Rational. software

Software Development … in the Large!

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IBM Rational Software Development Conference 2007

What keeps me **Rational**?

9 October – Johannesburg & 11 October – Cape Town

IBM

Group A

England hammered and humiliated

England 0-36 South Africa

England 0-36 South Africa

By James Standley

England (0)

South Africa (20) 36
Tries: Smith, Pietersen 2
Cons: Montgomery 3
Pens: Montgomery 4, Steyn

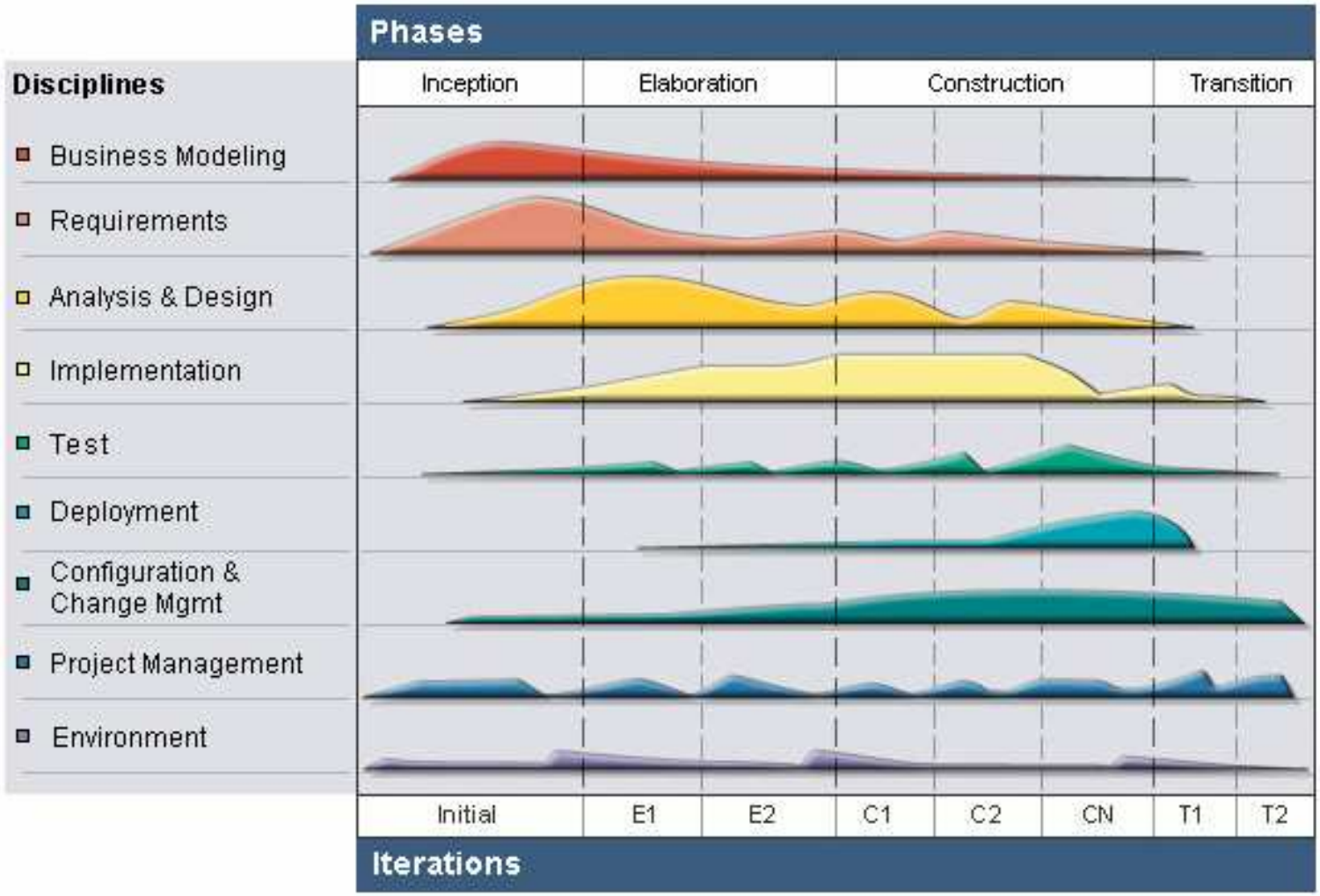
South Africa dealt England's chances of defending the World Cup a major blow as they destroyed the reigning champions.

England's defence of the World Cup is coming apart at the seams

Agenda

- What is a large-scale system?
- The importance of architecture
- Large-scale architecture in practice
- A worked example
- Summary

Rational Unified Process



Large-scale initiatives

- Large-scale initiatives extend beyond a single software development project
  - Single — Multiple?
  - Software — Software / hardware / people / information?
  - Development — Development / operations?
  - Project — Programme?

Large-scale initiatives

- 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

Architecture is key!

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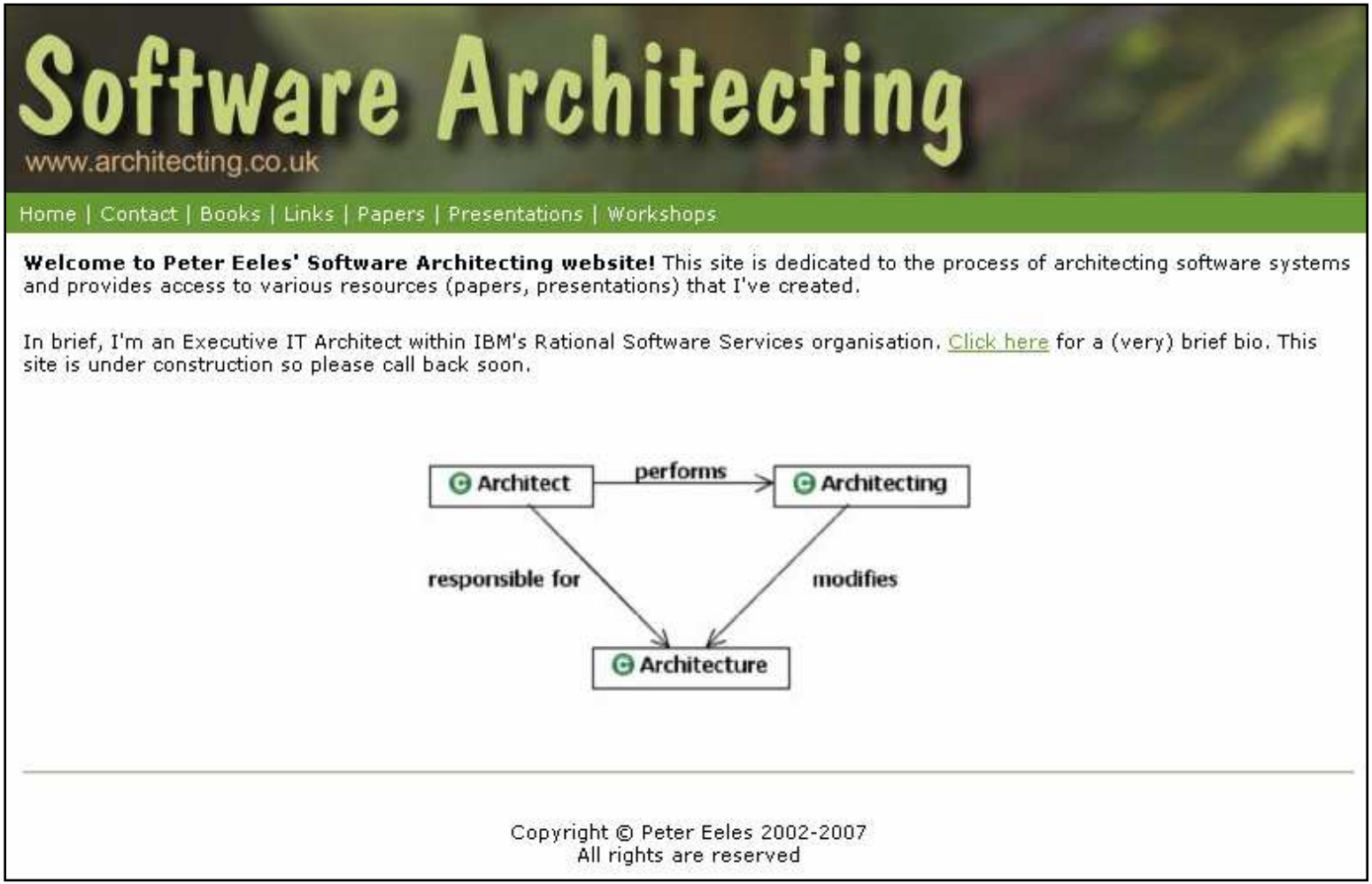
Various architecture-related papers available at …

- www.architecting.co.uk



Architecture

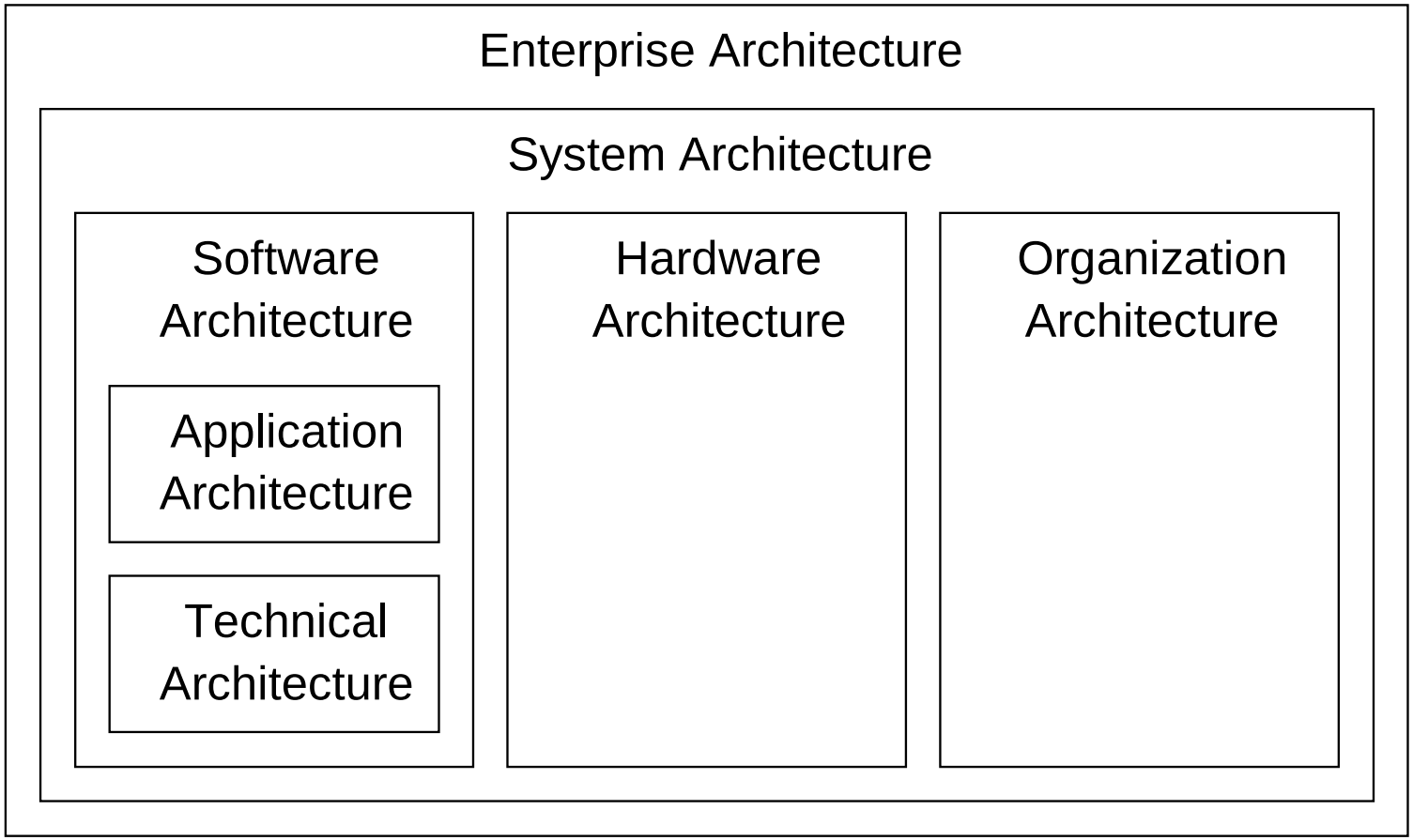
- *Architecture is the fundamental organization of a system embodied in its components, their relationships to each other, and to the environment, and the principles guiding its design and evolution. [IEEE 1471]*
- *The software architecture of a program or computing system is the structure or structures 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]*

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]

An architecture comes in many forms



The 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

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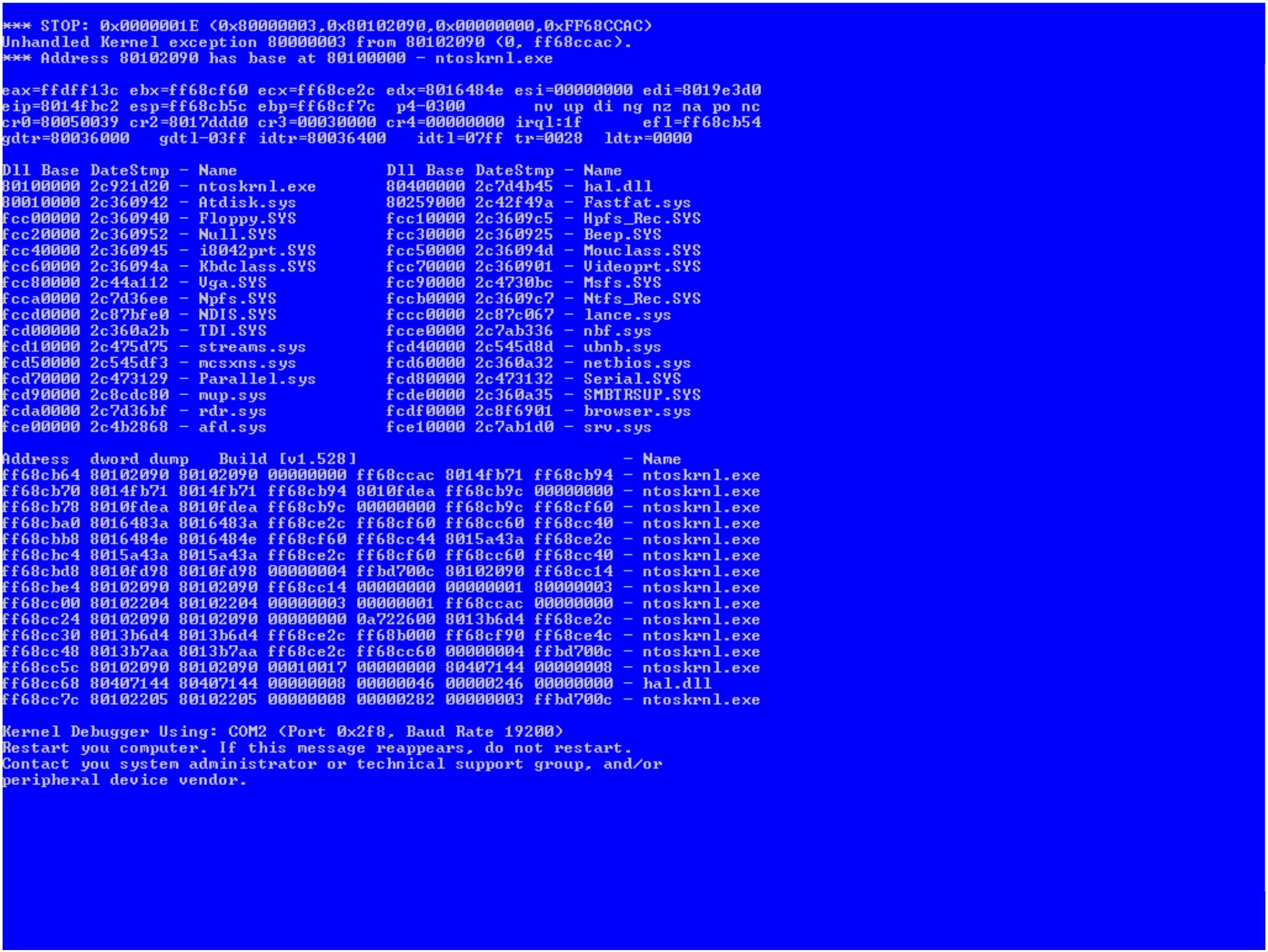
Enterprise, Business, System

- 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
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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
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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
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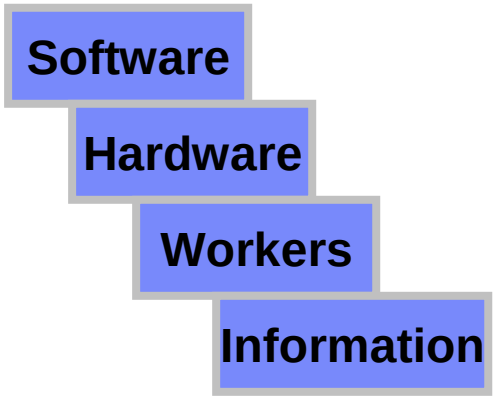
ff68cc48 8013b7aa 8013b7aa ff68ce2c ff68cc60 00000004 ffbd700c - ntoskrnl.exe
ff68cc5c 80102090 80102090 00010017 00000000 80407144 00000008 - ntoskrnl.exe
ff68cc68 80407144 80407144 00000008 00000046 00000246 00000000 - hal.dll
ff68cc7c 80102205 80102205 00000008 00000282 00000003 ffbd700c - ntoskrnl.exe
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.

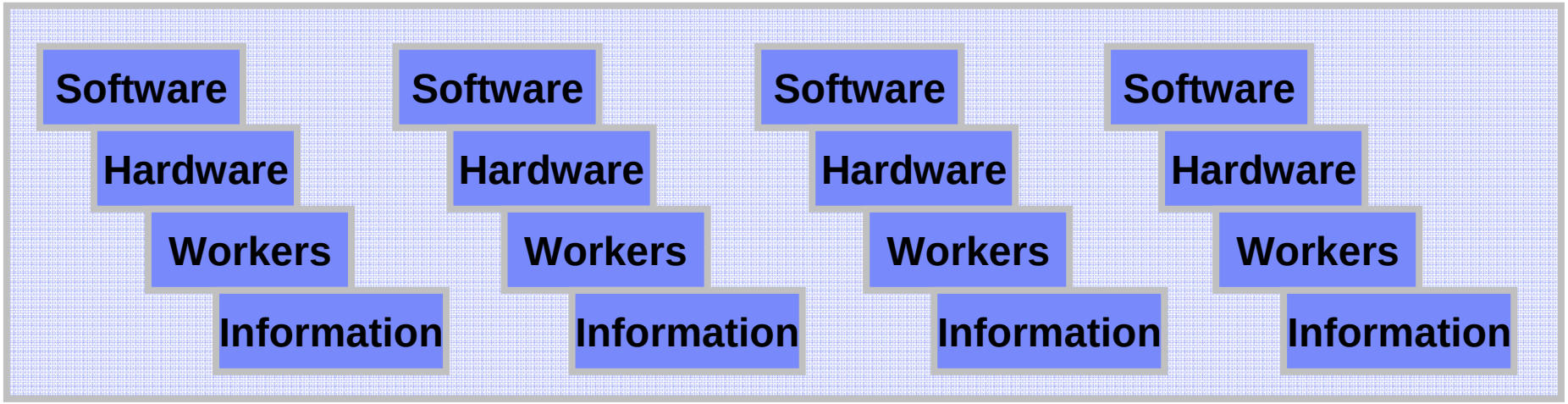
A System

- … is made up of
  - Software
  - Hardware
  - Workers (people)
  - Information (data)



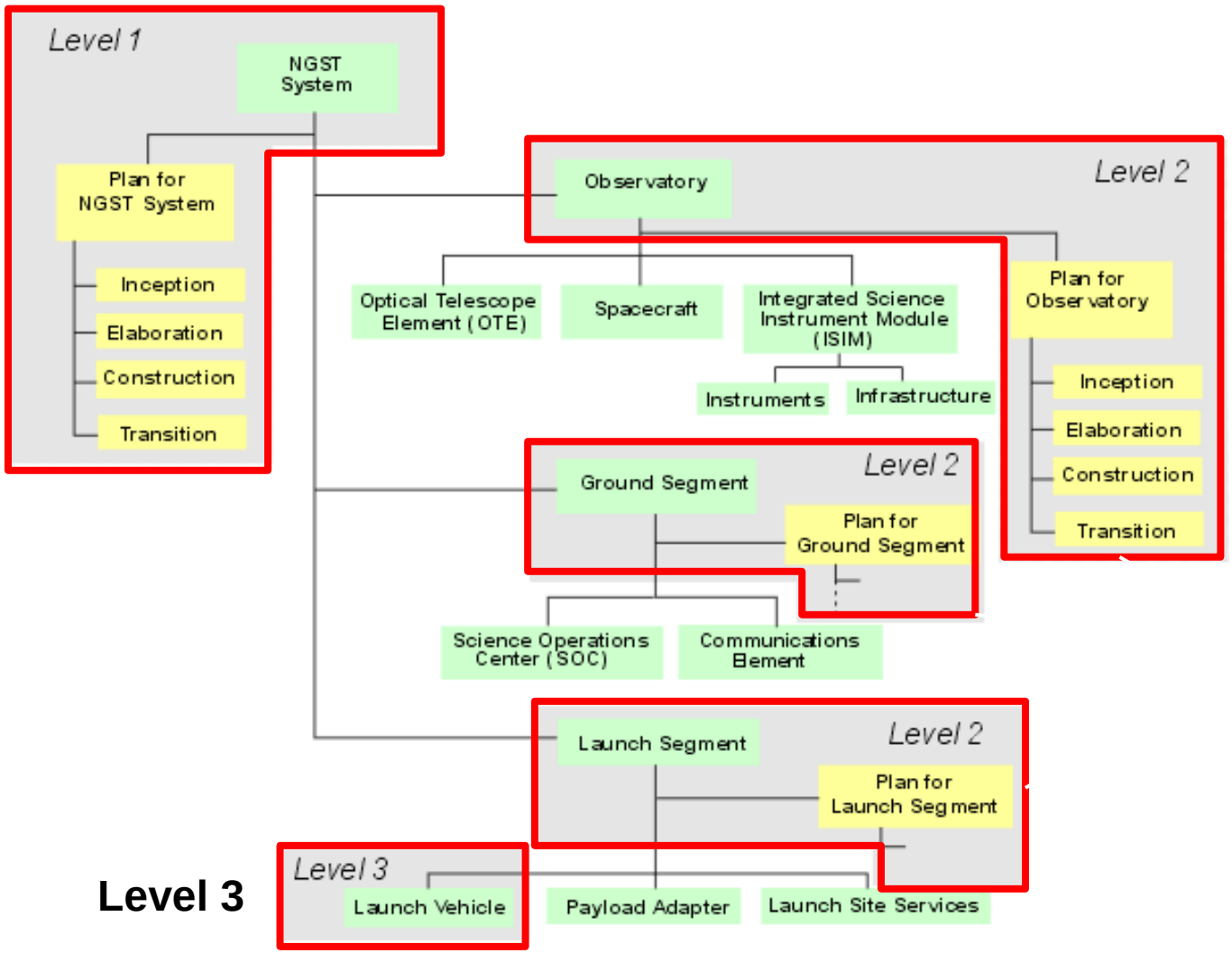
A System of Systems

- 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



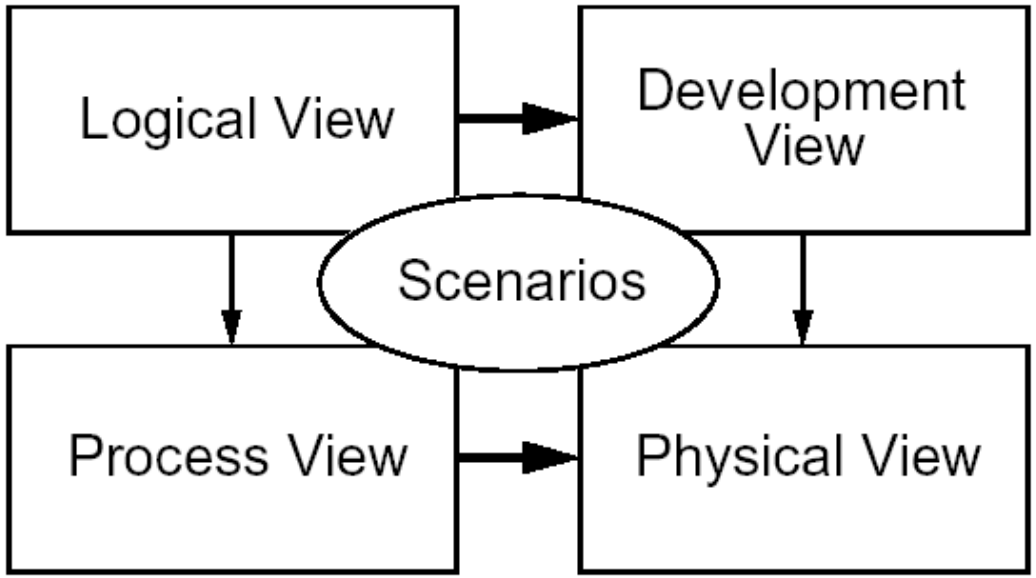
Level 2

Level 3

Architectural 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					

Agenda

- What is a large-scale system?
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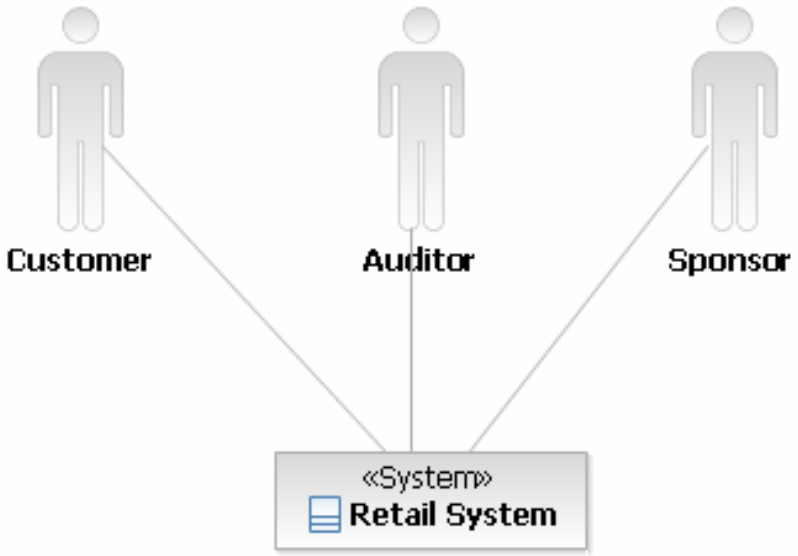
An example

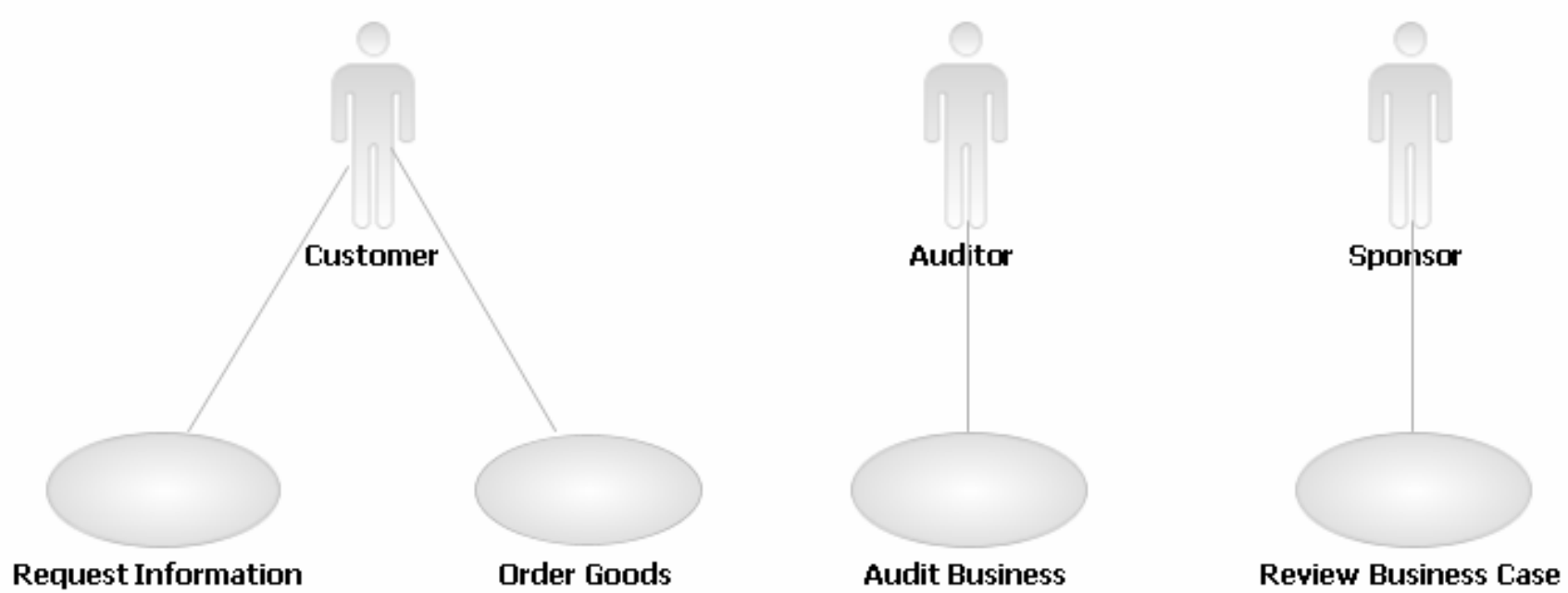
- A retail store
- Selling books, videos, DVDs, music CDs, etc.

Is a sales clerk inside or outside the system?

Level 1: Context Diagram (initial)



Level 1: Use-Case Model

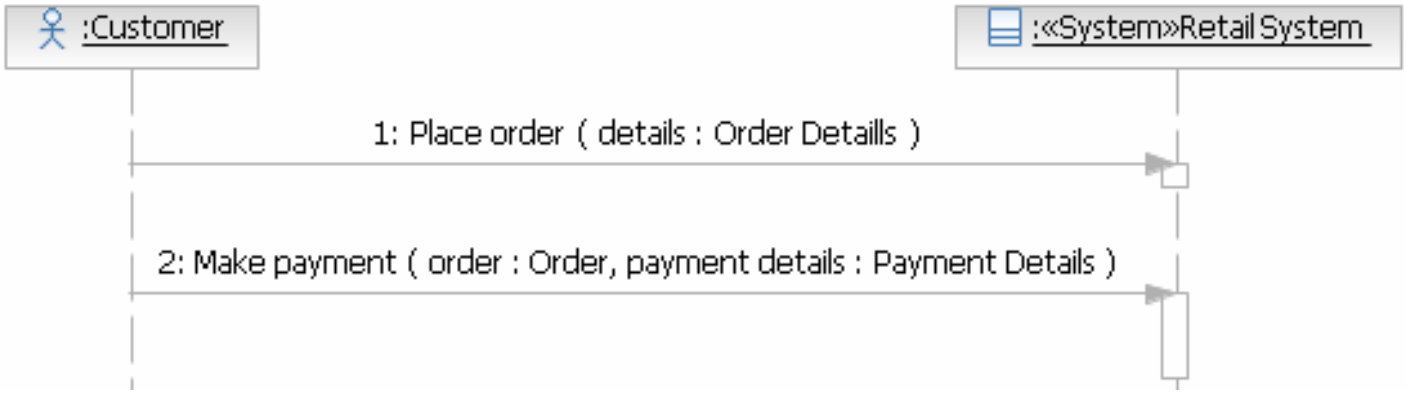


Level 1: Use-Case Model

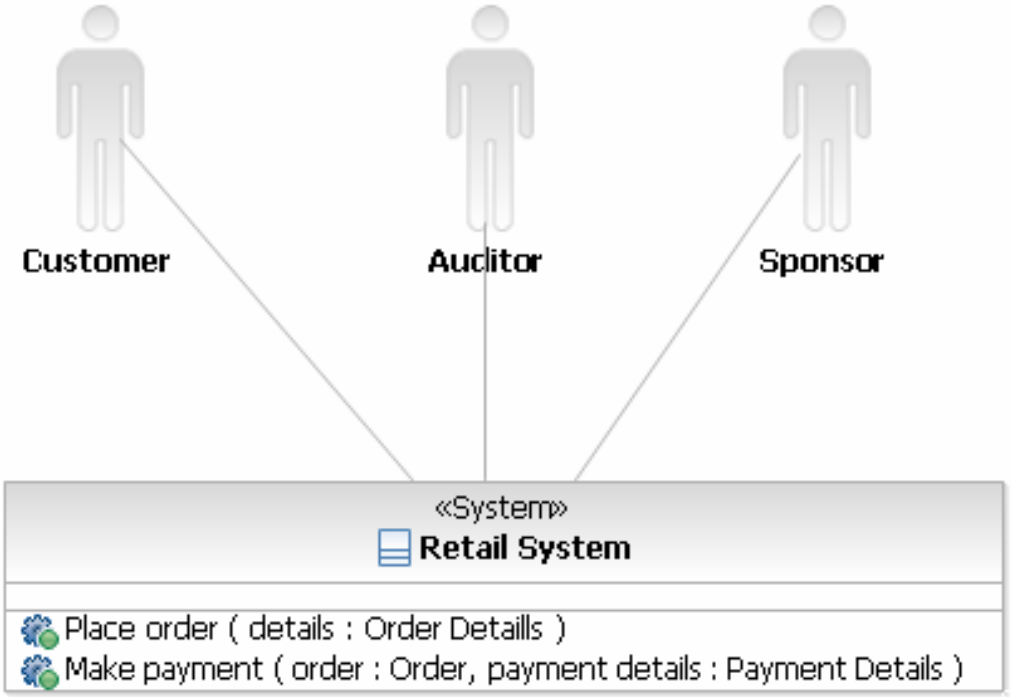
- Basic Flow of the “Order Goods” Business Use Case
  - The use case starts when the Customer initiates the placing of an Order for Products.
  - An appropriate Order is placed that contains the Products to be purchased, along with the relevant quantity of each Product. The Customer receives the ordered Products and a request for payment.
  - The Customer pays for the Order.
  - The use case ends.

Level 1: Use-Case Model

- Basic Flow of the “Order Goods” Business Use Case
- The system is treated as a “black box”
  - How the order is fulfilled and payment requested is internal to the system

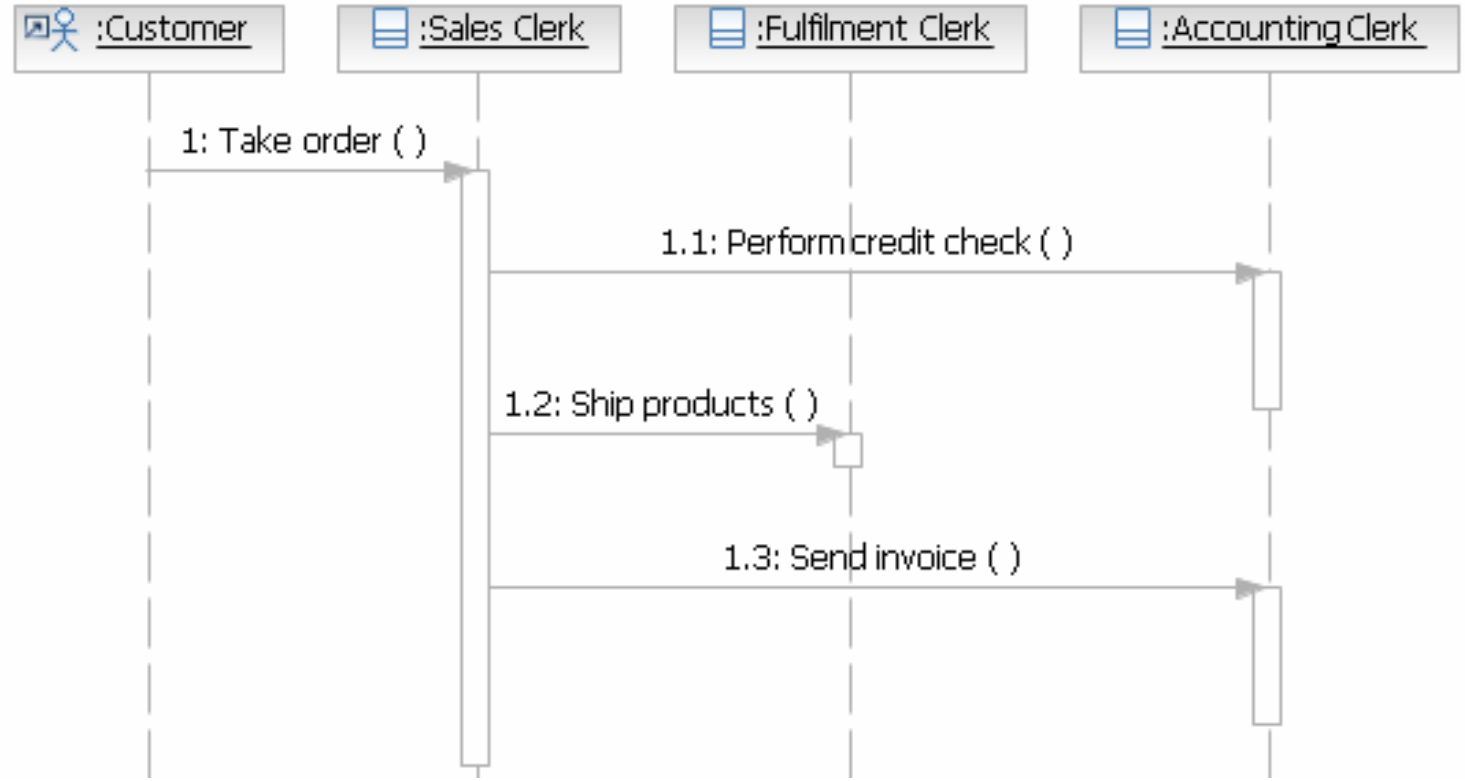


Level 1: Context Diagram (partial)



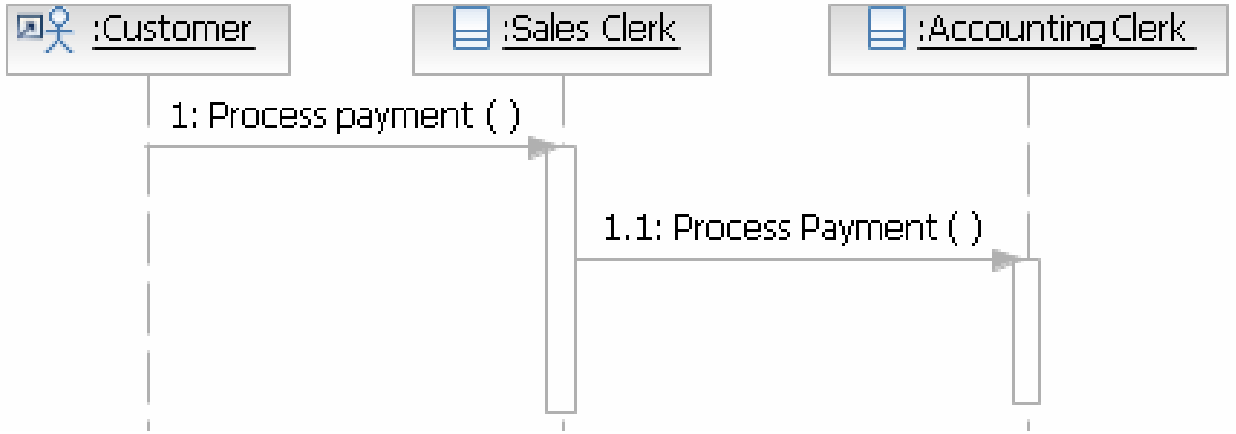
Level 1: Operation Realization

- For “Place order” operation
- The system is treated as a “white box”

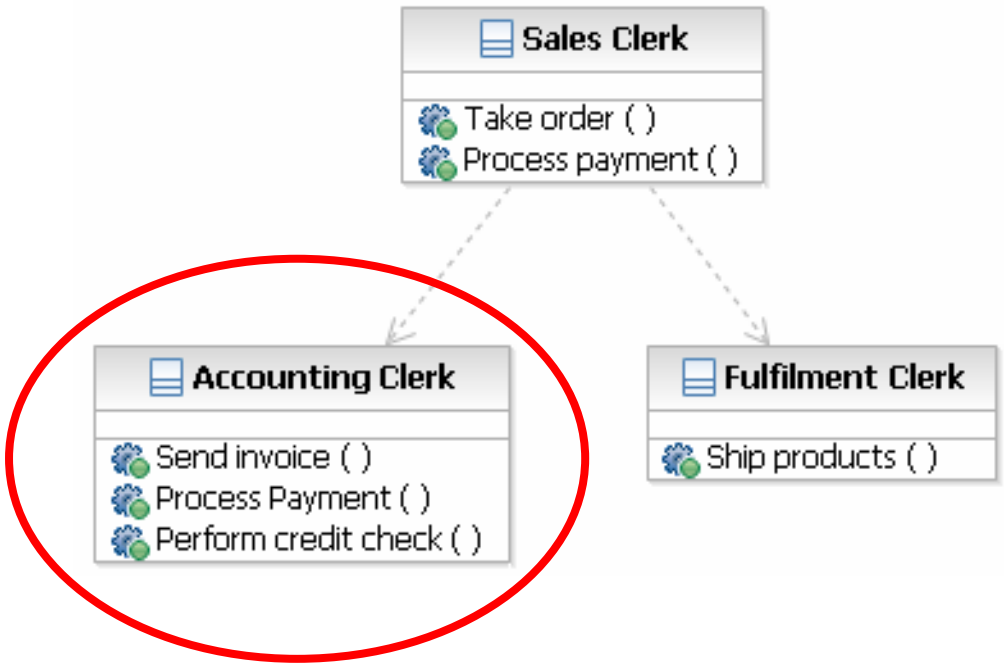


Level 1: Operation Realization

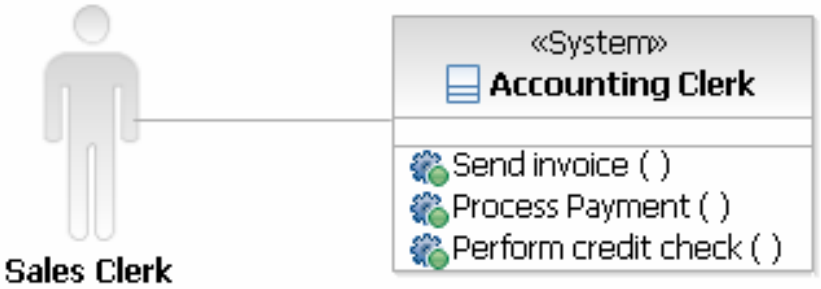
- For “Make Payment” operation



From Level 1 to Level 2

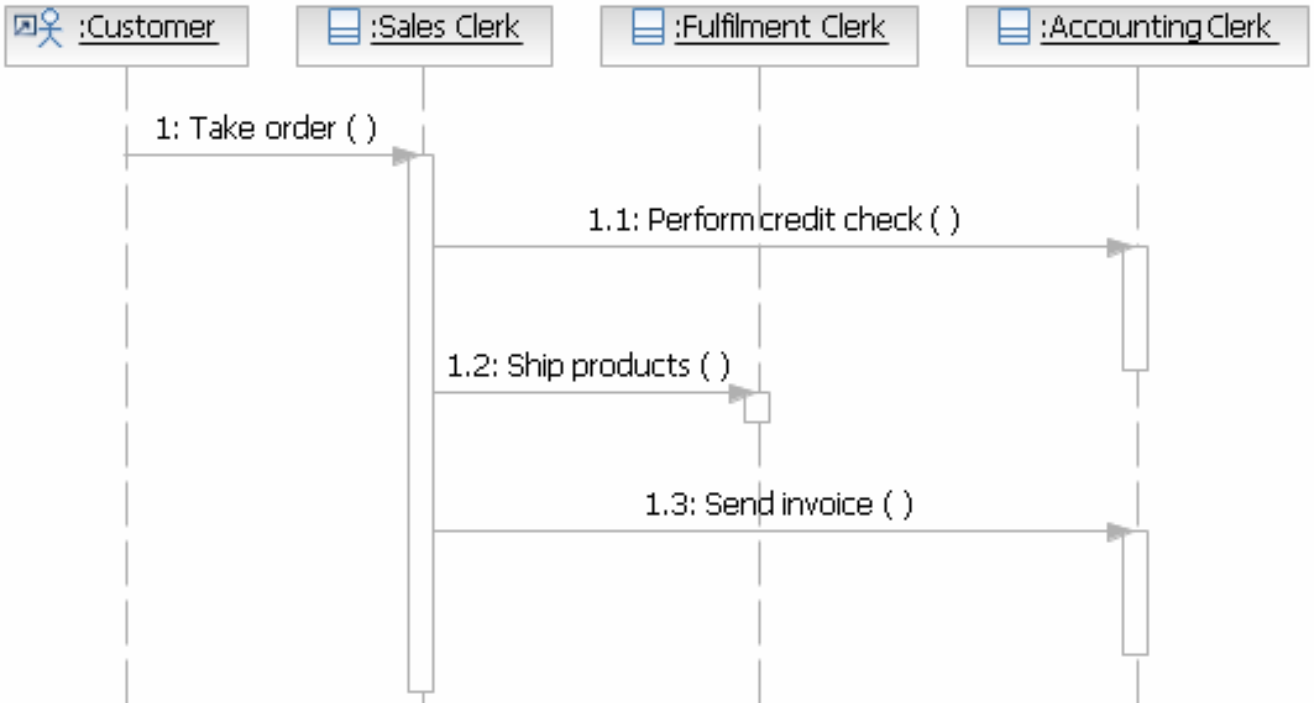


Level 2: Context Diagram



Level 1: Operation Realization

- What about non-functional requirements?
- What about other viewpoints (other than logical or worker)?



Describing an Architecture – Cantor (RUP-SE)

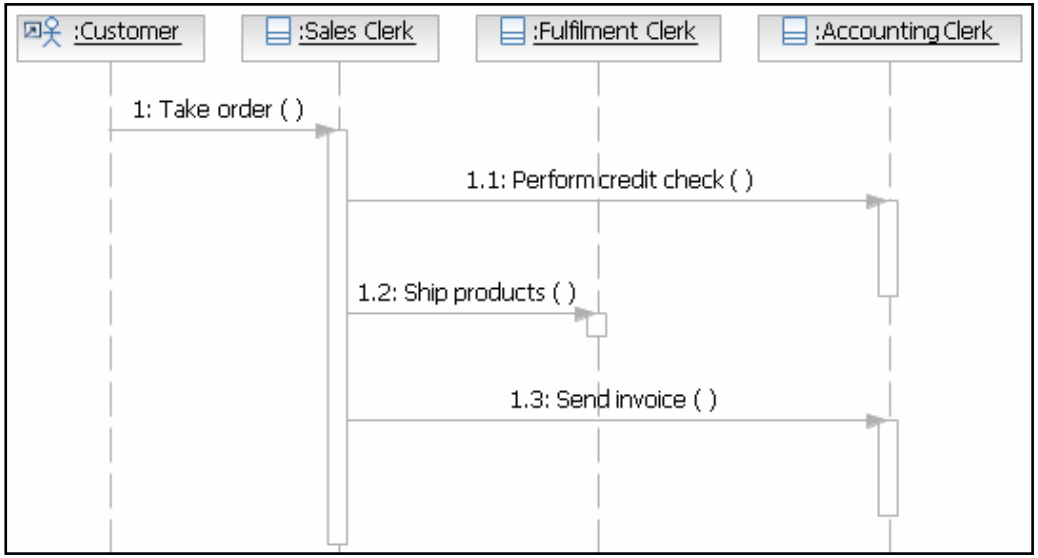
Viewpoint / Level	Worker	Logical	Information	Physical	Process
Context					
Analysis	Subsystem	Subsystem		Locality	
Design					
Implementation					

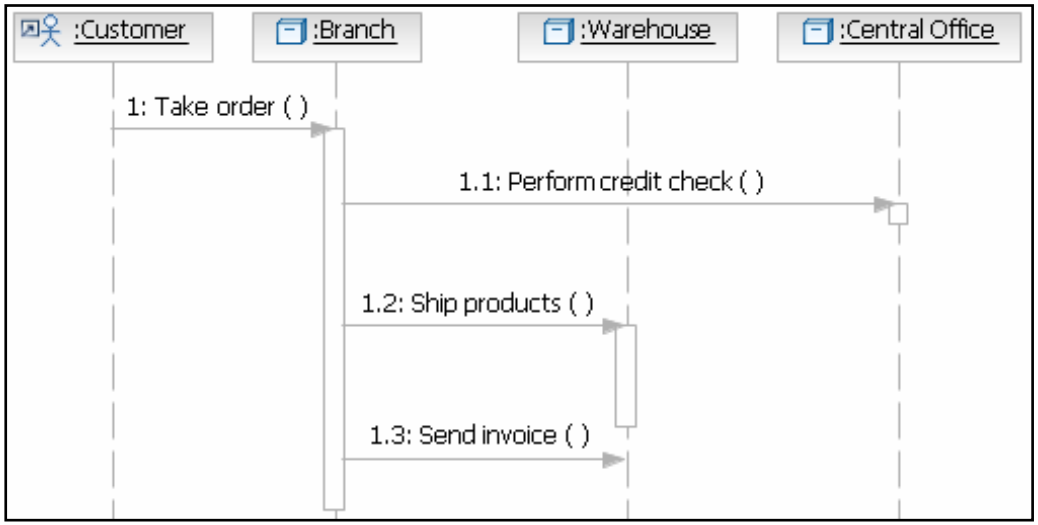
Level 1: Operation Realization

- For “Place order” operation
- This is “Joint realization” across different viewpoints (logical, worker, physical)

Step	Action Performed	Subsystem	Locality	Budgeted Requirements
1	The order details are taken	Sales Clerk	Branch	60 seconds
2	A credit check is performed	Accounting Clerk	Central Office	10 seconds
3	The products are shipped to the customer	Fulfilment Clerk	Warehouse	1 day
4	An invoice is sent to the customer	Accounting Clerk	Warehouse	1 day

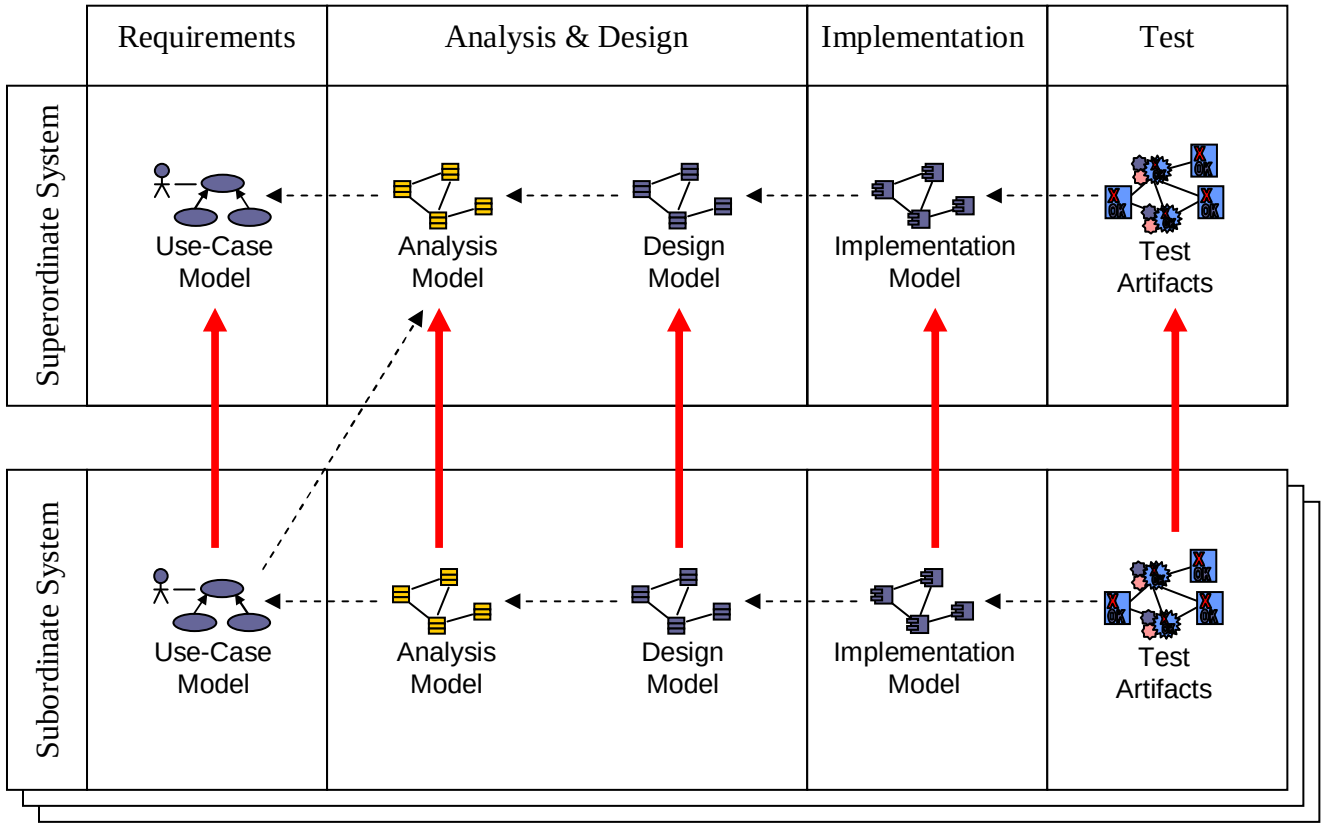
Joint Realization





The “System of Interconnected Systems” Pattern

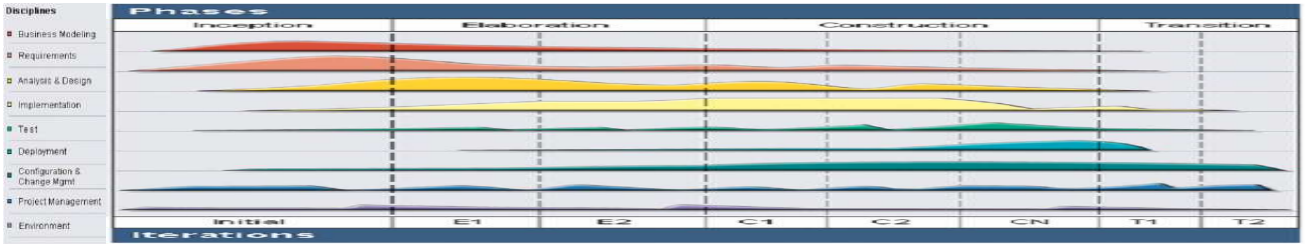
- An example using the Rational Unified Process



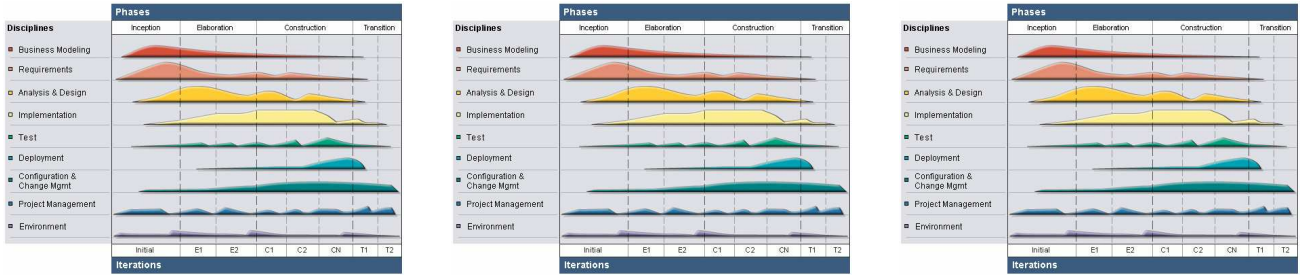
Programme / Project Governance

- Programme concerns
  - Alignment of projects within a programme

Programme



Projects



Programme / Project Governance

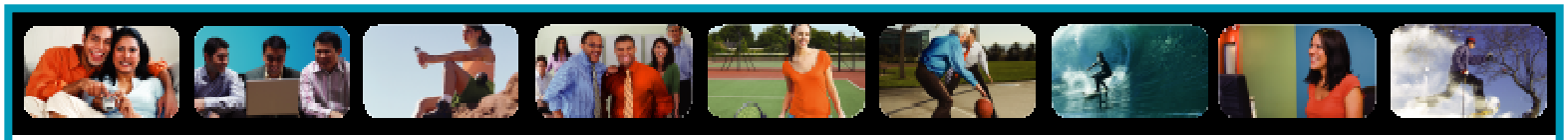
- Alignment of project management work products
  - Programme / project vision
  - Programme / project plans (schedules, budgets, signoff points, funding, releases)
- Alignment of project management processes
  - Scope (requirements) management
  - Change management
  - Test management
  - Risk and issues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

Architectural (Solution) Governance

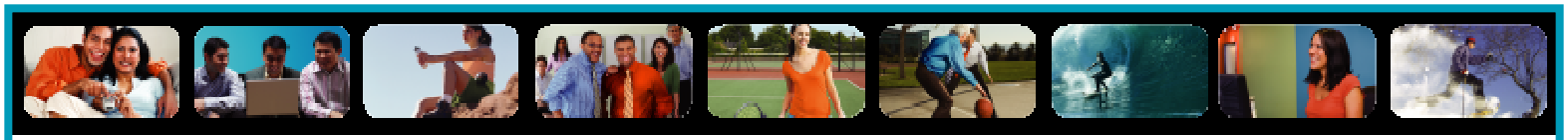
- Architectural concerns
  - Alignment of subordinate systems with the superordinate system
- Alignment of architectural work products
  - Requirements model
  - Design model
  - Implementation model
  - Data model
  - Standards and guidelines
  - Infrastructure definition
- Alignment of architectural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

Summary

- "Systems" thinking requires us to think beyond software
  - Systems engineering, enterprise architecture, strategic reuse, …
- Certain qualities cannot be achieved by software alone
  - Performance, reliability, …
- RUP best practices can scale to support the development of large-scale systems
- The "system of interconnected systems" pattern provides a means of managing complexity within such initiatives



Questions



Thank You

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