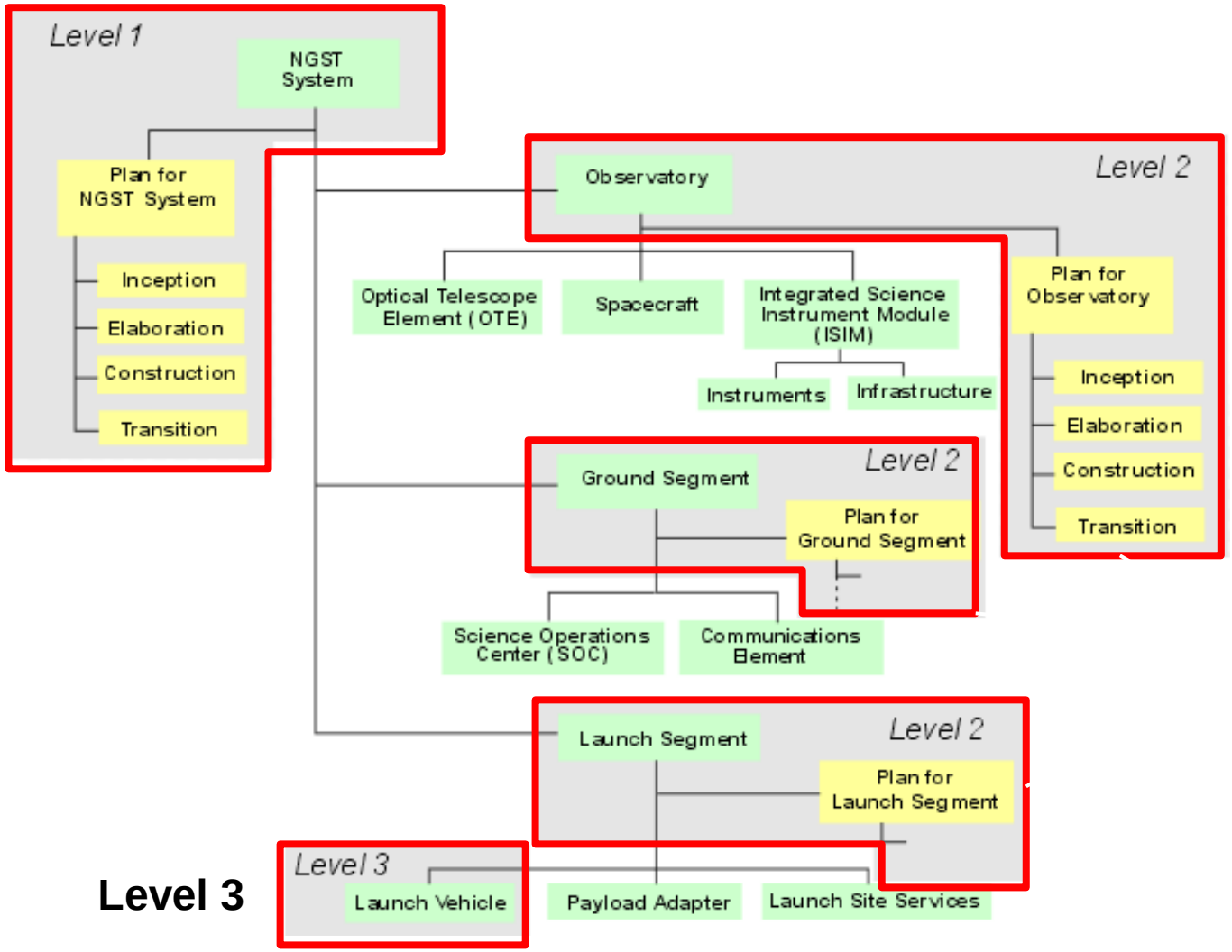
Consider a system to be made up of a collection of other systems, each made up of software, hardware, workers and information

A “system of systems”



An Example

Level 1



Level 2

Level 3

Architecture Representation

IEEE-1471

- The IEEE Recommended Practice for Architectural Description of Software-Intensive Systems
- This standard provides a conceptual framework for architectural description and defines what is meant by a 1471-compliant architectural description

4 + 1 Views of Software Architecture

Siemens

DoDAF

MoDAF

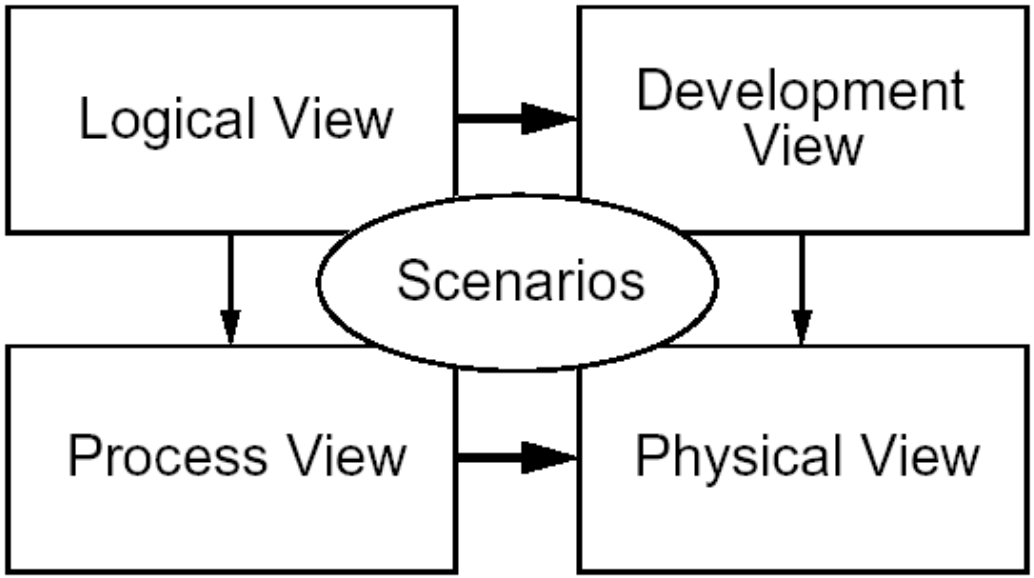
ToGAF

RM-ODP

The Zachman Framework

RUP for Systems Engineering (RUP-SE)

Describing an Architecture – Kruchten 4+1 views



Describing an Architecture – Cantor (RUP-SE)

Viewpoint / Level	Worker	Logical	Information	Physical	Process
Context					
Analysis					
Design					
Implementation					

An Example

A Vehicle

4 Wheels, ABS, ASP, Radar assisted cruise, ….

Is the driver inside or outside of the system?

Considerations

Software, hardware or people?

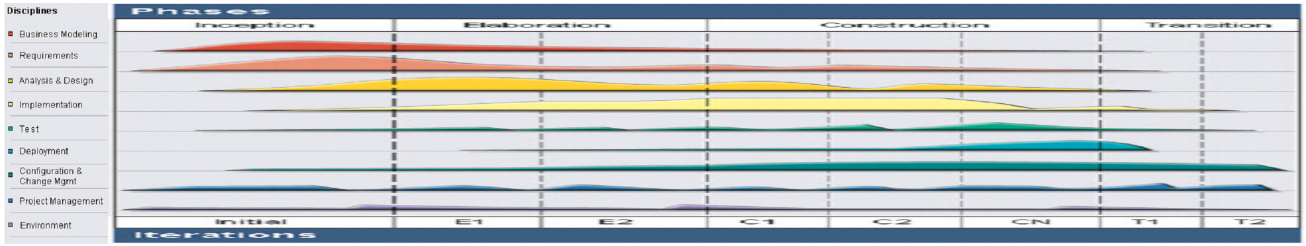
“Joint realization” across these elements

“Flow down” to subsystems

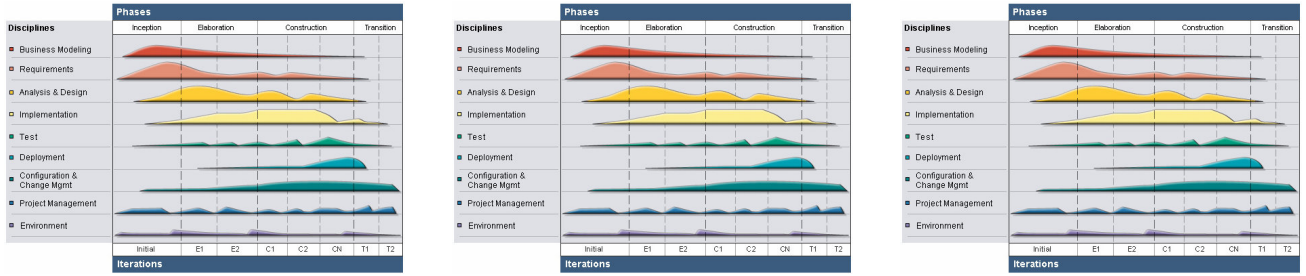
- Functional requirements
- Non-functional requirements (qualities, constraints)

Programme / Project Governance

Programme



Projects



Programme / Project Governance

- Alignment of project management work products
  - Programme / project vision
  - Programme / project plans (schedules, budgets, signoff points, funding, releases)
- Alignment of project management processes
  - Scope (requirements) management
  - Change management
  - Test management
  - Risk and issues management
  - Quality management
  - Measurement / metrics gathering
  - Programme / project management reviews
  - Configuration management
  - …

Architecture Governance

- Architectural concerns
  - Alignment of subordinate systems with the superordinate system
- Alignment of architectural work products
  - Requirements model
  - Design model
  - Implementation model
  - Data model
  - Standards and guidelines
  - Infrastructure definition
- Alignment of architectural processes
  - Identification / refinement of interfaces and components
  - Identification / refinement of architectural properties (cost, performance)
  - Architecture reviews
  - …

- "Systems" thinking requires us to think beyond software
  - Systems engineering, enterprise architecture, strategic reuse, …
- Certain qualities cannot be achieved by software alone
  - Performance, reliability, …
- Software/systems engineering principles and practices can scale both up and down

Introducing Telelogic

Mission: Help each customer succeed the first time by aligning and optimizing product, systems and software development lifecycles with business objectives and customer needs to dramatically improve quality and predictability, while significantly reducing time-to-market and overall costs

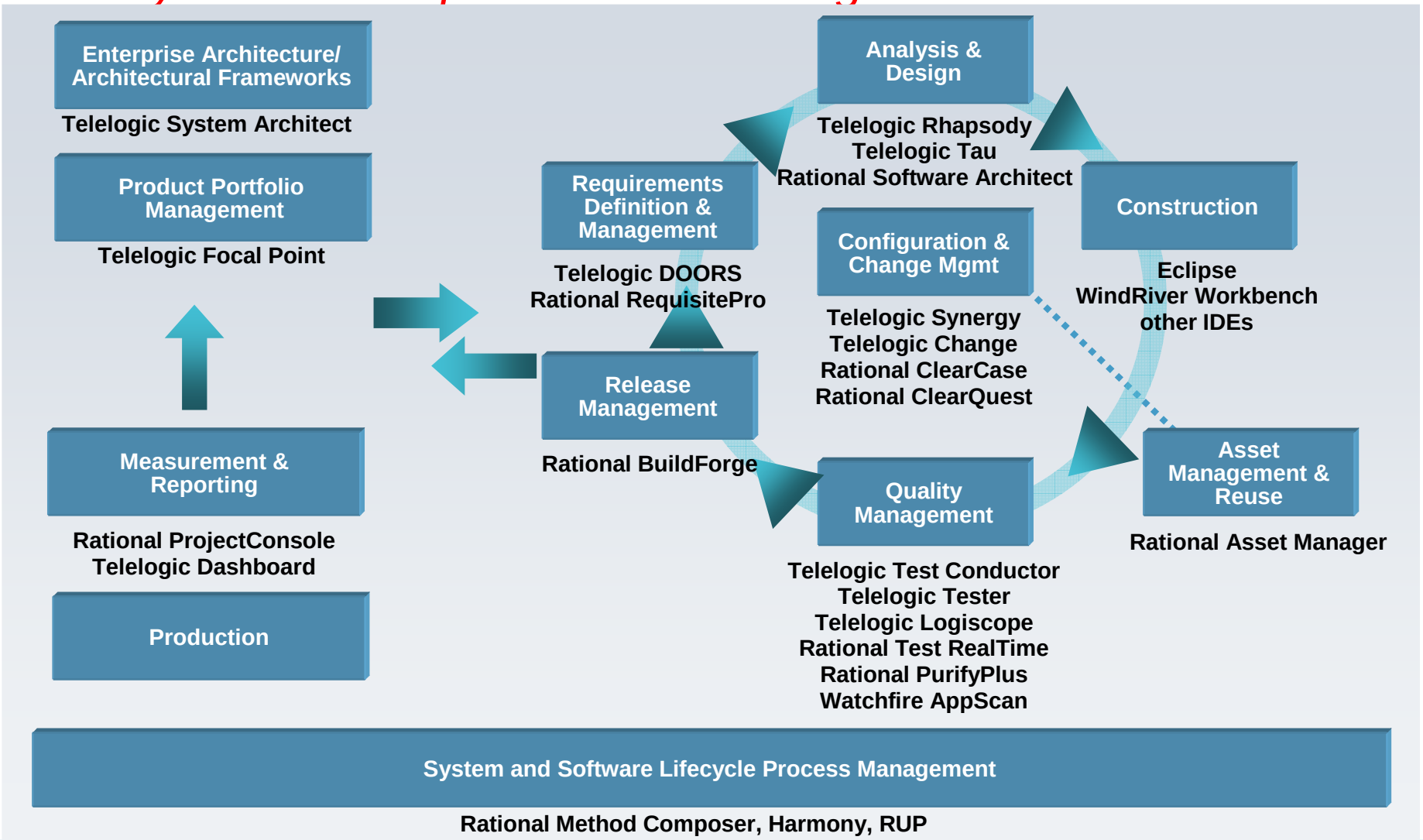
- Founded in 1983
- More than 1,100 employees worldwide
- More than 8,000 customers worldwide
- Worldwide direct sales and partner ecosystem
- Headquartered in Malmo, Sweden with US headquarters in Irvine, CA

Telelogic
An IBM Company

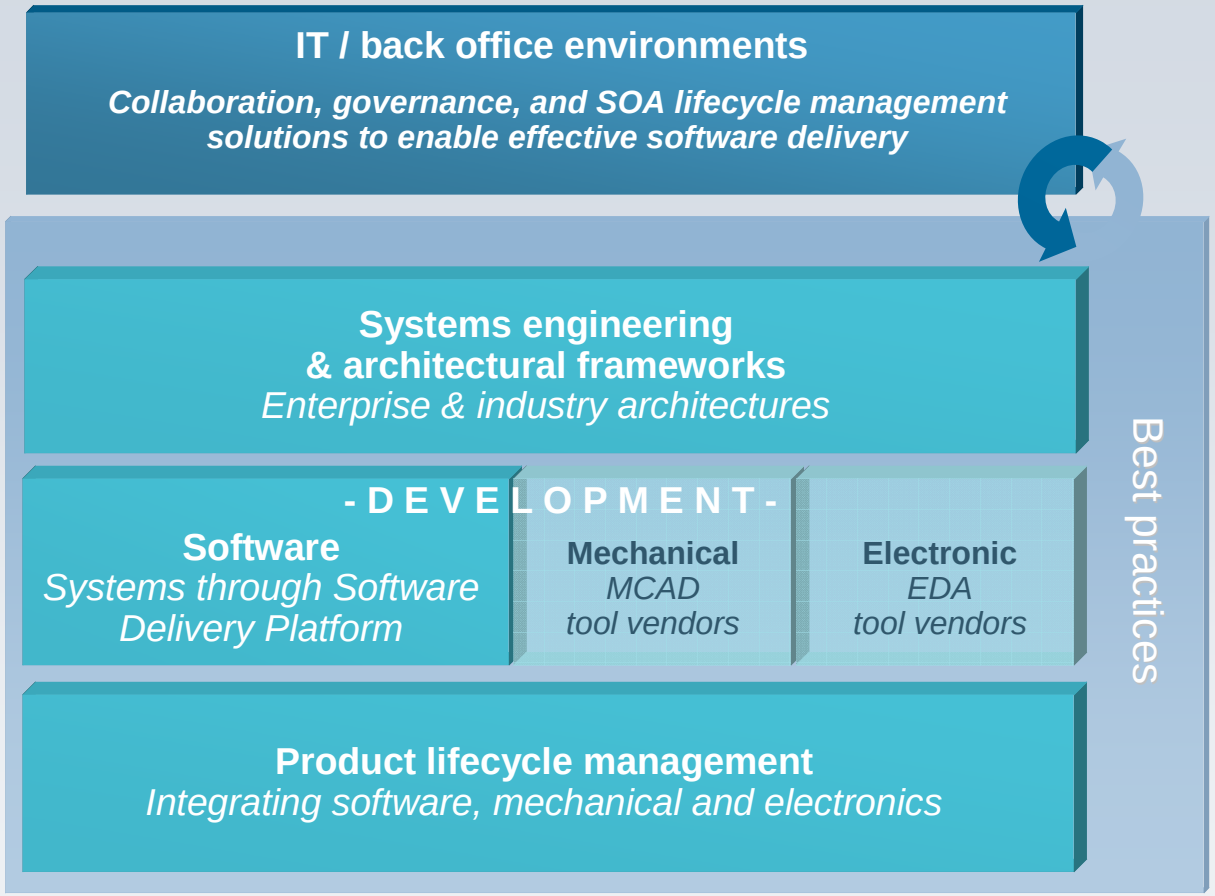
- Focal Point (product management and product portfolio management)
- DOORS (requirements lifecycle management)
- System Architect (enterprise architecture)
- Tau (MDD for IT/enterprise SW)
- Rhapsody (MDD for embedded/real-time SW)
- Statemate (systems design)
- SDL (MDD for communication protocol SW)
- Synergy & Change (configuration & change management)
- Logiscope (quality assurance)

Combined Portfolio in Action

Industry's most comprehensive offering



Our Vision for Systems and Software Delivery



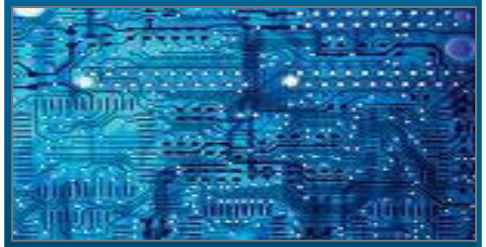
Removing Friction from Tools and Processes

Requirements Management | **Systems Engineering** | **Integrated Change Management**

Requirements management and system design across system of systems and down to the component level

Integration of requirements, configuration and change management with PLM/EDA

Electronics



cadence

Mentor Graphics

Software

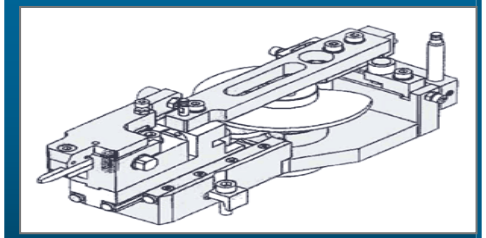
Software and Systems Development Governance

Process & Product Management

- Architecture management
- Quality management
- Requirements management
- Change & release management

Open technology, open standards & community innovation

Mechanical



agile

DASSAULT SYSTEMES

PTC

Integration, Collaboration & Workflow Infrastructure

How is the Thinking Behind Jazz Different?

Desktop Integration → **Lifecycle Integration**

Eclipse established a desktop client integration model for individuals, Jazz will establish a similar integration model across the lifecycle of software projects

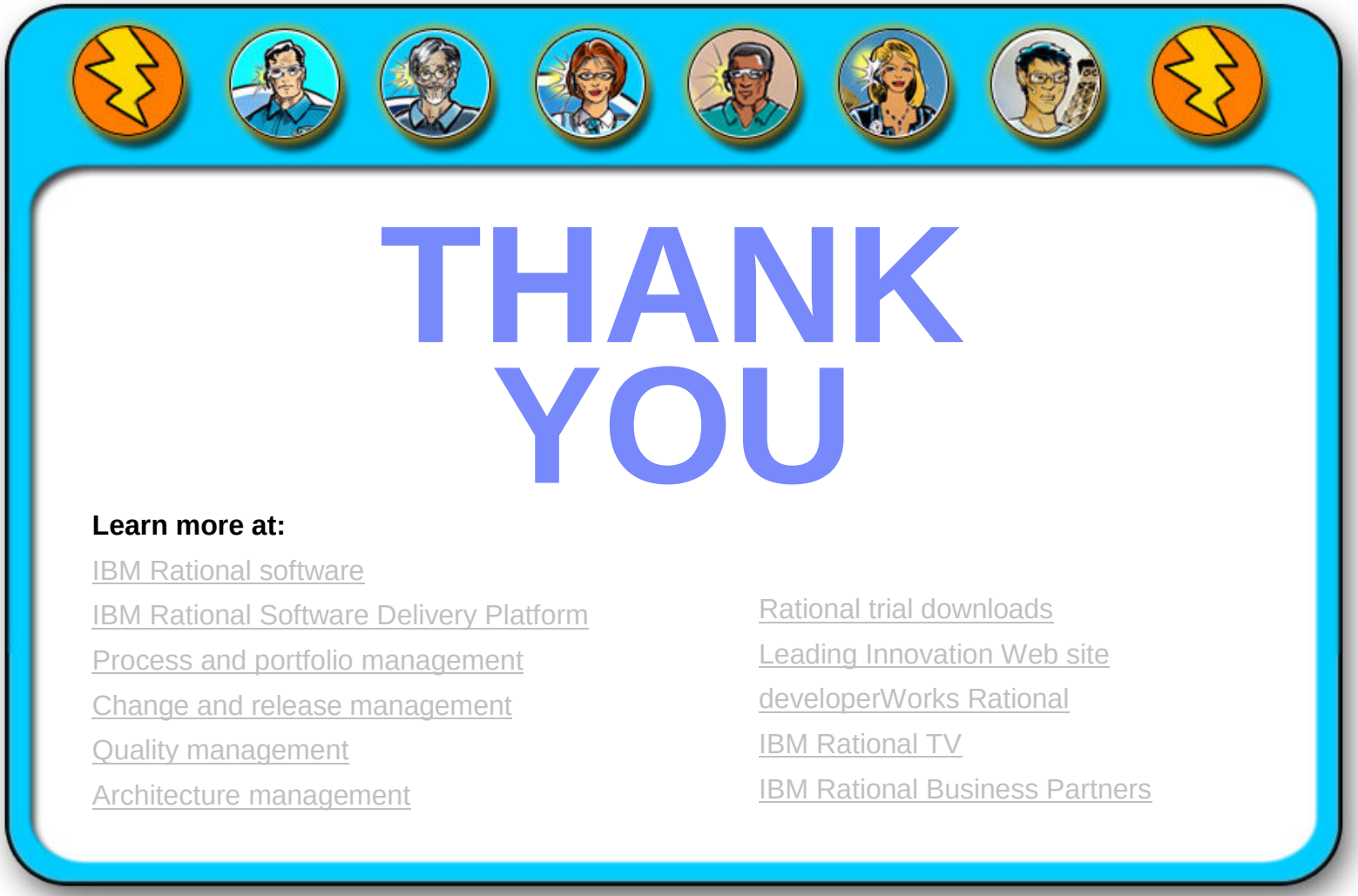
Function First → **Team First**

Jazz will challenge us to think first about how people work together and then about the tool function needed by individual practitioners for specific roles

Manual → **Process Aware & Transparent**

Focuses on automating the unique dynamic of a team enhancing productivity by enabling real-time collaboration, visibility and transparency across the team, and process enactment


QUESTIONS



THANK YOU

Learn more at:

IBM Rational software

IBM Rational Software Delivery Platform

Process and portfolio management

Change and release management

Quality management

Architecture management

Rational trial downloads

Leading Innovation Web site

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