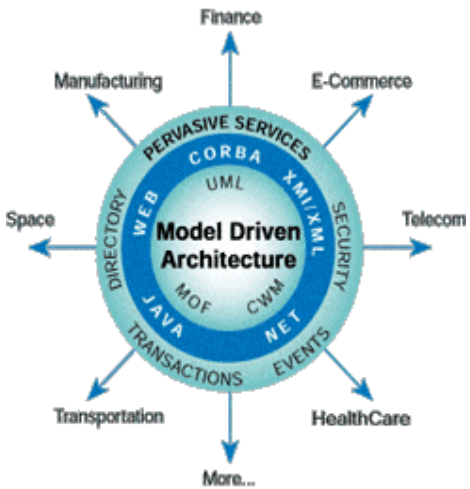
MDA & SOA in the Enterprise



VCA
MDA
SOA/ESB

EDOC

UNIFIED MODELING LANGUAGE™

Applying Model Driven Architecture (MDA) to Services Oriented Architecture (SOA) to enable the Executable Enterprise

Introductions

DataAccessTechnologies

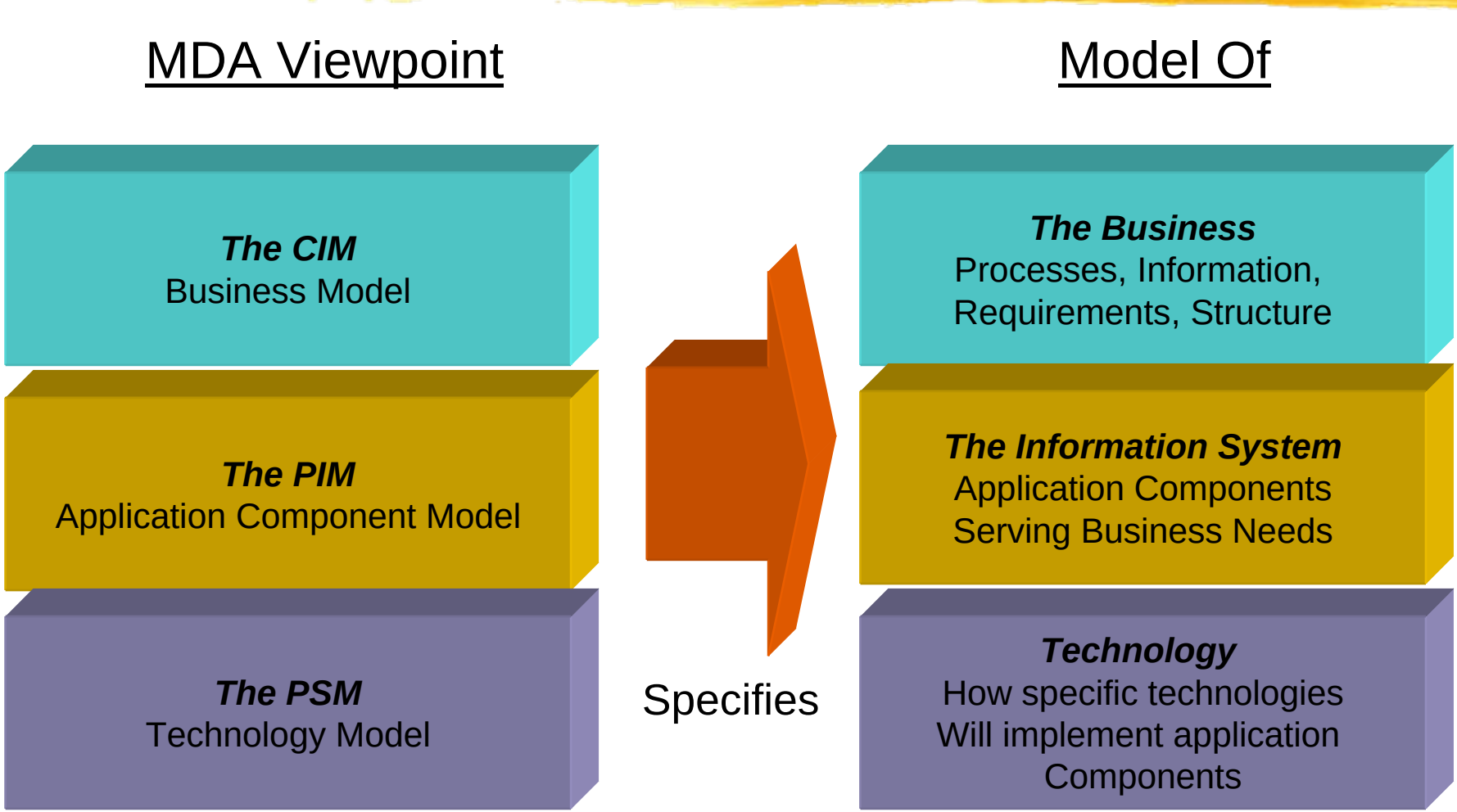
Where Business Meets Technology

Cory Casanave

cory-c@enterprisecomponent.com

Primary author of “CCA” in EDOC

Enterprise MDA



Case Study

U.S. General Services Administration (GSA)

Customer: GSA OCIO

Provider: LMI & Data Access Technologies

Tooling: Component-X, Magicdraw UML, OsEra

Sections reproduced with the permission of the GSA – George Thomas

"Sea Change"

- Sea of change
  - Get-it-right (Initiative for better acquisition)
  - Merger of FTS/FSS (Major Internal Organizations)
  - Restructuring to provide a unified face to the customer
  - OMB and Congressional mandates and changes of mission
  - Integrating and modernizing financial management
  - Reduction of redundant processes and systems
- Implications
  - Massive organizational change
  - Massive system changes
  - Retraining staff
  - High cost of change
  - Risky and hard to achieve
  - Change combined with current costs and inefficiencies of redundant stovepipe systems is not practical

“Sea Change” Enablers & Cost Reduction

- Value Chain Analysis
  - Analyzing and restructuring business processes based on realized customer value
- Model Driven Executable Architecture
  - Executable enterprise architecture to realize business goals with systems and workflow automation
- Business Service Oriented Architecture / ESB
  - An enterprise modernization strategy supporting business services, integration, reuse and common components across a system of systems integrated with SOA/ESB
- Combined effect of more automated processes

Being able to realize your business goals – priceless!

Tactical Goals

- Replacement of outdated systems
- Improve business processes
- Position to become a government wide service
- “Get to green” (OMB Requirements for architectural maturity)

One-GSA Initiative

Stovepipes

PBS

FSS

FTS

Un-Architected Solution

One GSA

One-GSA Solutions

Schedules

Buildings

I.T.

Telecoms

Auto

Supplies

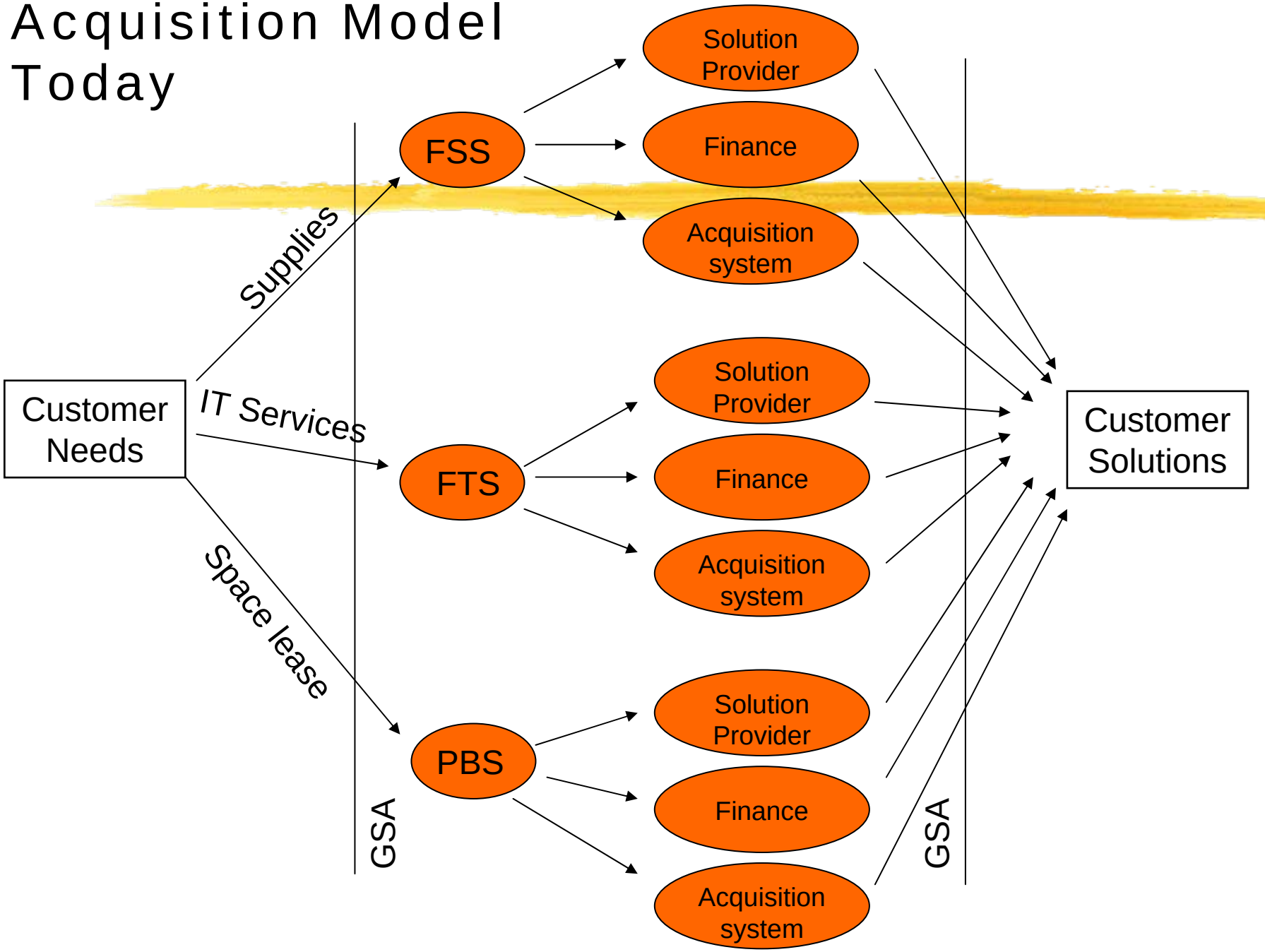
Marketing

Finance

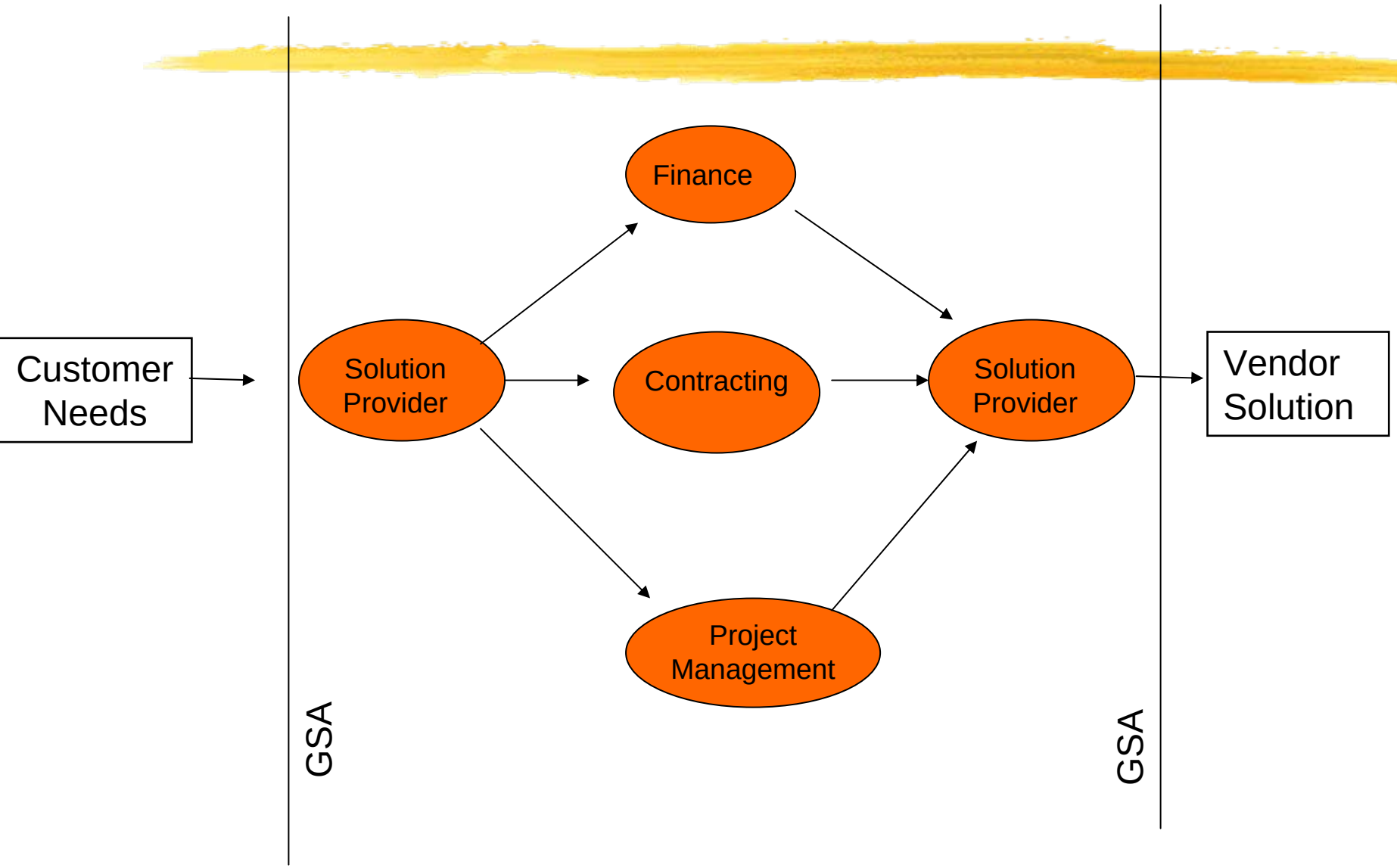
H.R.

Architected Solution

Acquisition Model Today

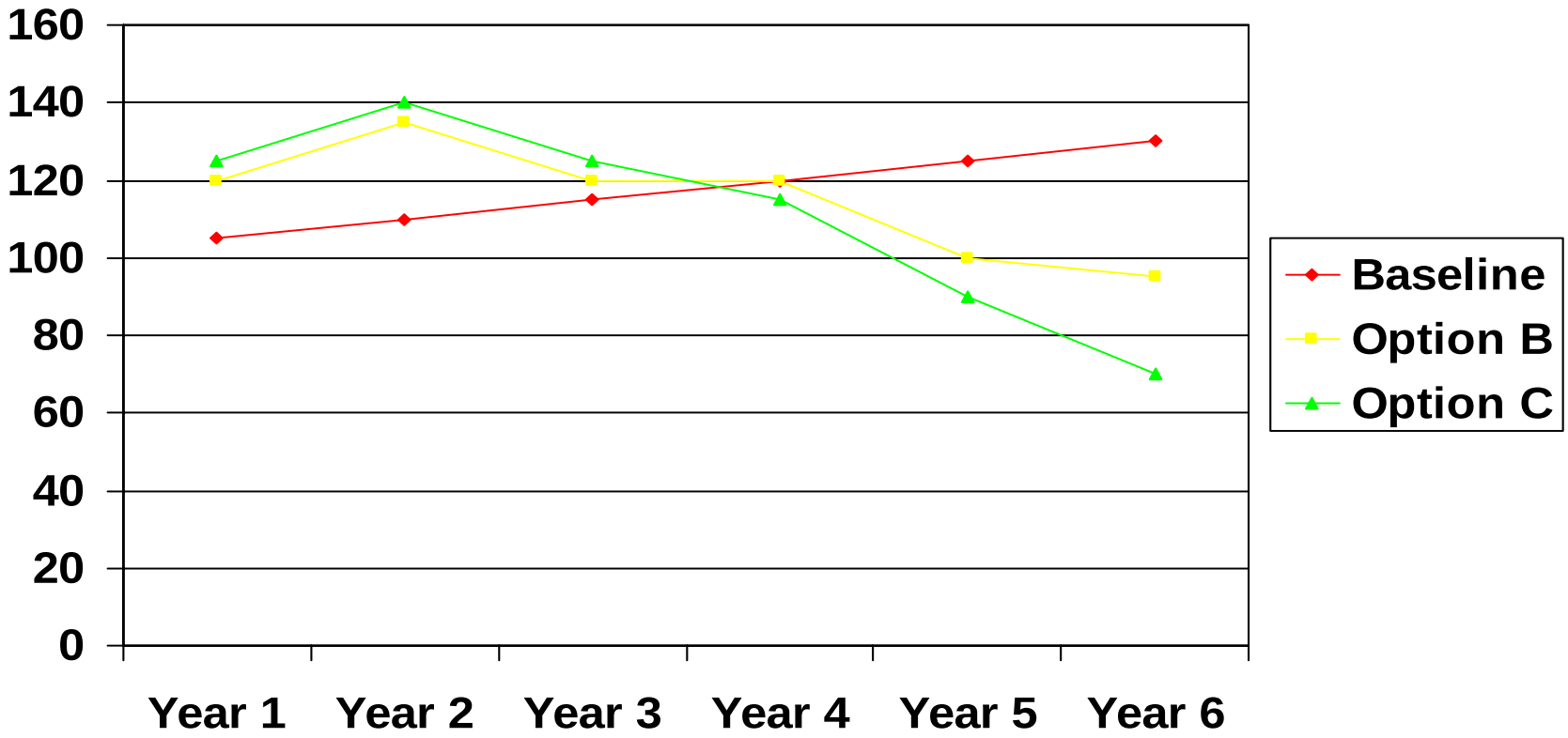


To Be Acquisition Model



System + Investment cost over 6 years

Business Advantage Savings Not Included

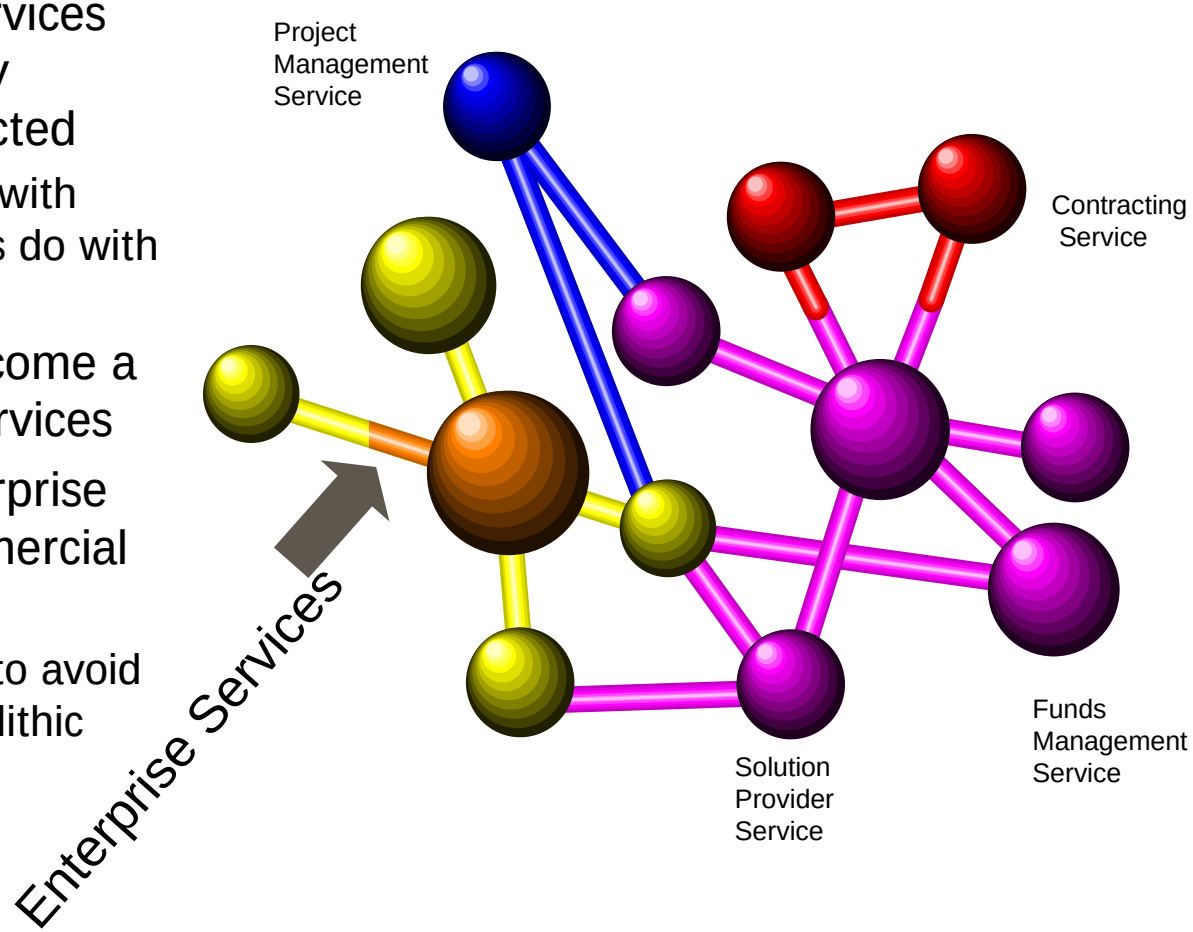


Note: Representative Numbers Est. NPV Break Even – About 6 Years

Enterprise Service Bus to Enable Target State

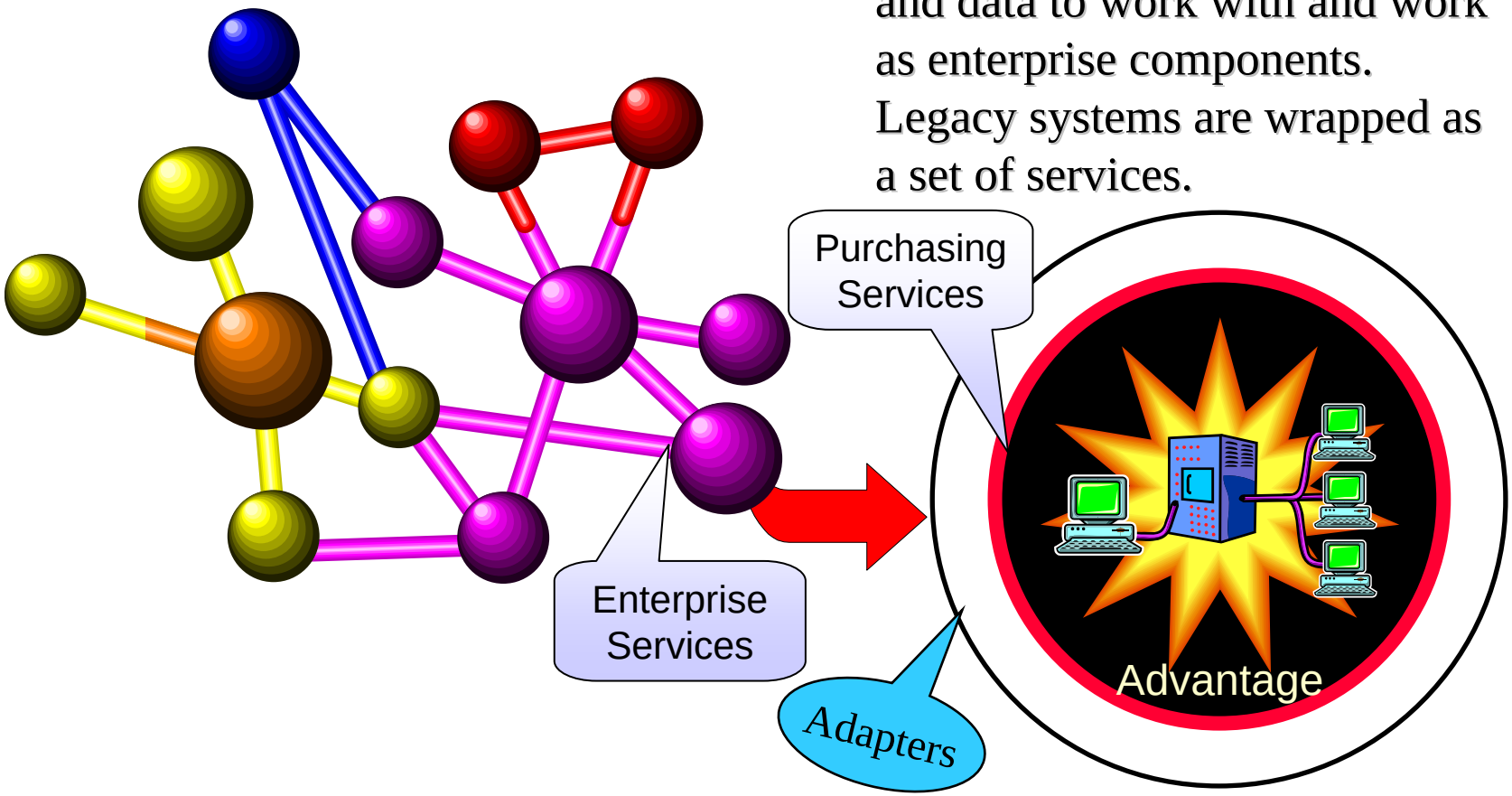
One-GSA Business Model

- Services driven from the business model
- Reusable Enterprise Services are independent & easily adapted and interconnected
  - Services communicate with each other like humans do with email
- Information systems become a lattice of cooperating services
- CIO to Provide an “Enterprise Service Bus” using commercial standards
  - Industry best practice to avoid developing large monolithic applications



Legacy “Wrapping”

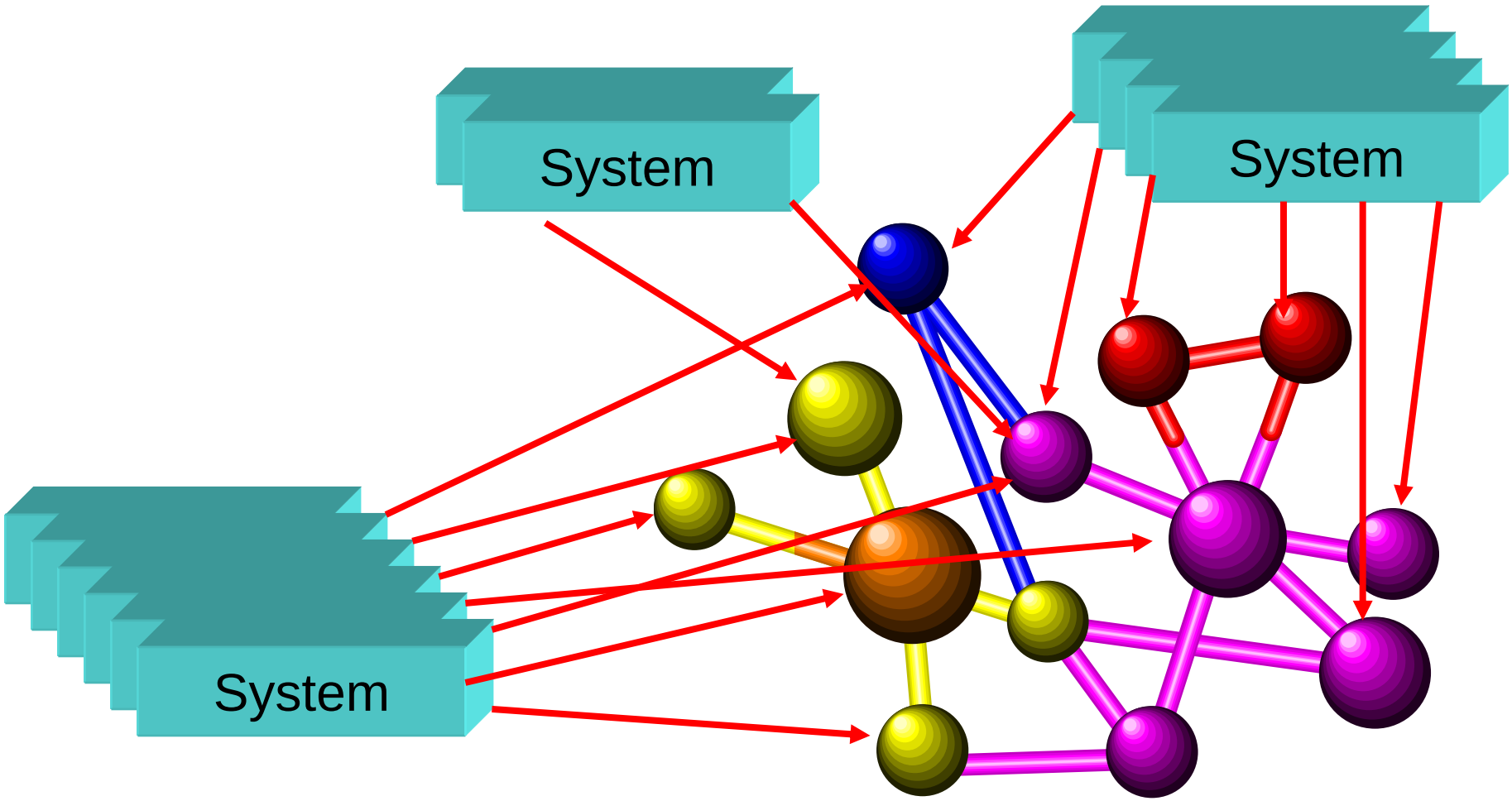
Wrapping allows existing programs and data to work with and work as enterprise components. Legacy systems are wrapped as a set of services.



Enterprise Systems Modernization Strategy

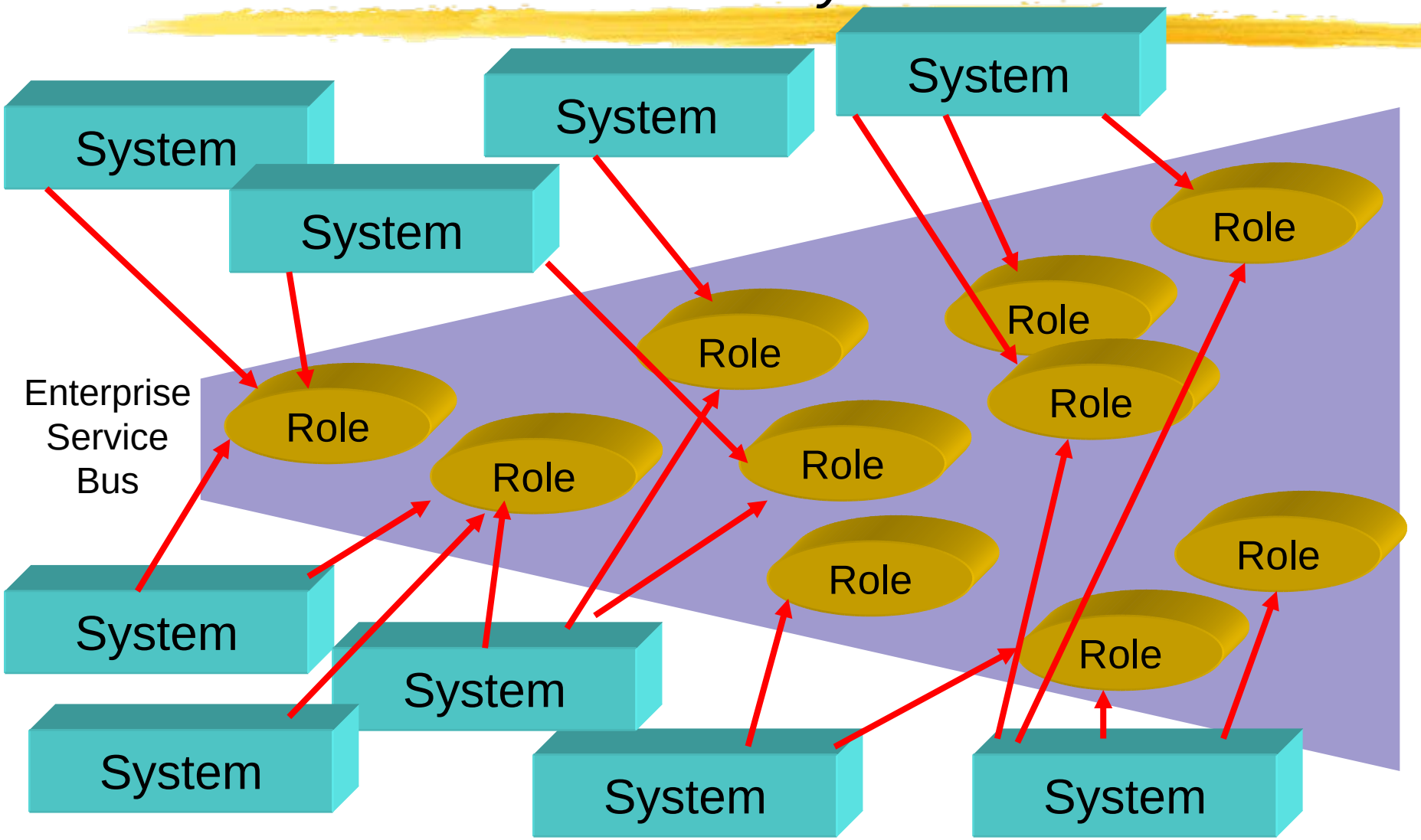
- Identify components that will offer greatest ROI
  - Create target executable model
    - OneGSA enterprise model is baseline
  - Identify system of systems to consider for target
  - Pick an alternative for each;
    - Evolve one or more current systems to support target processes, take on new capabilities and support One-GSA interfaces and/or
    - Harvest one or more systems to build a replacement and/or
    - Integrate functionality into shared services as common components and/or
    - Replace systems or parts of systems that are no longer suitable.
  - Model driven SOA provides the flexibility to mix and match approaches as required. Commonality where possible – diversity where necessary. Evolving over time from integration to common components.
  - End result – architected system of systems

Systems to Role Based Service Components



Transition by role, not system

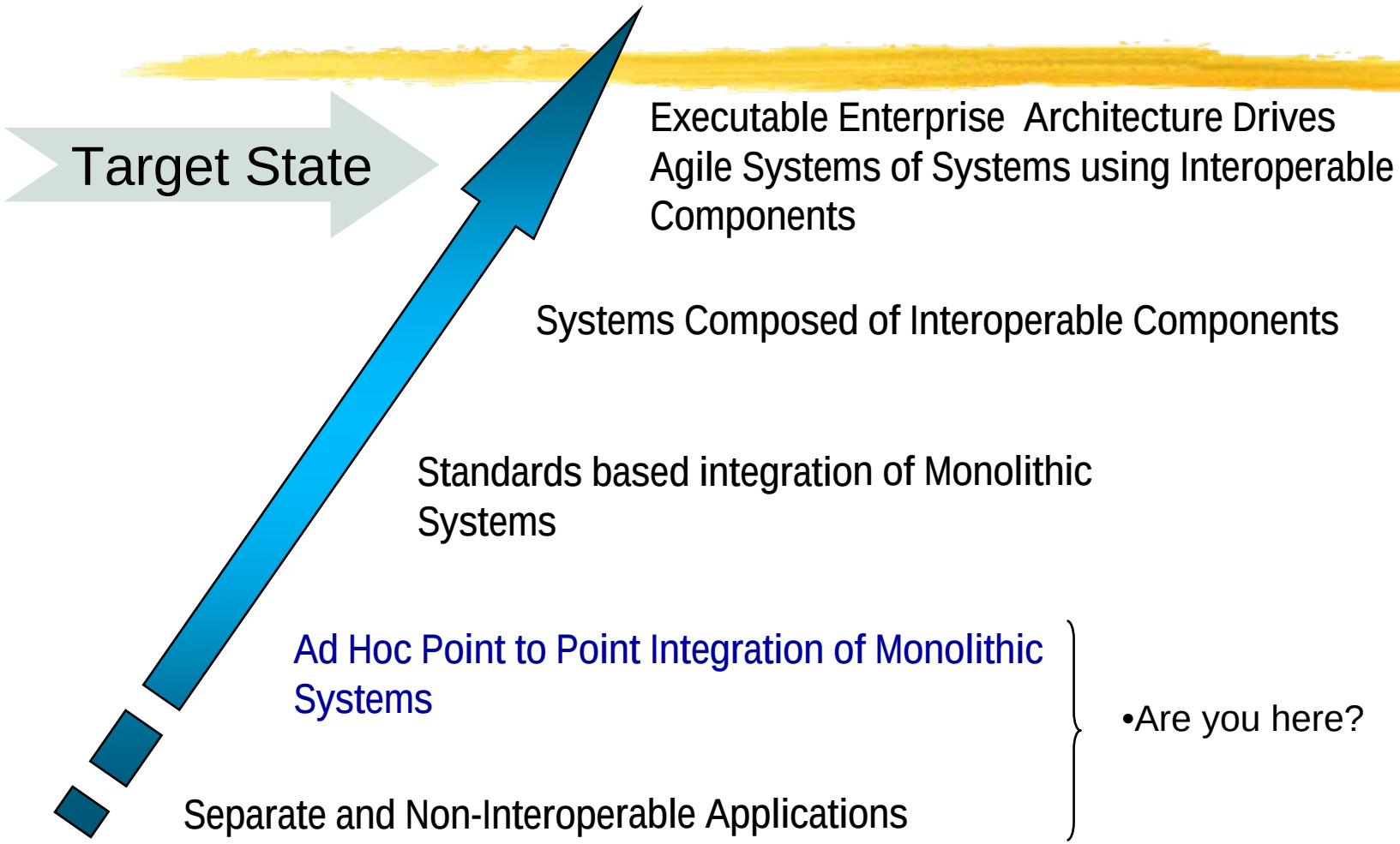
Still Theory



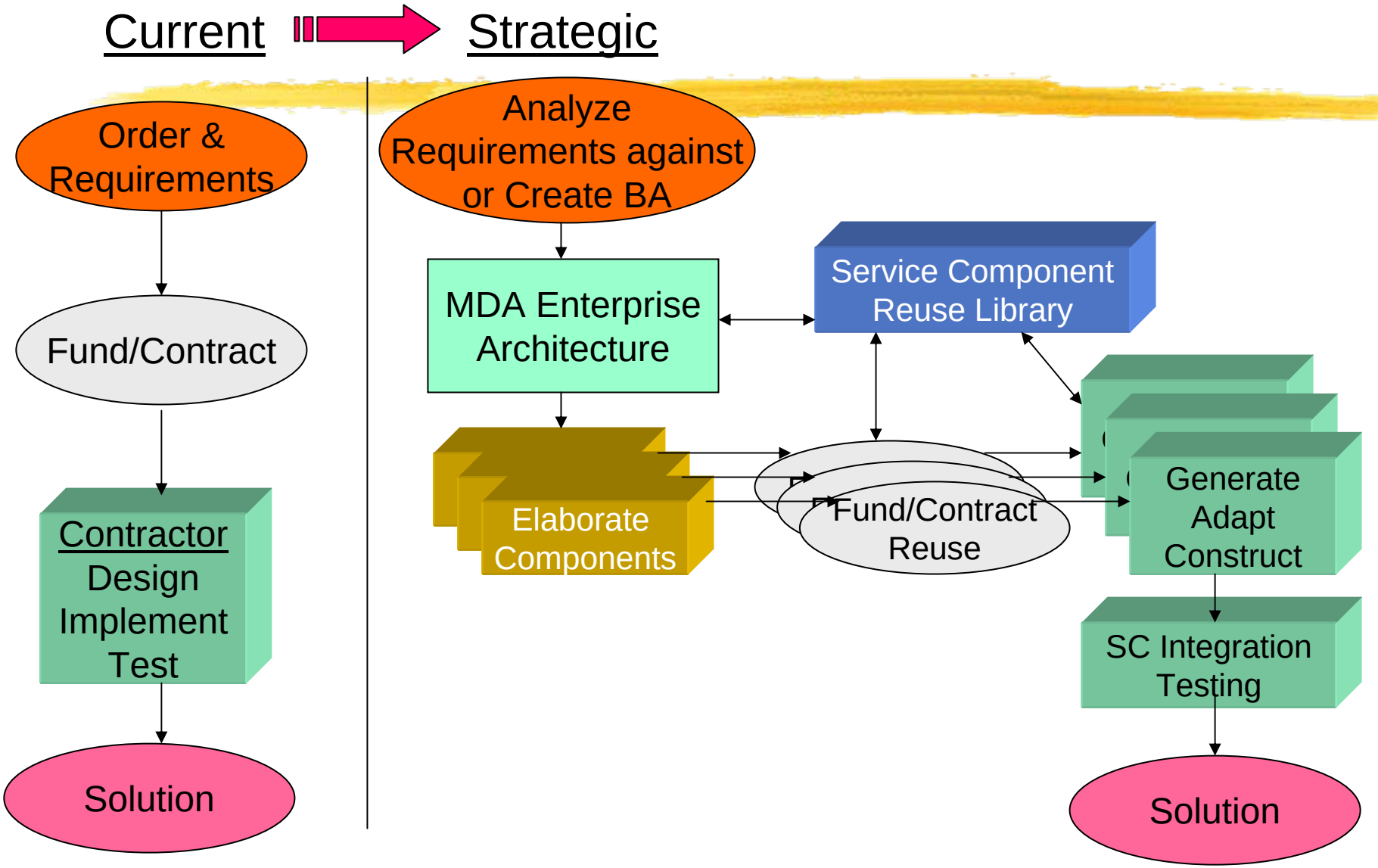
Consolidation into Service Components

- The Good
  - Strategic reduction in operating cost – up to 50%
  - Agile business processes
  - Unification of the enterprise
  - Only way to achieve enterprise transition?
- The Bad
  - Investment in change – As high as 25%
  - Legacy and packaged systems are not componentized
- The Ugly
  - Change is expensive and can be disruptive
  - Current boundaries and ownership change – may require centralized authority and budgeting
  - Requires more “enterprise” agreement – very difficult to get consensus

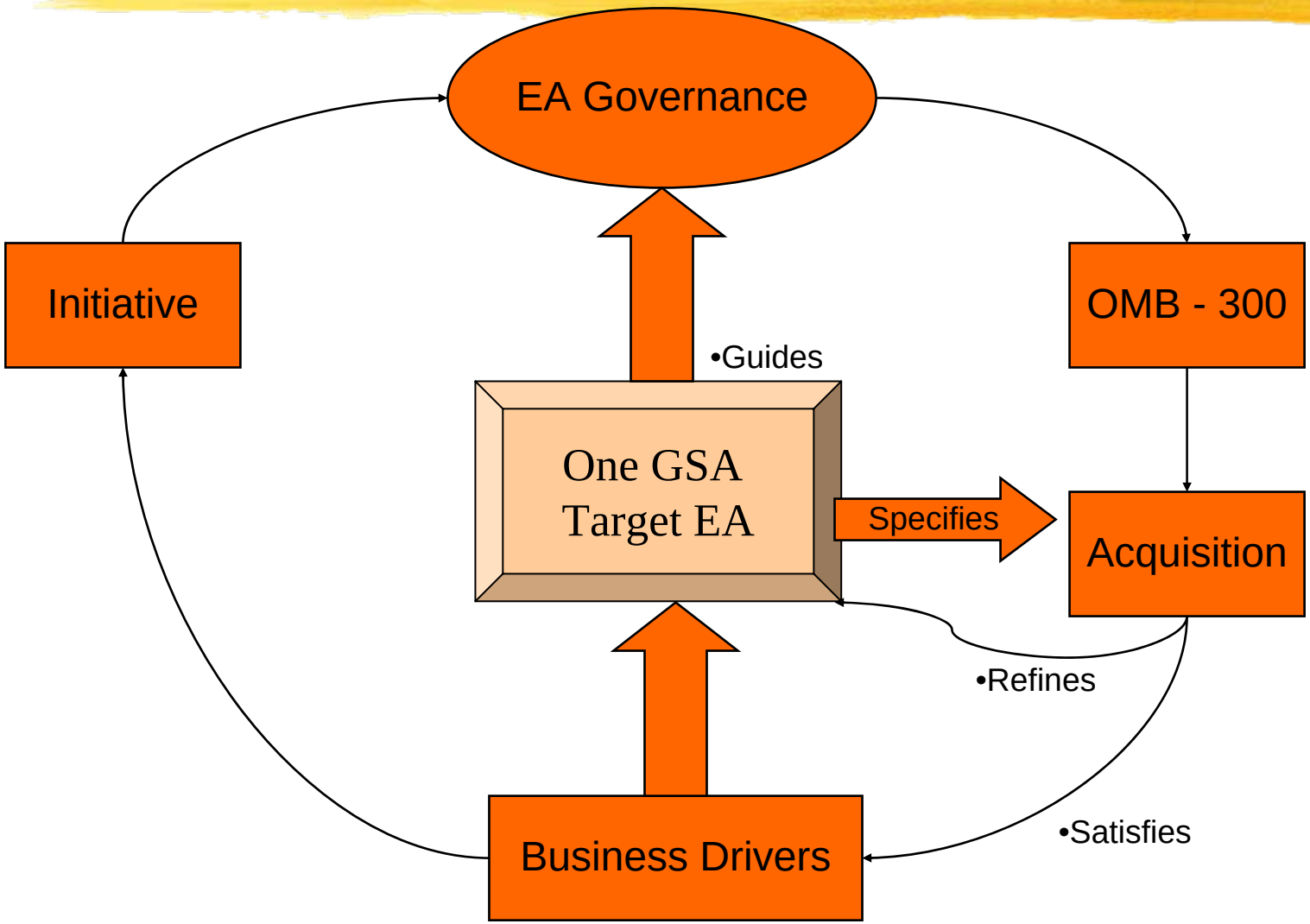
Strategic Migration



MDA Enhanced Procurement

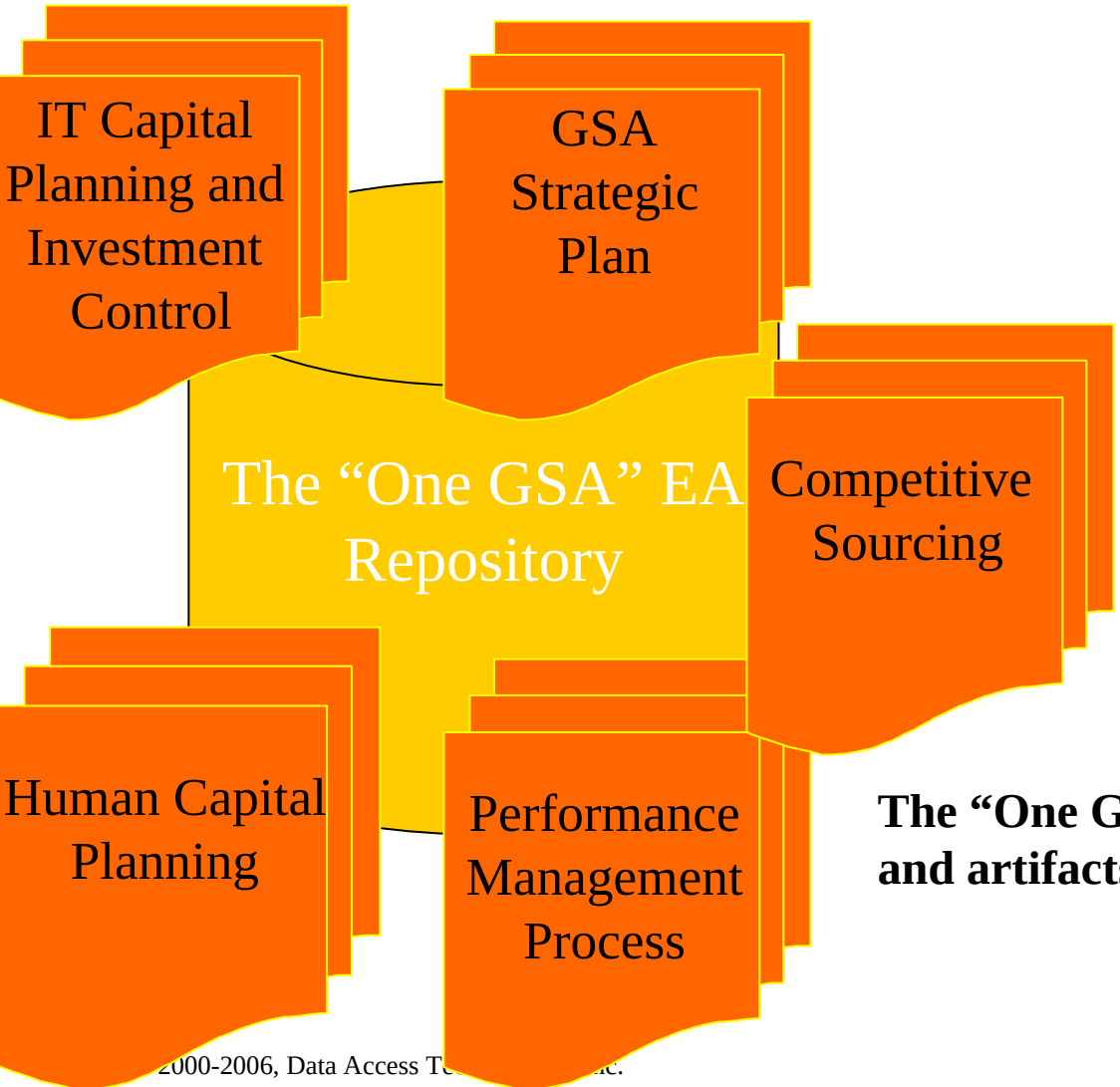


EA Governance Structure



“One GSA” EA Strategic Integration

EA is a STRATEGIC ASSET



- The “One GSA” EA aligns with:
  - GSA Strategic Plan
  - IT Capital Planning and Investment Control process
  - Human Capital Planning process
  - Performance Management process
  - Competitive Sourcing
  - Governance

The “One GSA” EA repository houses models and artifacts that have been vetted and agreed to.

Enterprise MDA

An approach to realizing executable enterprise architecture with MDA and SOA

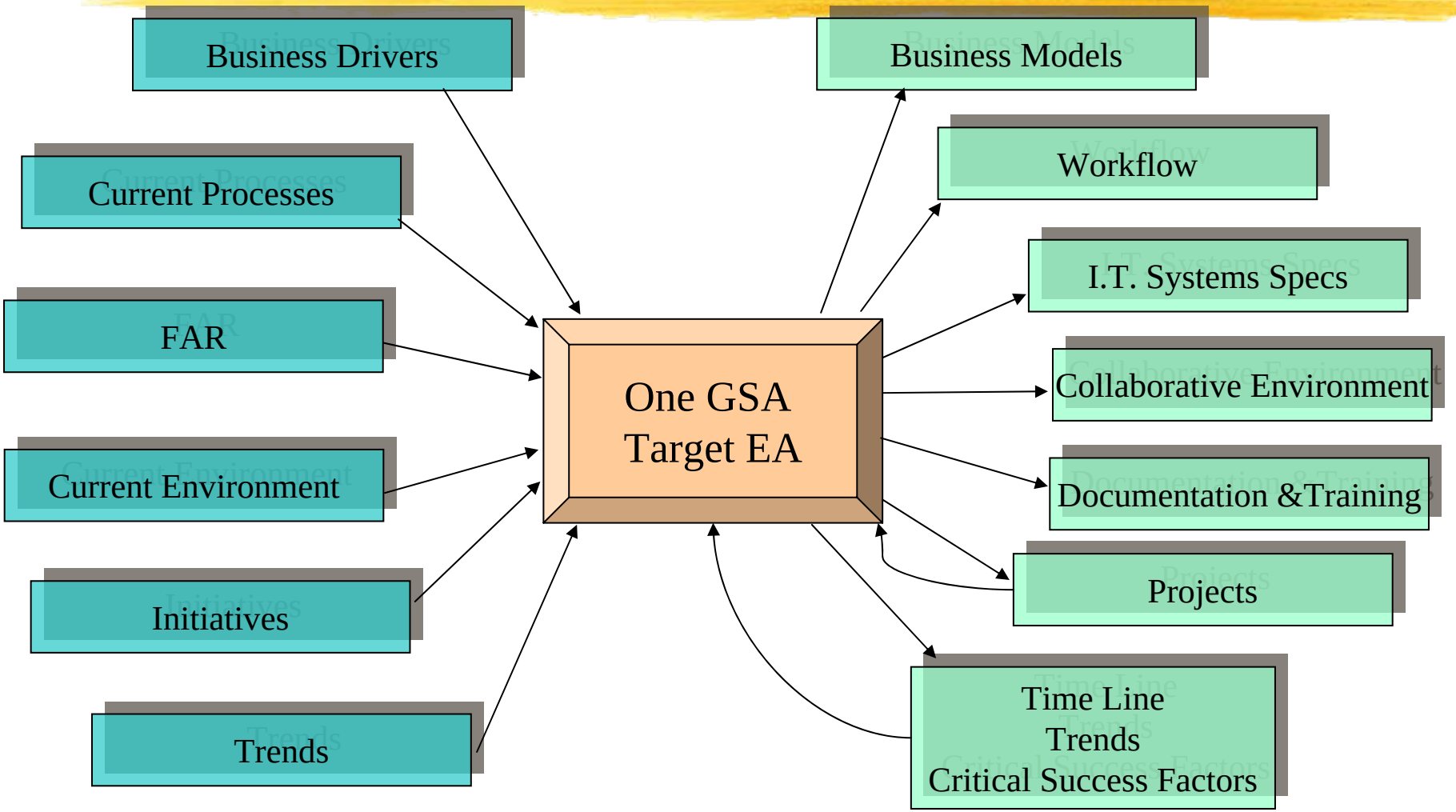
Enterprise MDA

- Architecture at the Enterprise Level
  - Systems of systems
  - Collaboration of organizations, systems & people
  - Wide-scale collaborative processes
    - roles and responsibilities
  - Business Service Oriented Architecture
  - Enterprise Components
  - Componentizing functionality – not creating it
  - Executable processes – smooth transition from model to simulation to solution
- Executable Enterprise Architecture

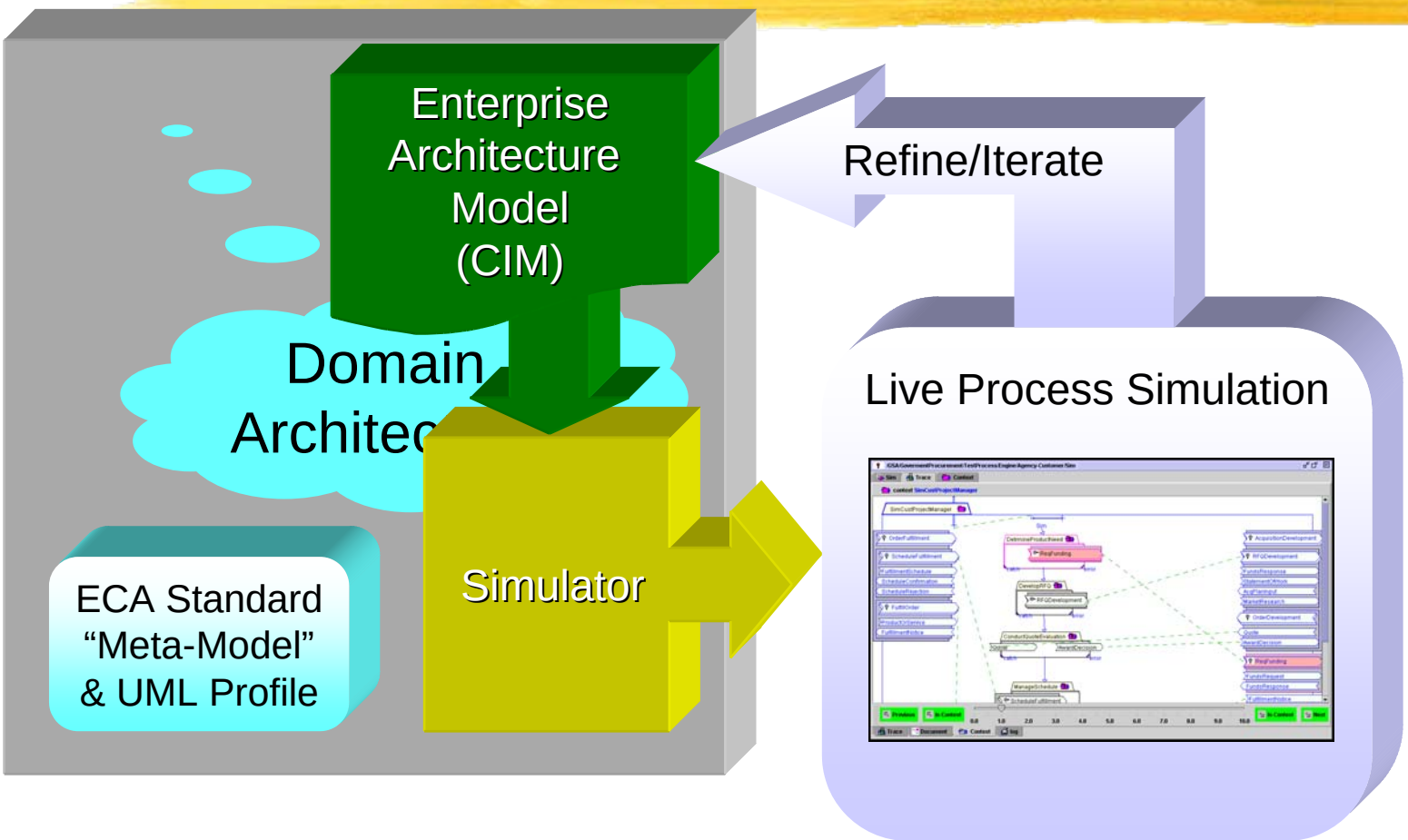
The OMG-Enterprise Collaboration Architecture

- ECA is a “profile of UML”, a way to use UML for a specific purpose - it is an OMG standard
  - That purpose is *modeling enterprise systems*.
- You can also think of this as a “modeling framework” for enterprise computing
- ECA is part of the “Model Driven Architecture” (MDA) initiative of the OMG
  - Using precise modeling techniques as part of the development lifecycle to speed development and provide technology independence
- ECA has been adopted by the OMG as part of the EDOC Profile for UML specification.

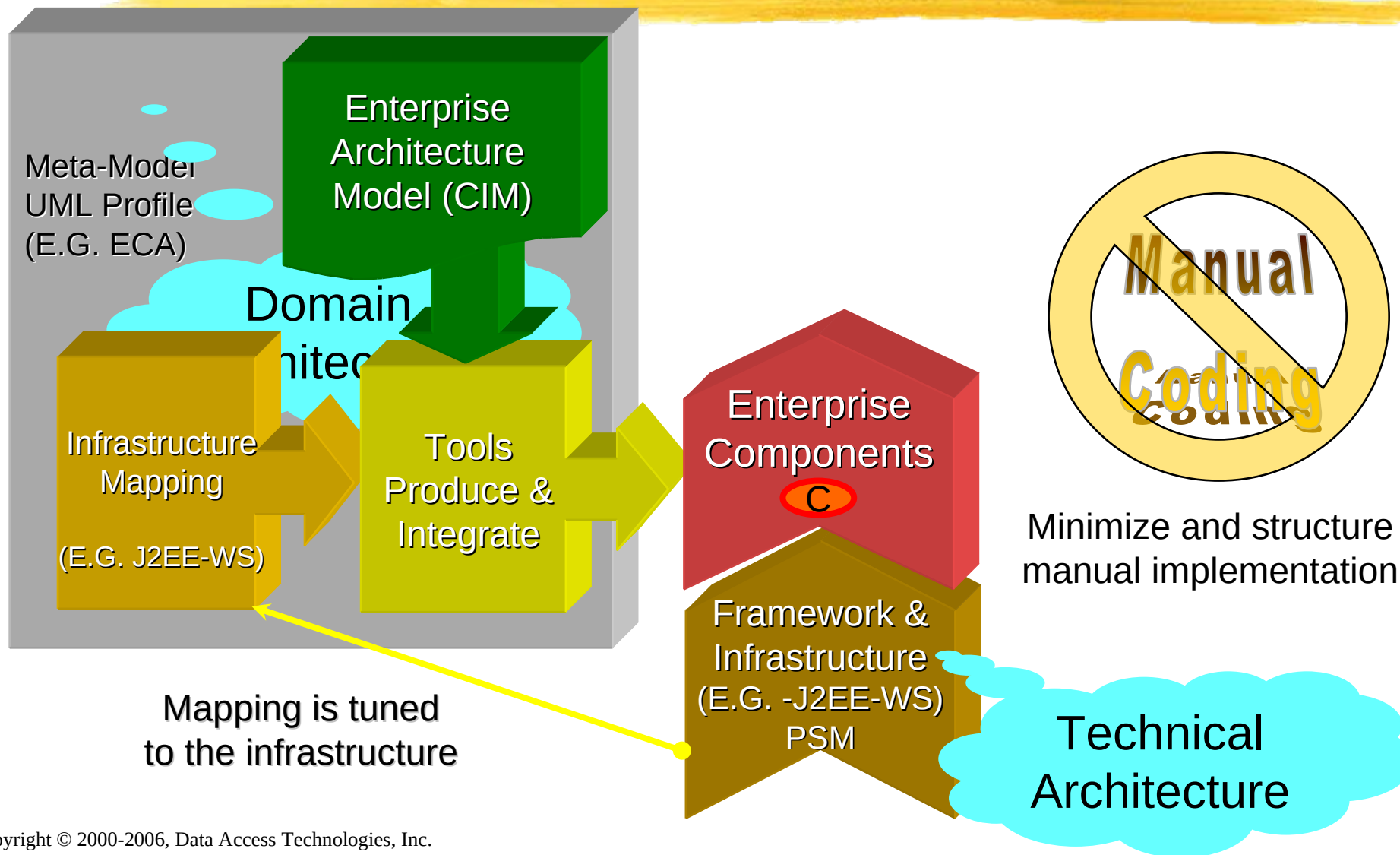
Value Focused Target Architecture



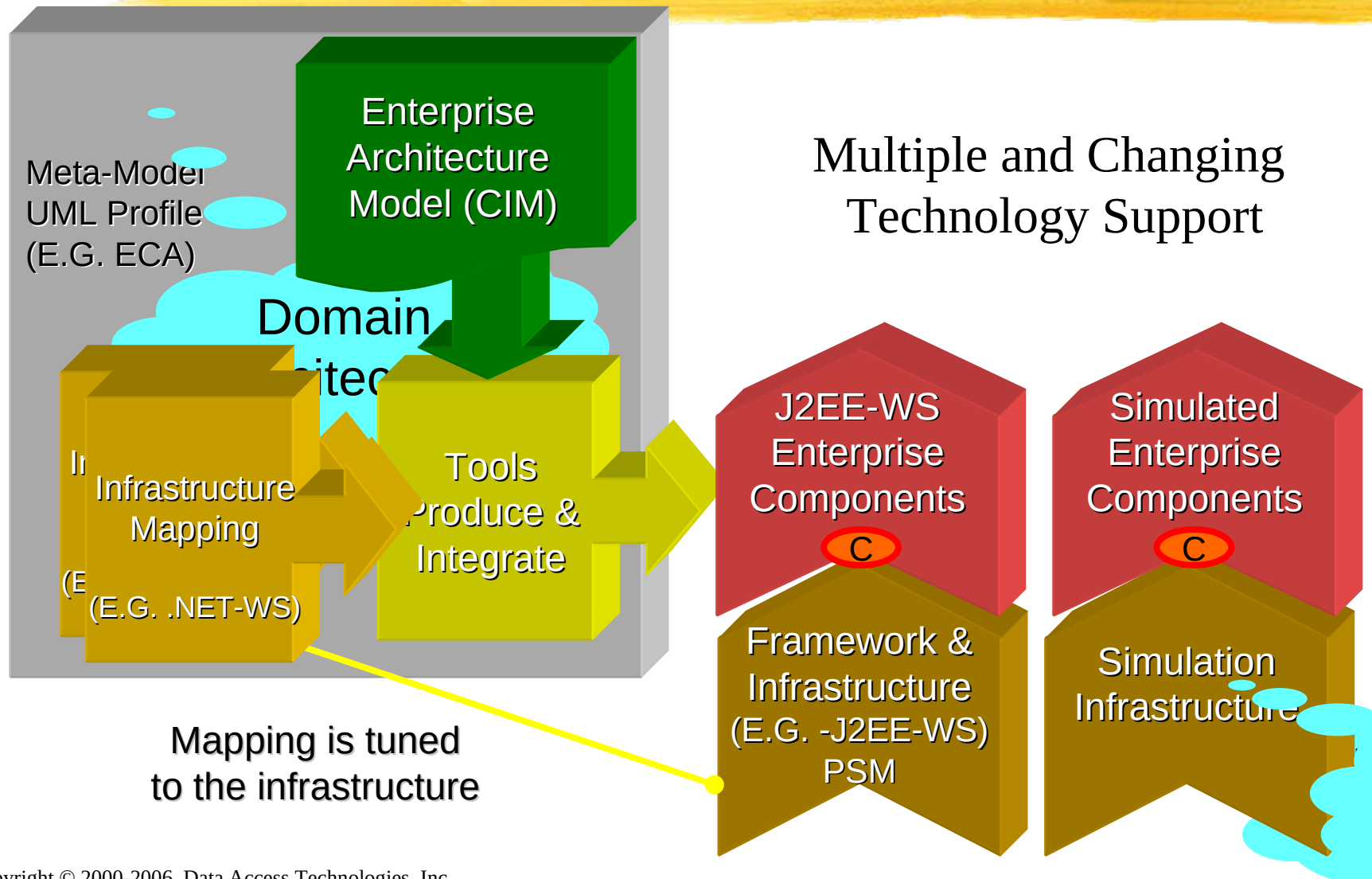
Simulated Model Driven Architecture



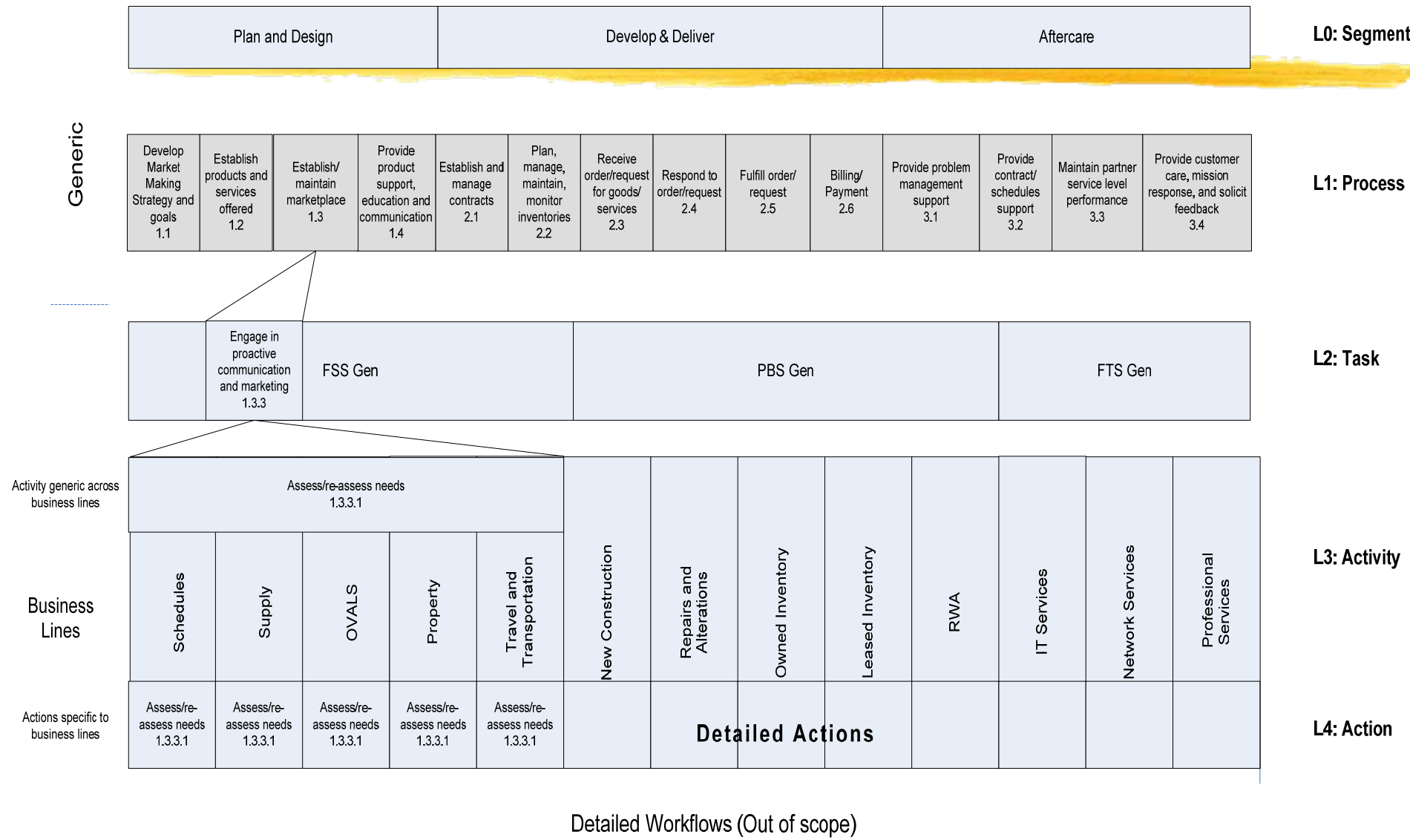
Automated Model Driven Architecture



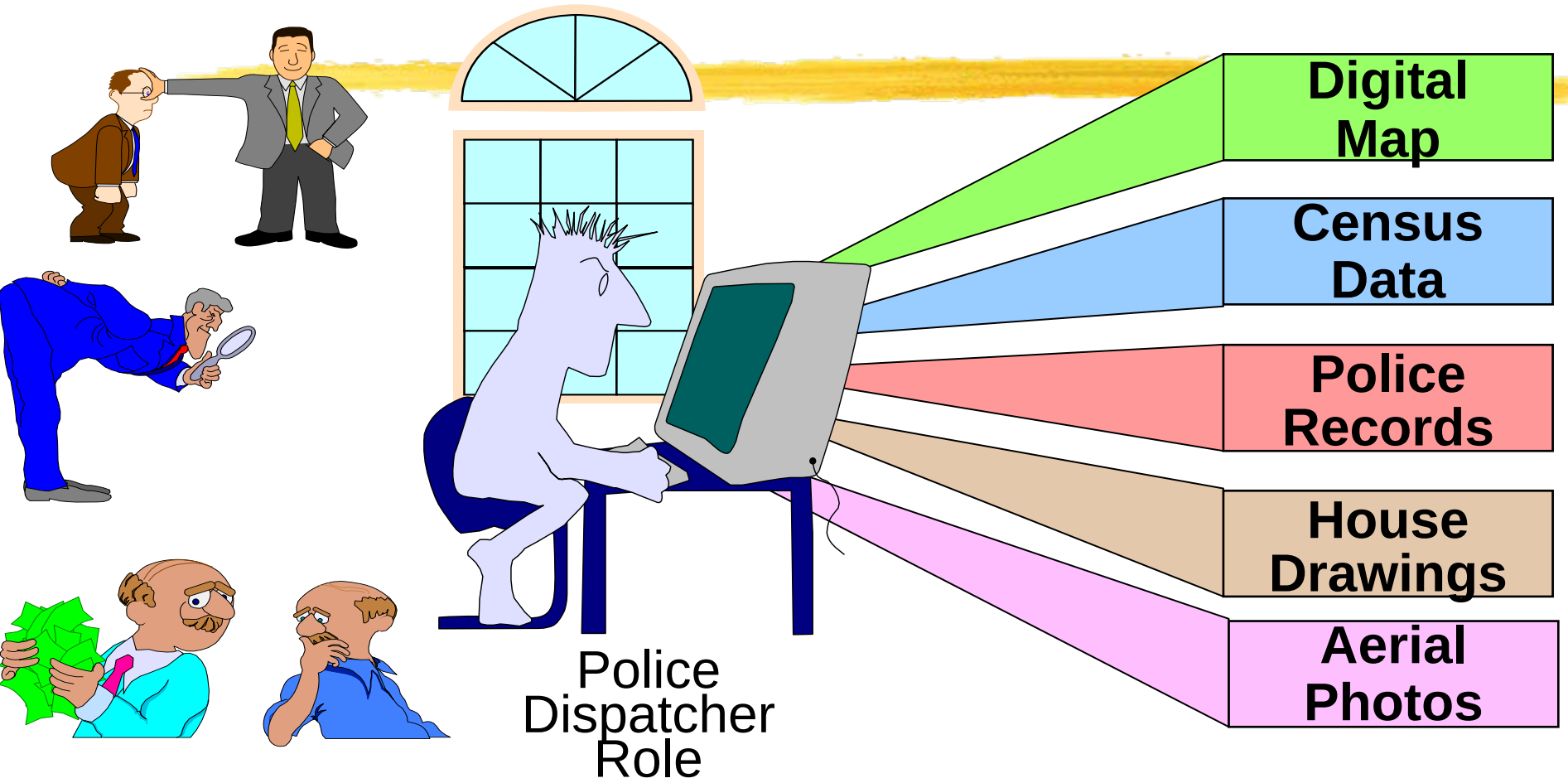
Automated Model Driven Architecture



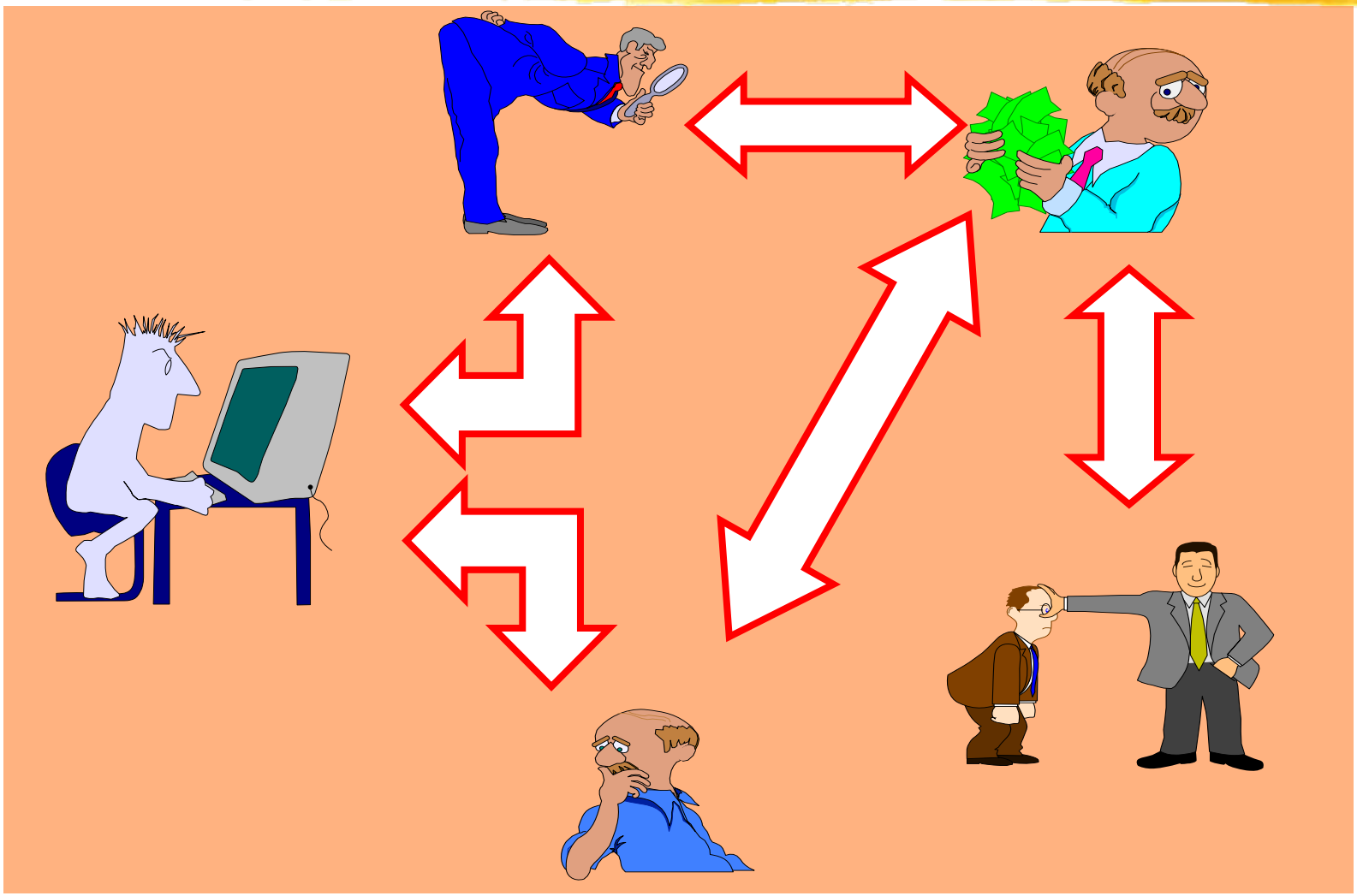
Mission Critical Value Chain



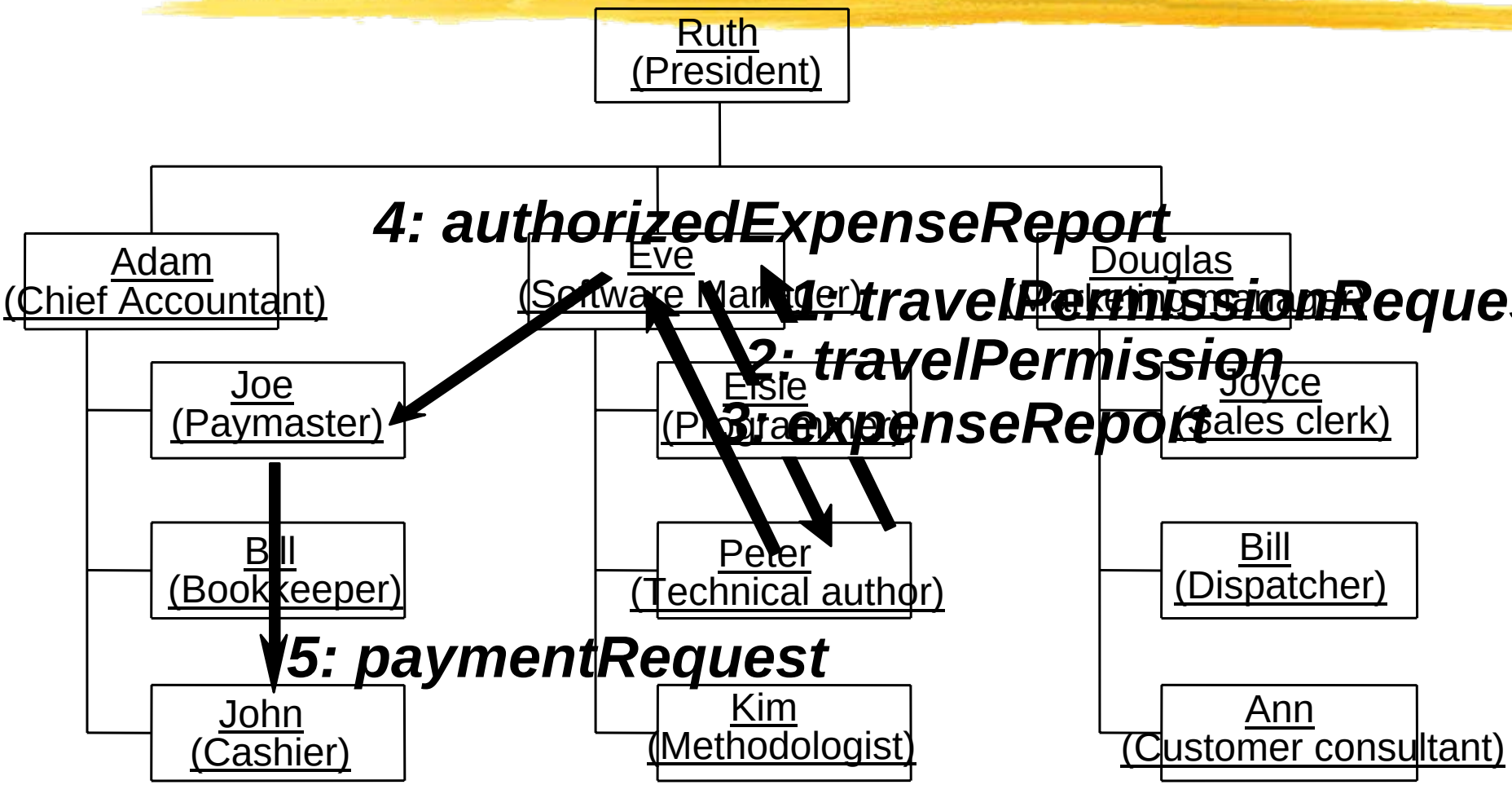
The Connected Enterprise
Content and Communication



Multiple roles in a collaboration

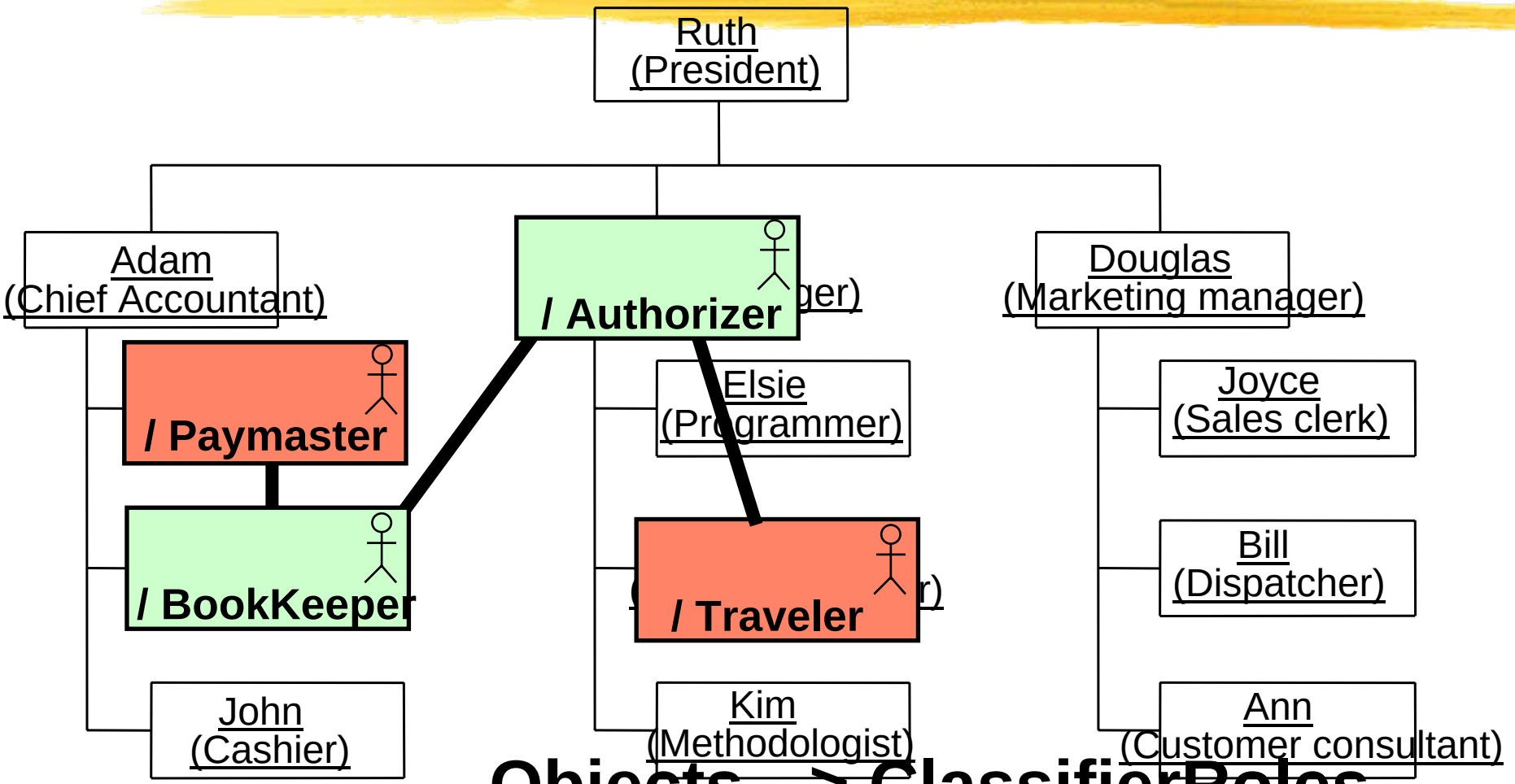


Travel Expense Example



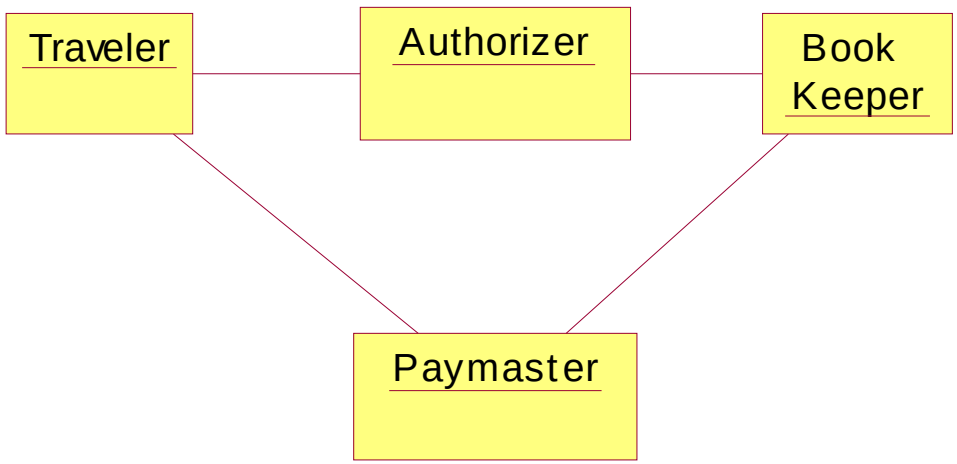
Diagram

Travel Expense Model



Objects --> ClassifierRoles

Collaboration Diagram



The Marketplace Example

Mechanics Are Us
Buyer

Order

Conformation

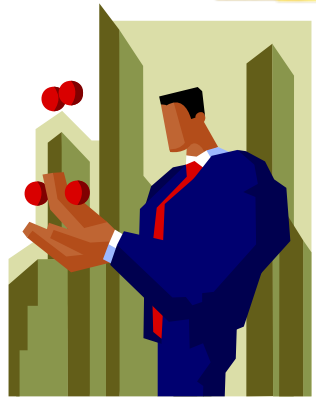
Shipped

Process
Complete

Status

Physical
Delivery

GetItThere Freight
Shipper



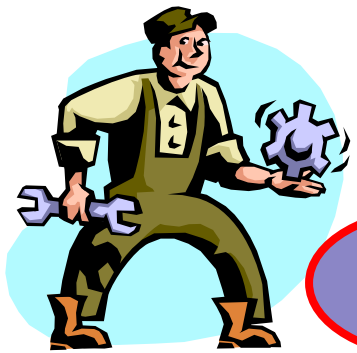
Acme Industries
Seller

Ship Req

Shipped

Delivered

Where are the services?



Web Service

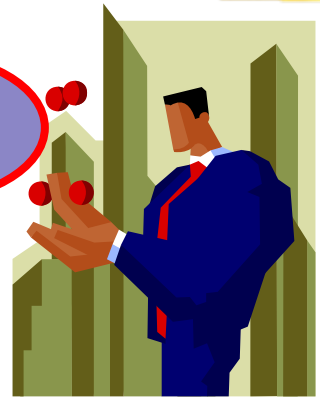
Mechanics Are Us
Buyer

Order

Conformation

Shipped

Web Service

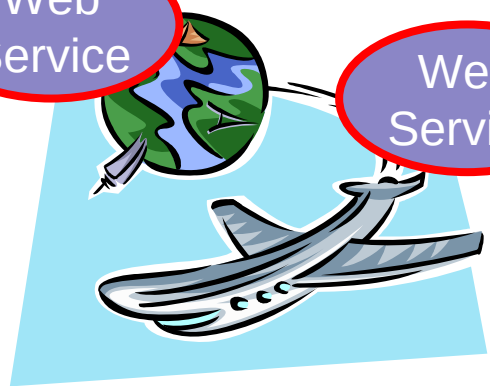


Acme Industries
Seller

Web Service

Status

Physical
Delivery



Web Service

Ship Req

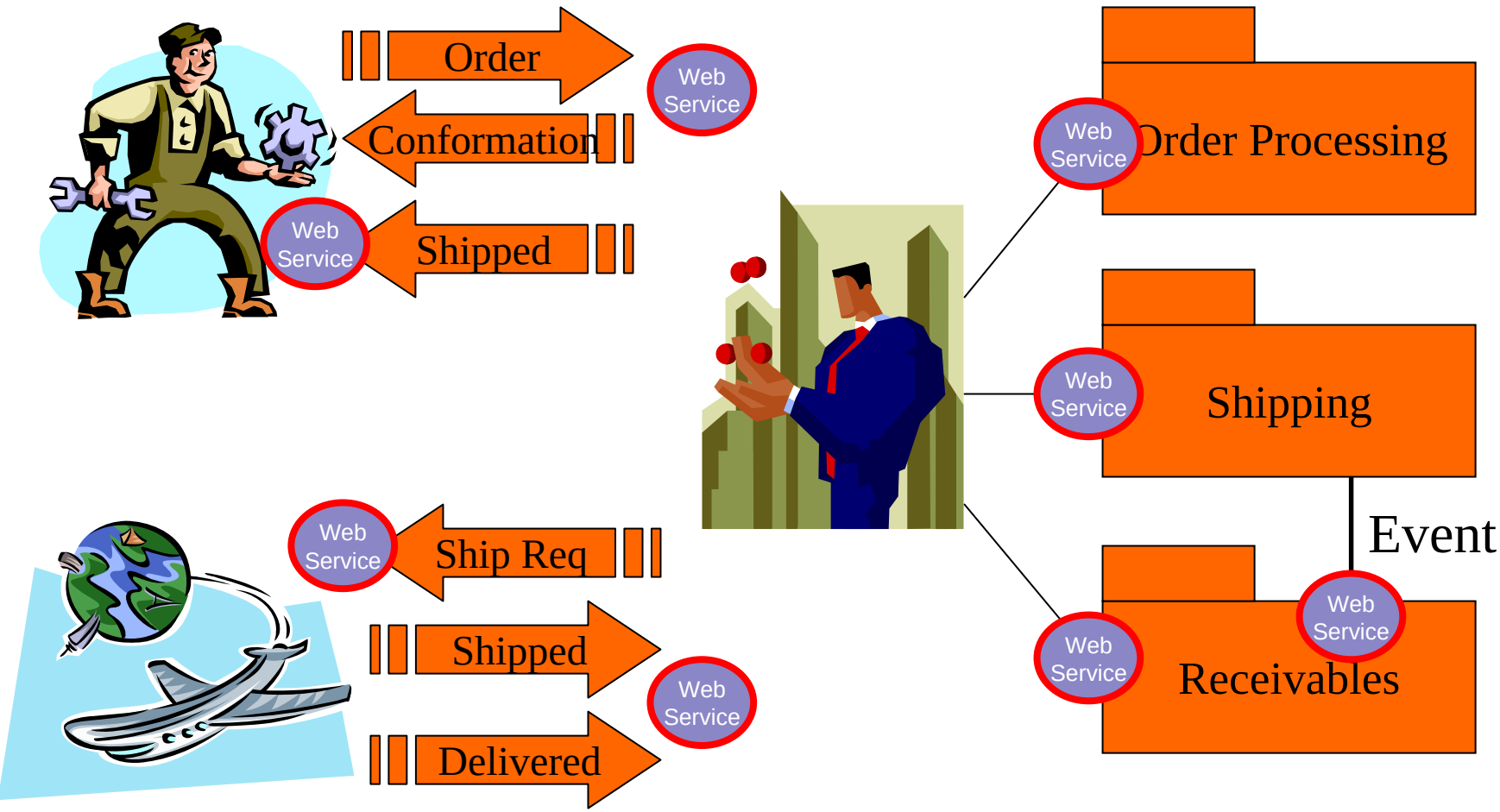
Shipped

Delivered

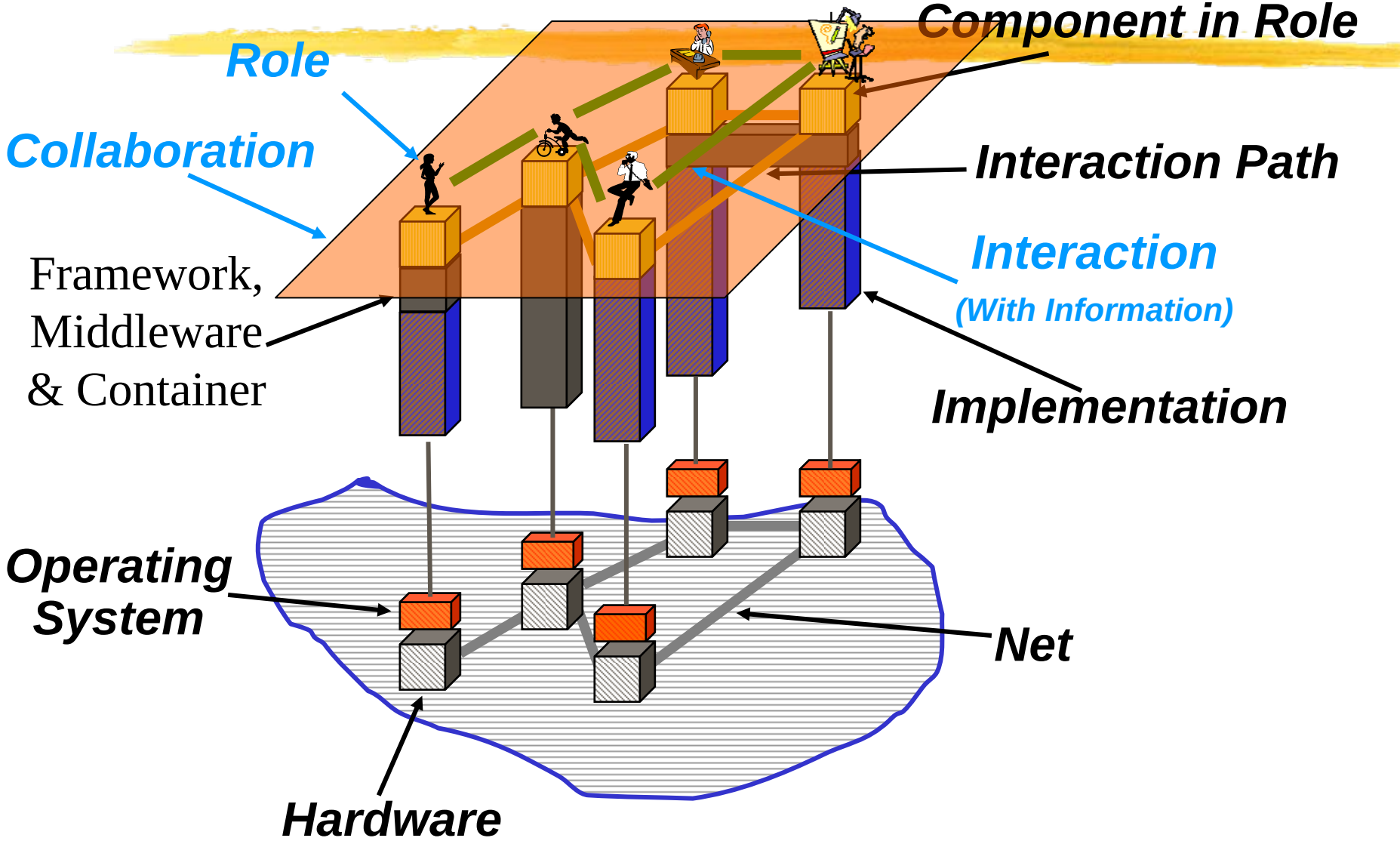
Web Service

GetItThere Freight
Shipper

Inside the Seller



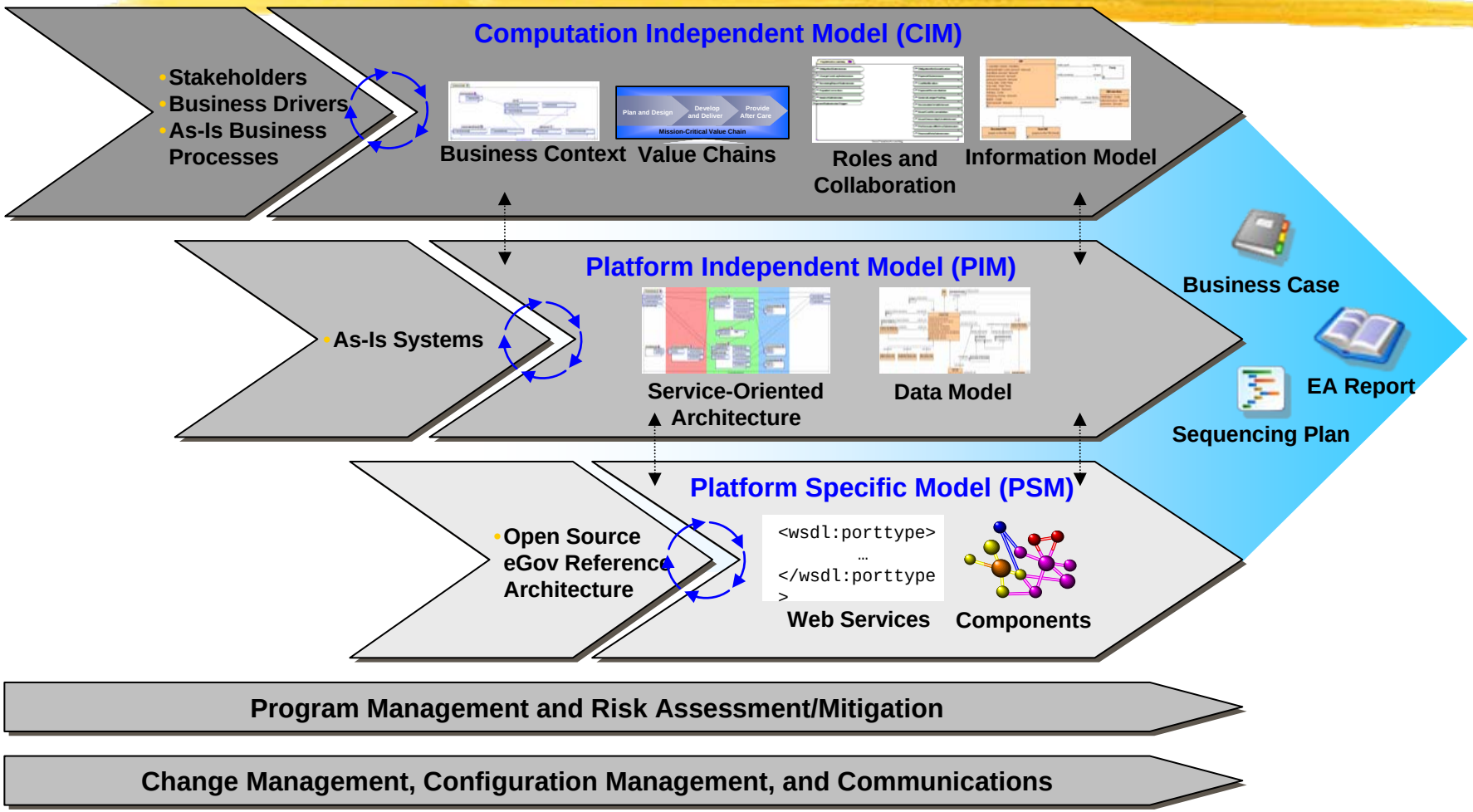
Roles to Systems



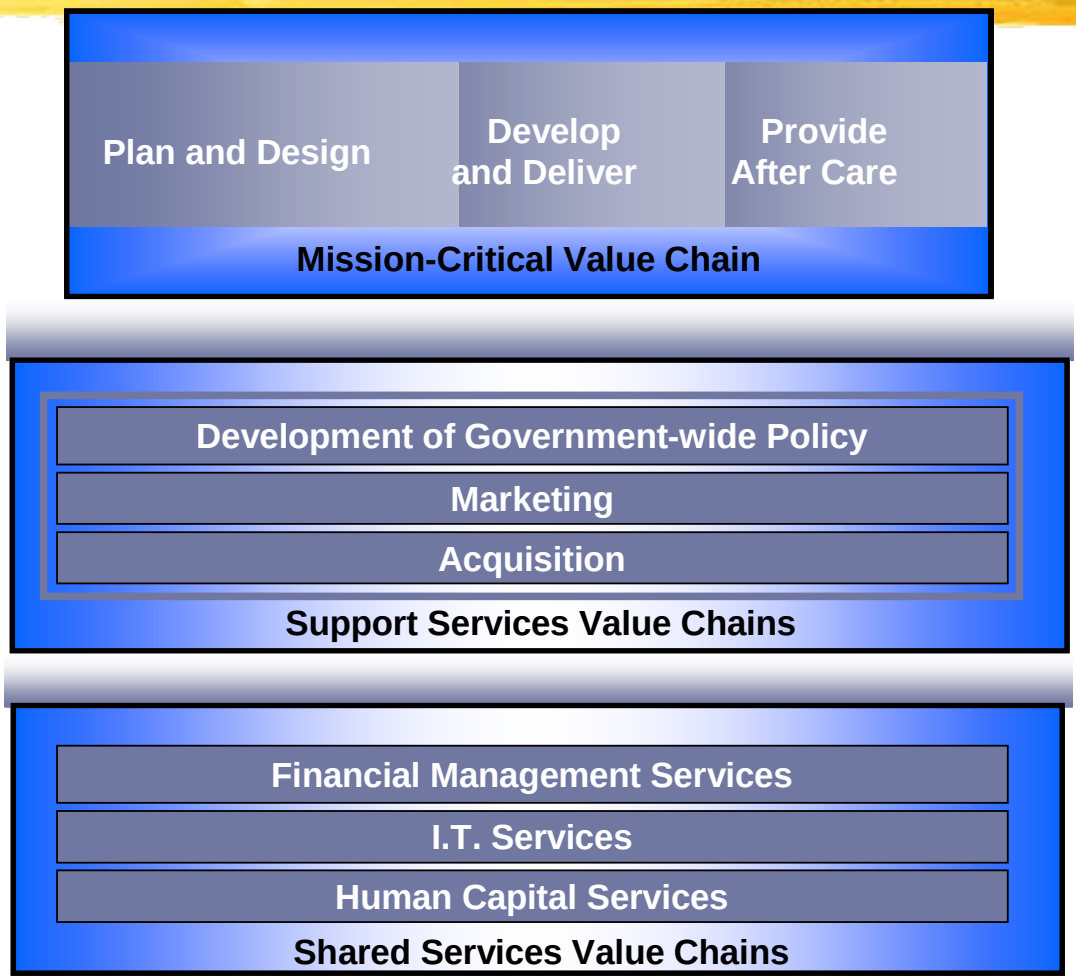
Model to Integrate

From business needs to executing solutions

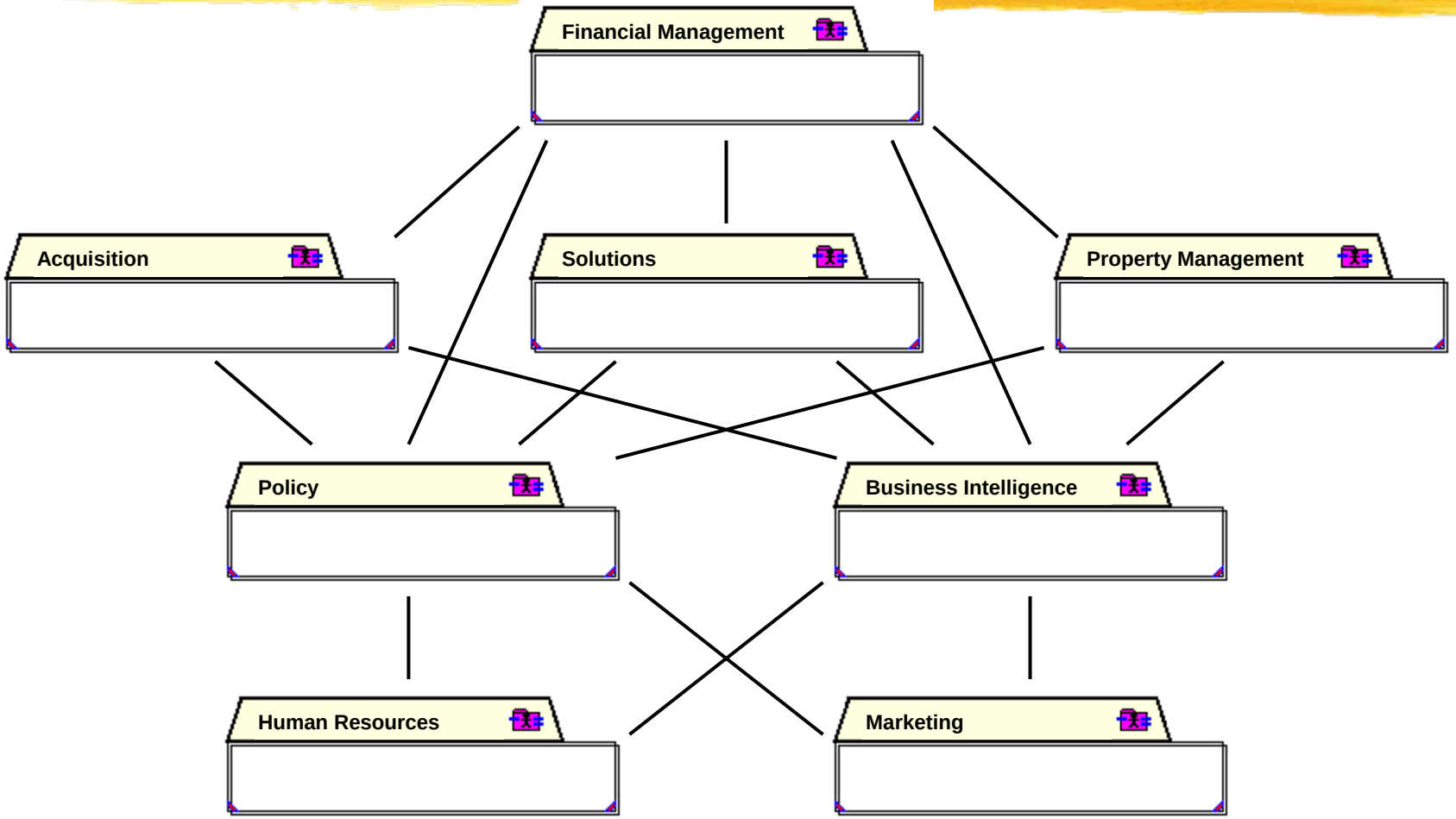
Enterprise MDA Process



Value Chains



Disciplines – Areas of Responsibility



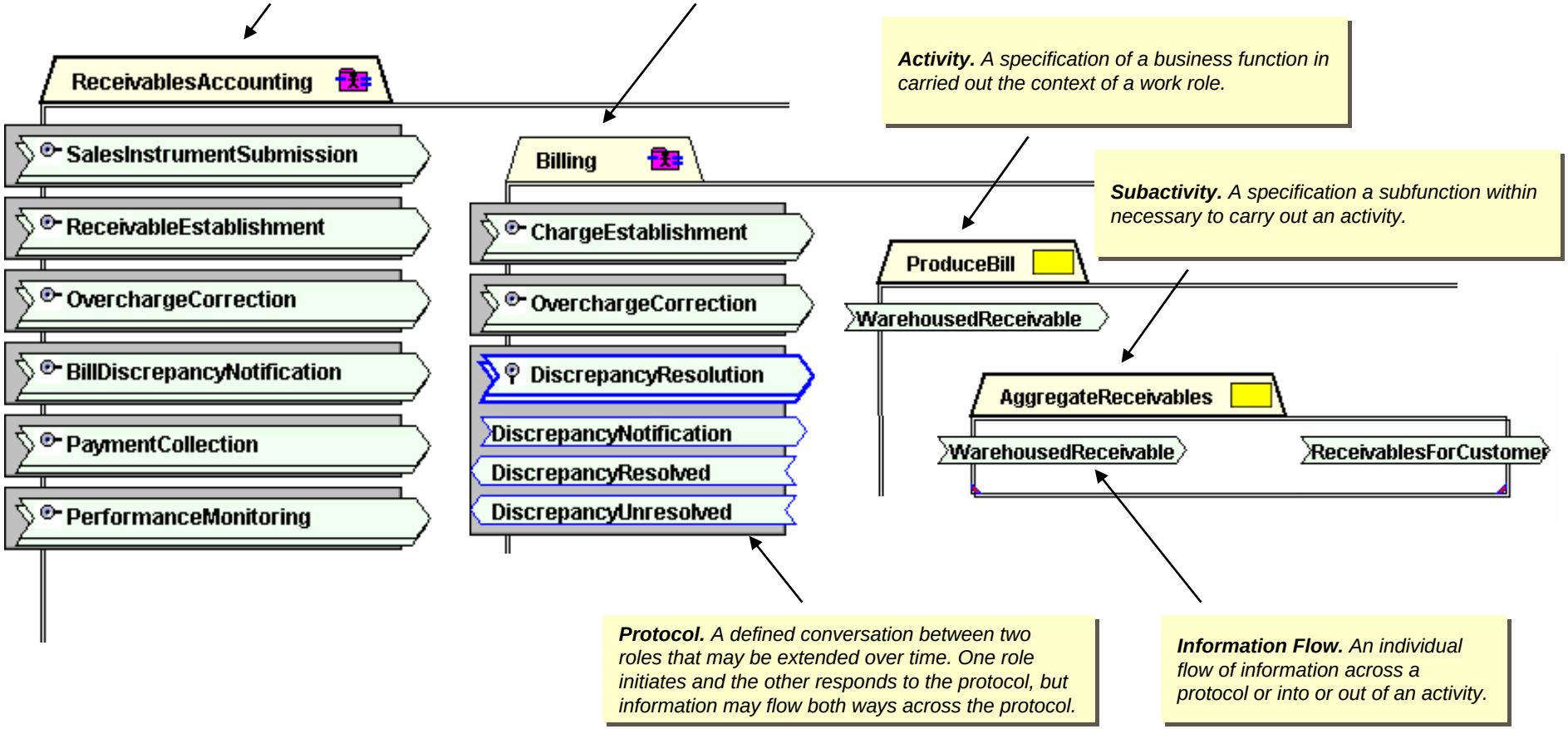
Collaborative Process Model

Enterprise Role. *A major area of functional responsibility within the discipline of financial management.*

Work Role. *A role responsible for a specific functional area within an enterprise role, such as might be assigned to a single worker or supported by an IT system.*

Activity. *A specification of a business function in carried out the context of a work role.*

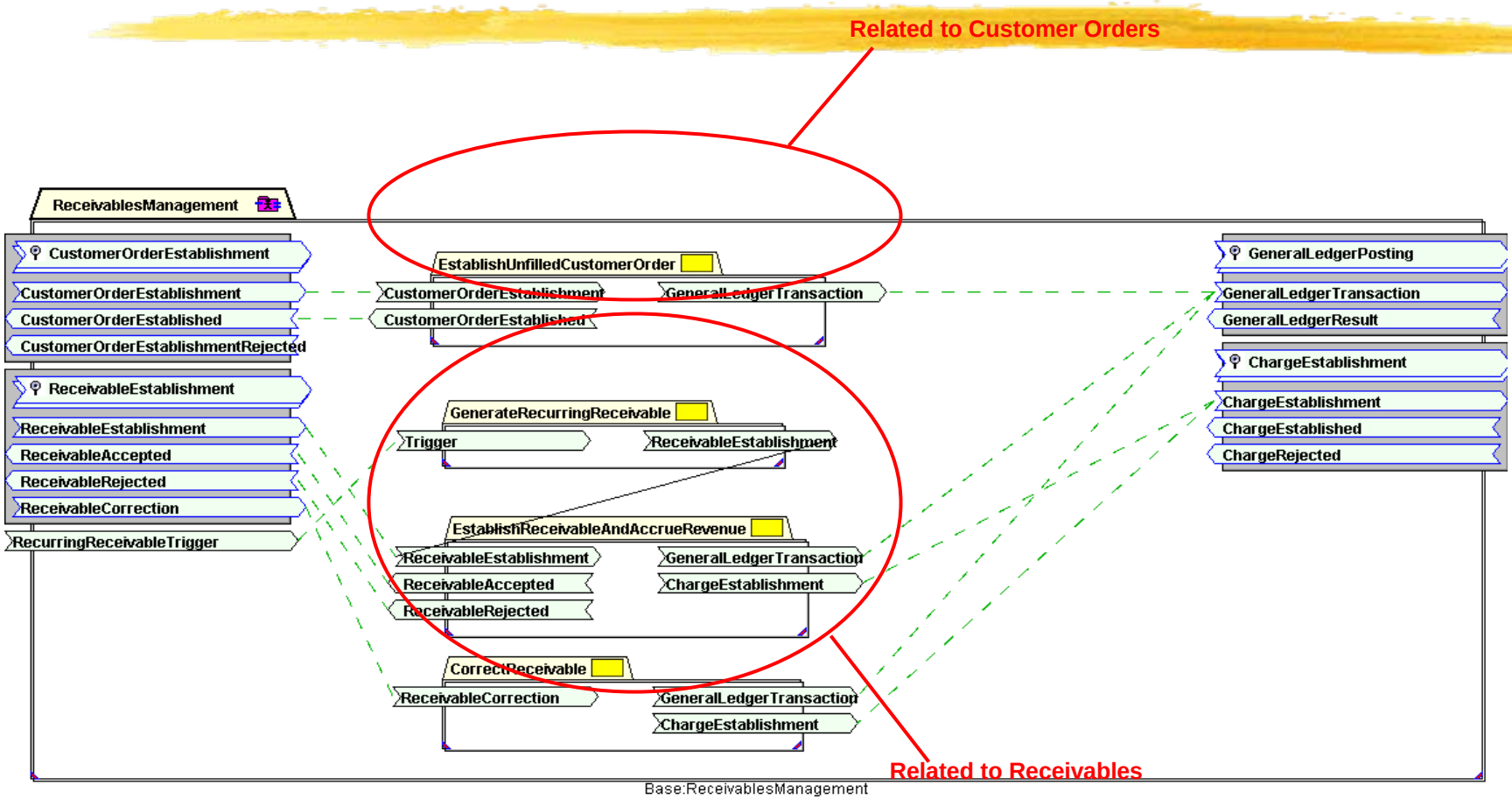
Subactivity. *A specification a subfunction within necessary to carry out an activity.*



Protocol. *A defined conversation between two roles that may be extended over time. One role initiates and the other responds to the protocol, but information may flow both ways across the protocol.*

Information Flow. *An individual flow of information across a protocol or into or out of an activity.*

Receivables Management Example



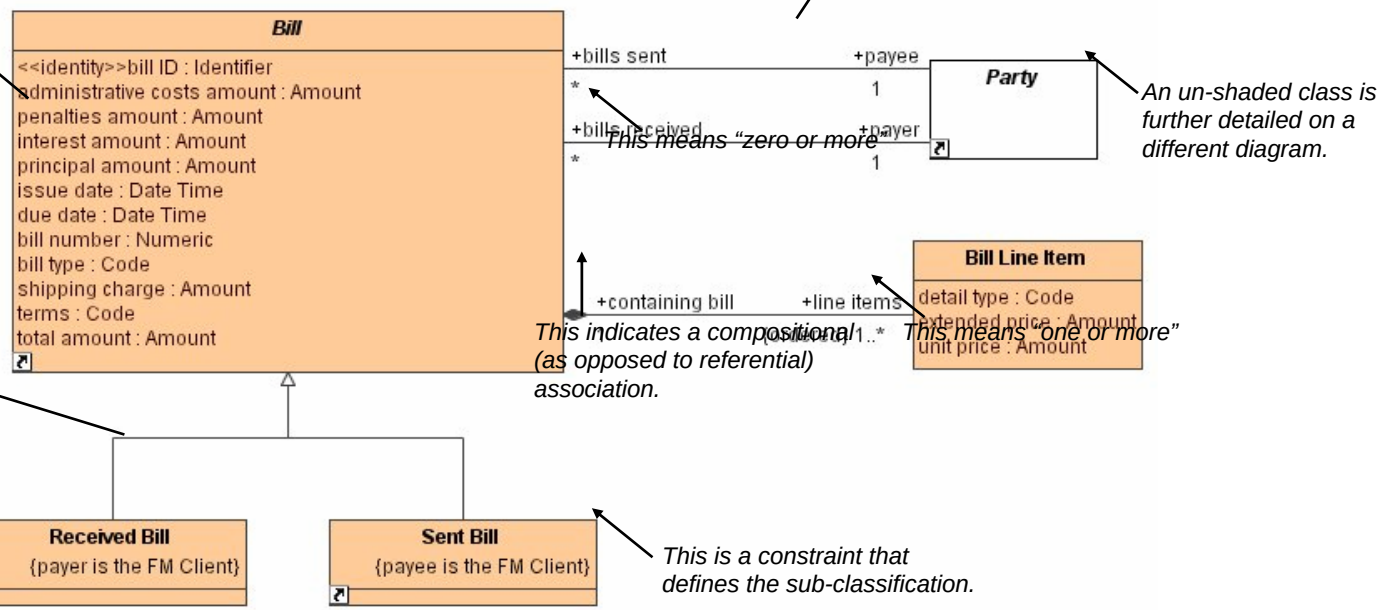
Information Model Example

*A term in the vocabulary represents a **class** of things to be described.*

*Entities may be described as having a unique **identity**.*

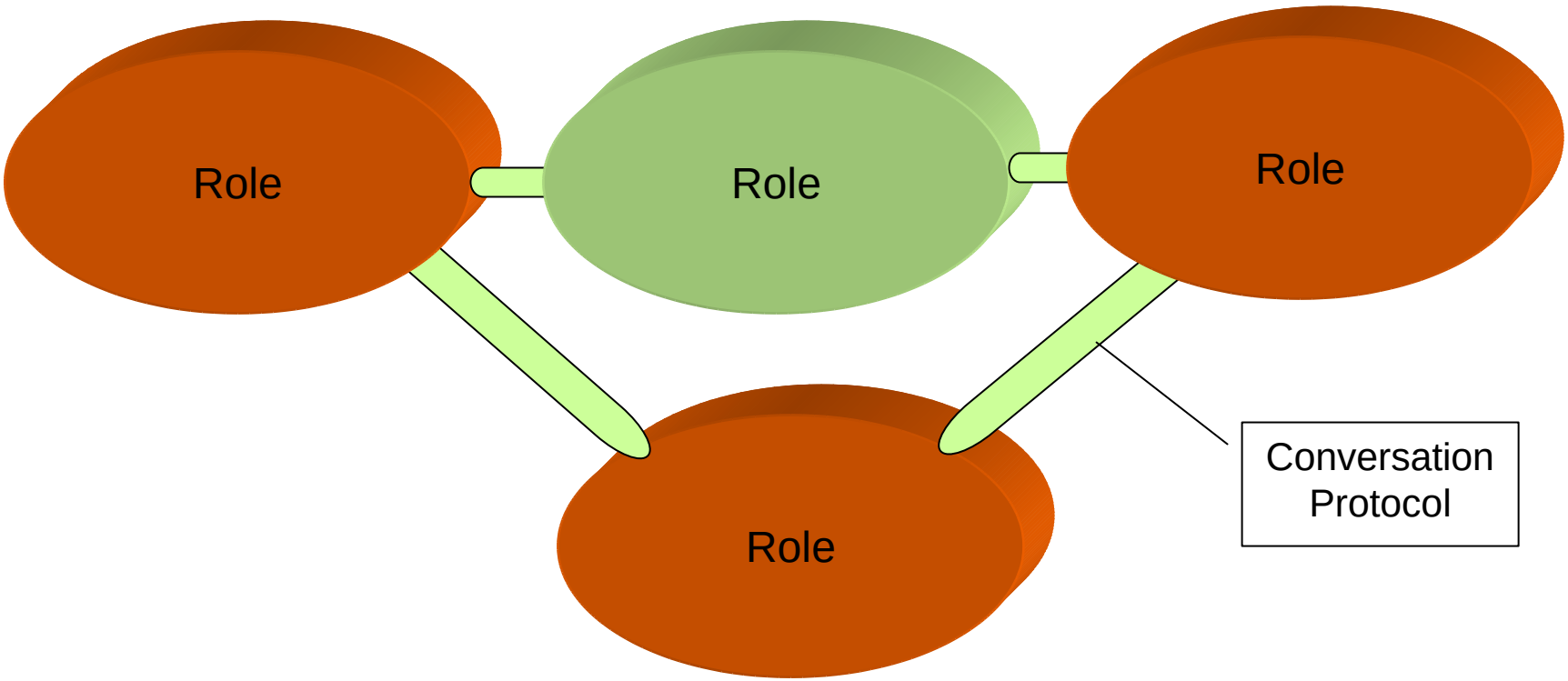
*A relation between terms is described by an **association** between classes.*

***Attributes** specify descriptive information having simple types.*



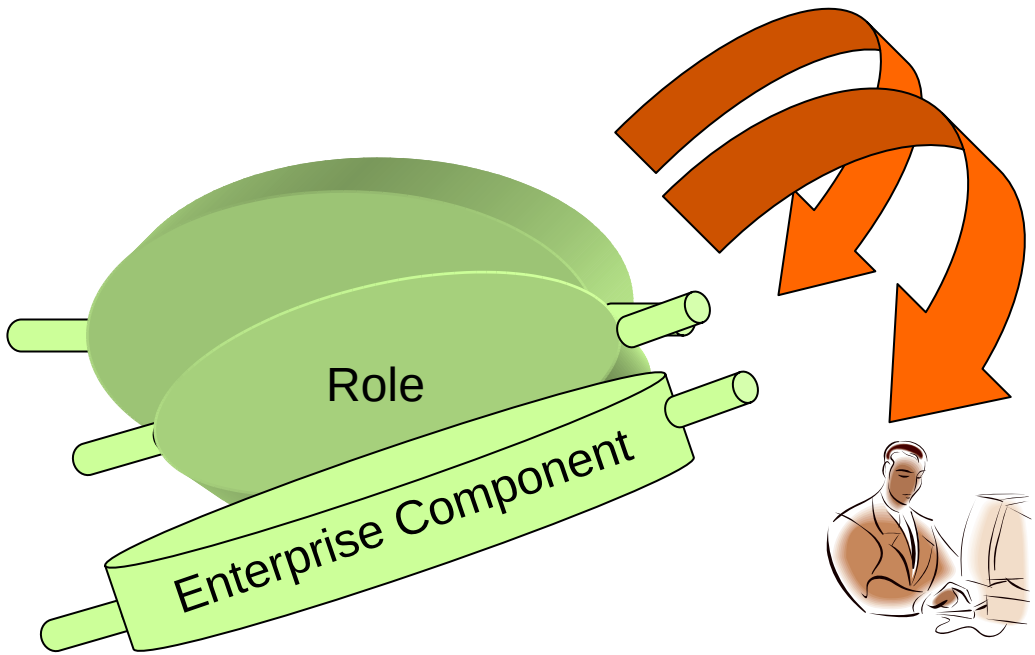
*A class may be **specialized** into sub-classifications.*

Business (CIM) view - Collaborating Roles with Processes



“Upper” PIM (system) View - Enterprise Component

“Rotate” to look
At other aspects
of the component



People, organizations
And/or enterprise components
play roles in Business
Processes.

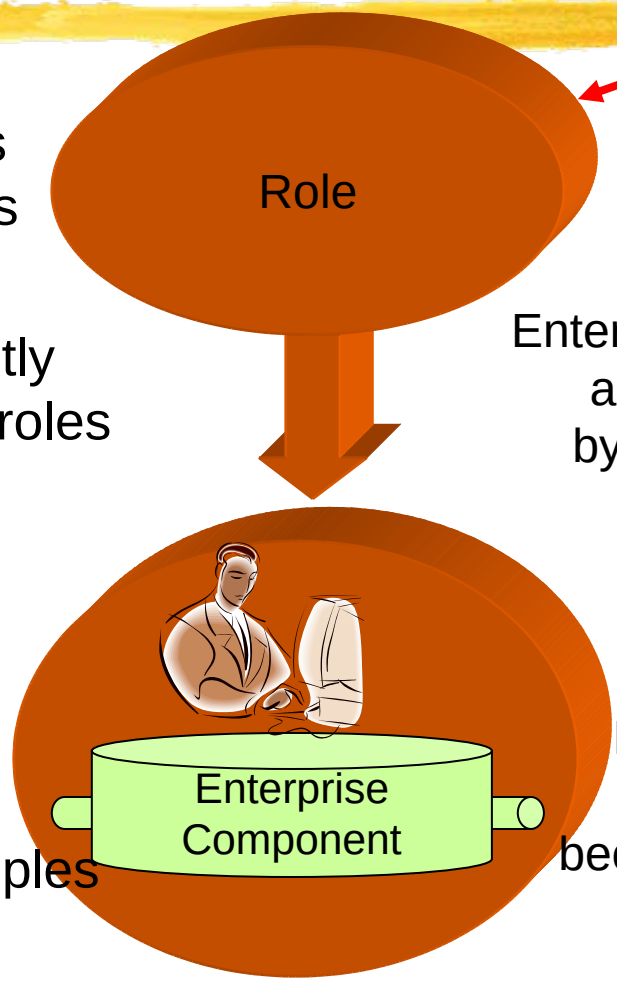
The “Enterprise Digital Assistant”

People, Organizations
And systems play roles

Components frequently
help people play these roles

People, organizations
and systems
components work
together to realize roles

Components are the peoples
Automated assistant

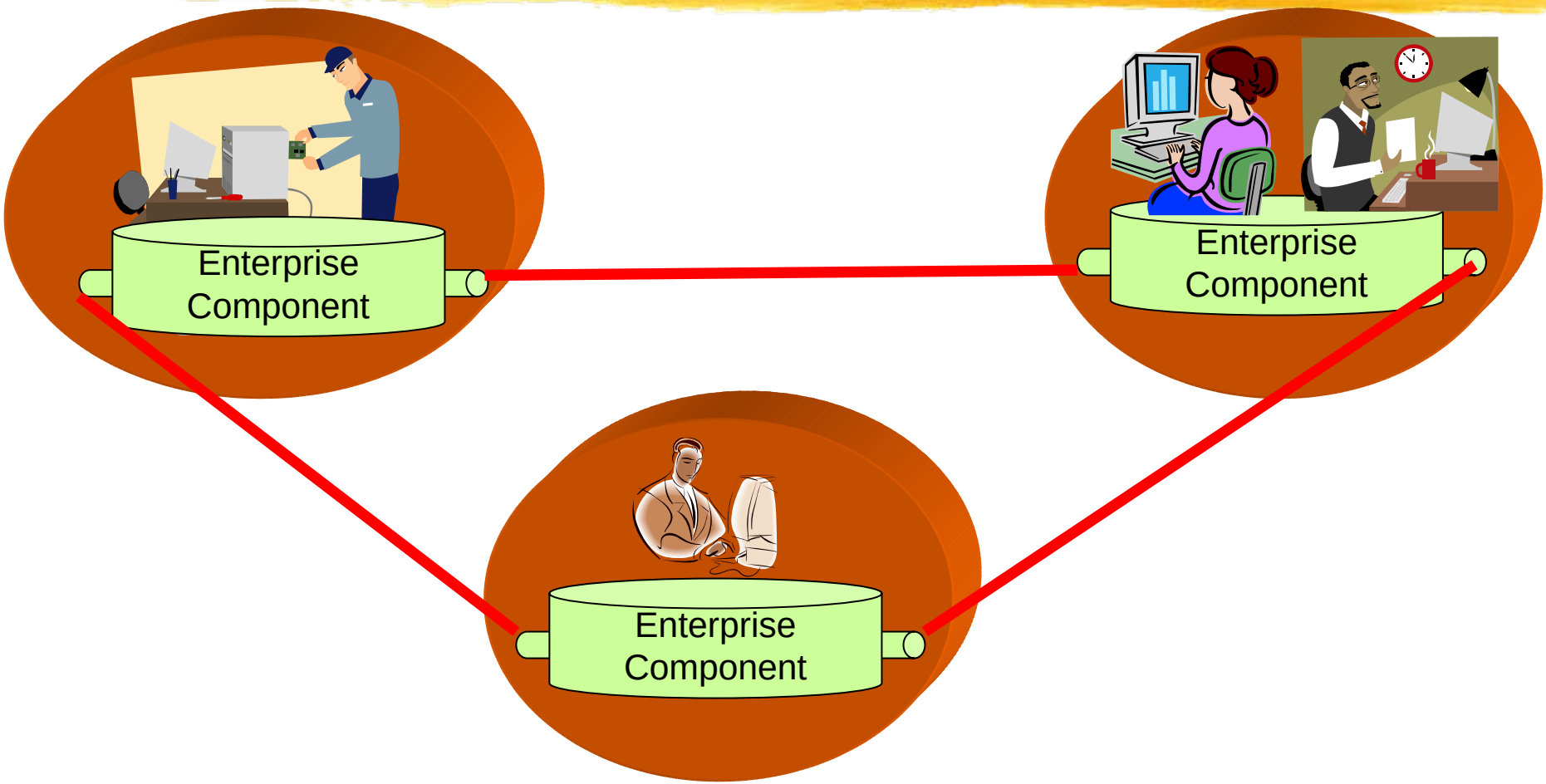


Business
Process

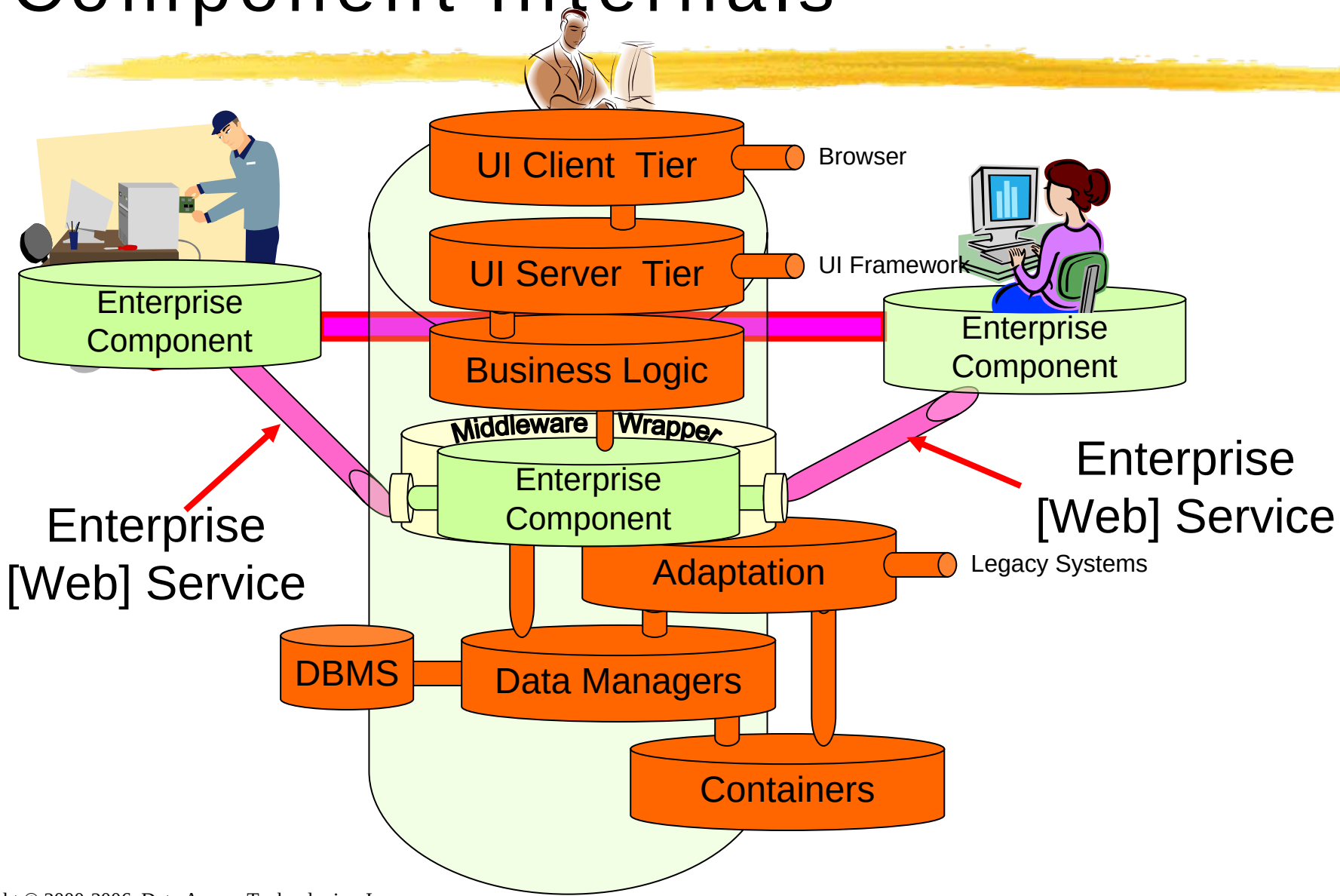
Enterprise components help people
and organizations play roles
by automating and monitoring
The business process

From the system perspective.
People and organizations
become part of the implementation
Of the role

People, Components & Organizations Collaborating

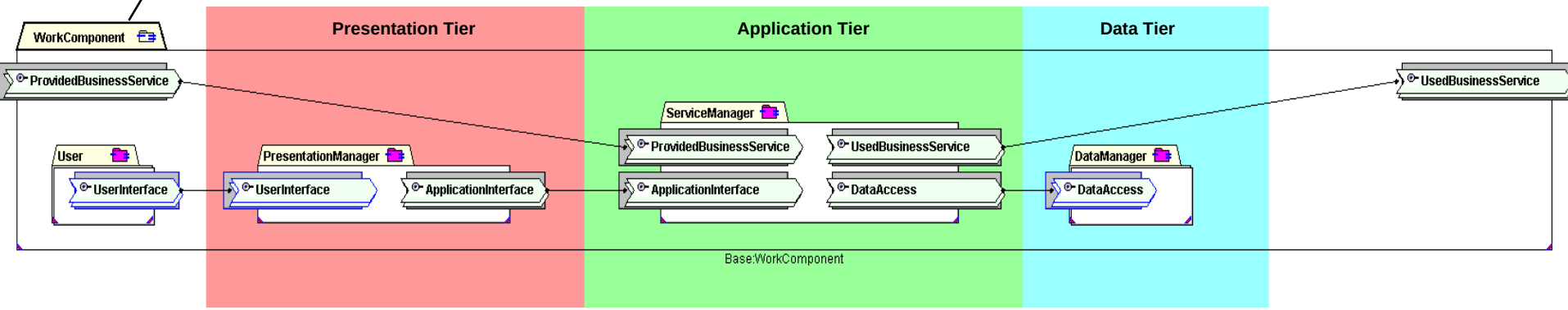


“Lower” PIM View - Enterprise Component Internals



PIM: Service-Oriented Component Architecture

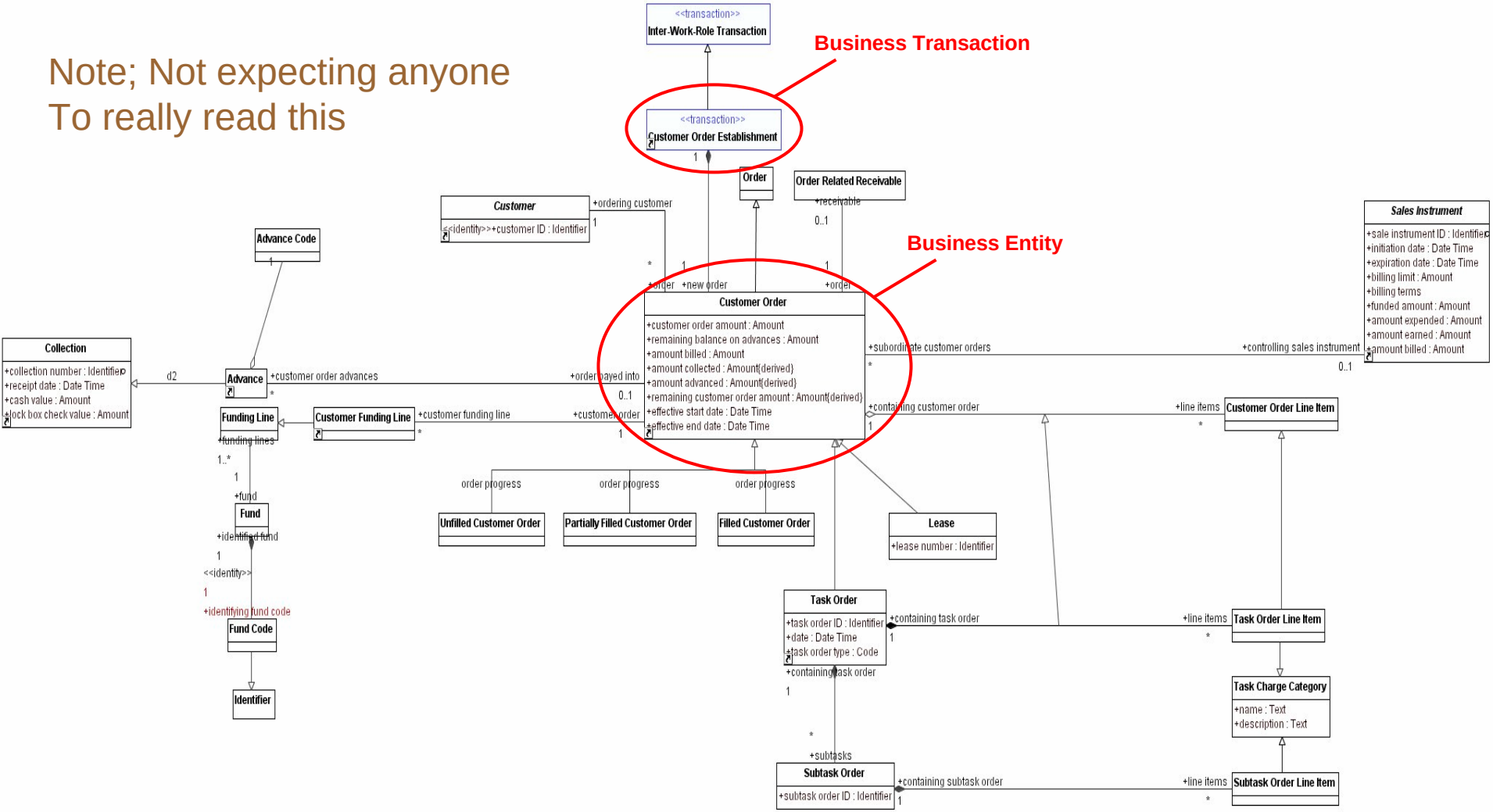
Each Work Component in the PIM implements a Work Role from the CIM.



Service Managers implement as system services the business services defined in the CIM.

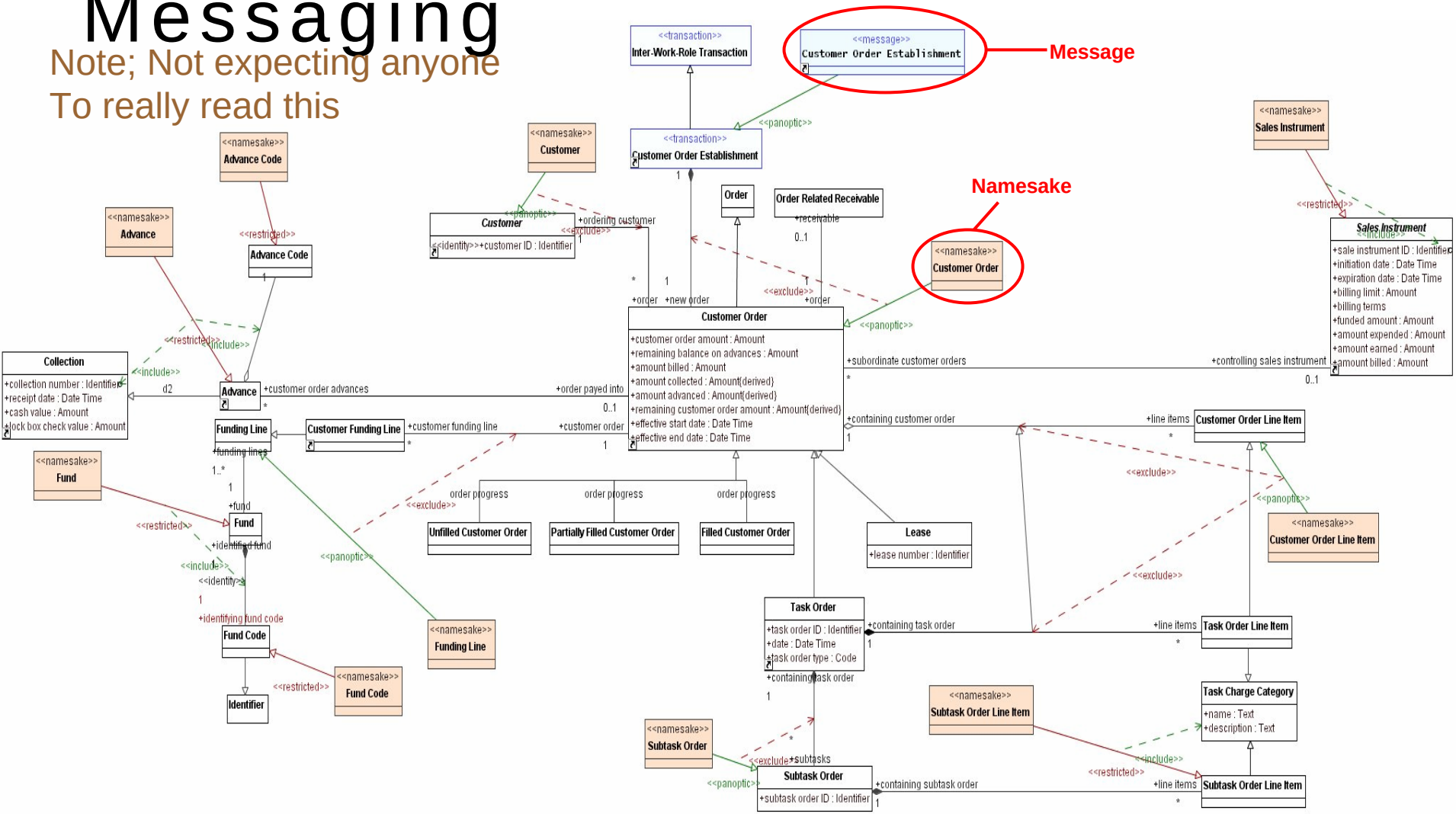
Information Model

Note; Not expecting anyone
To really read this

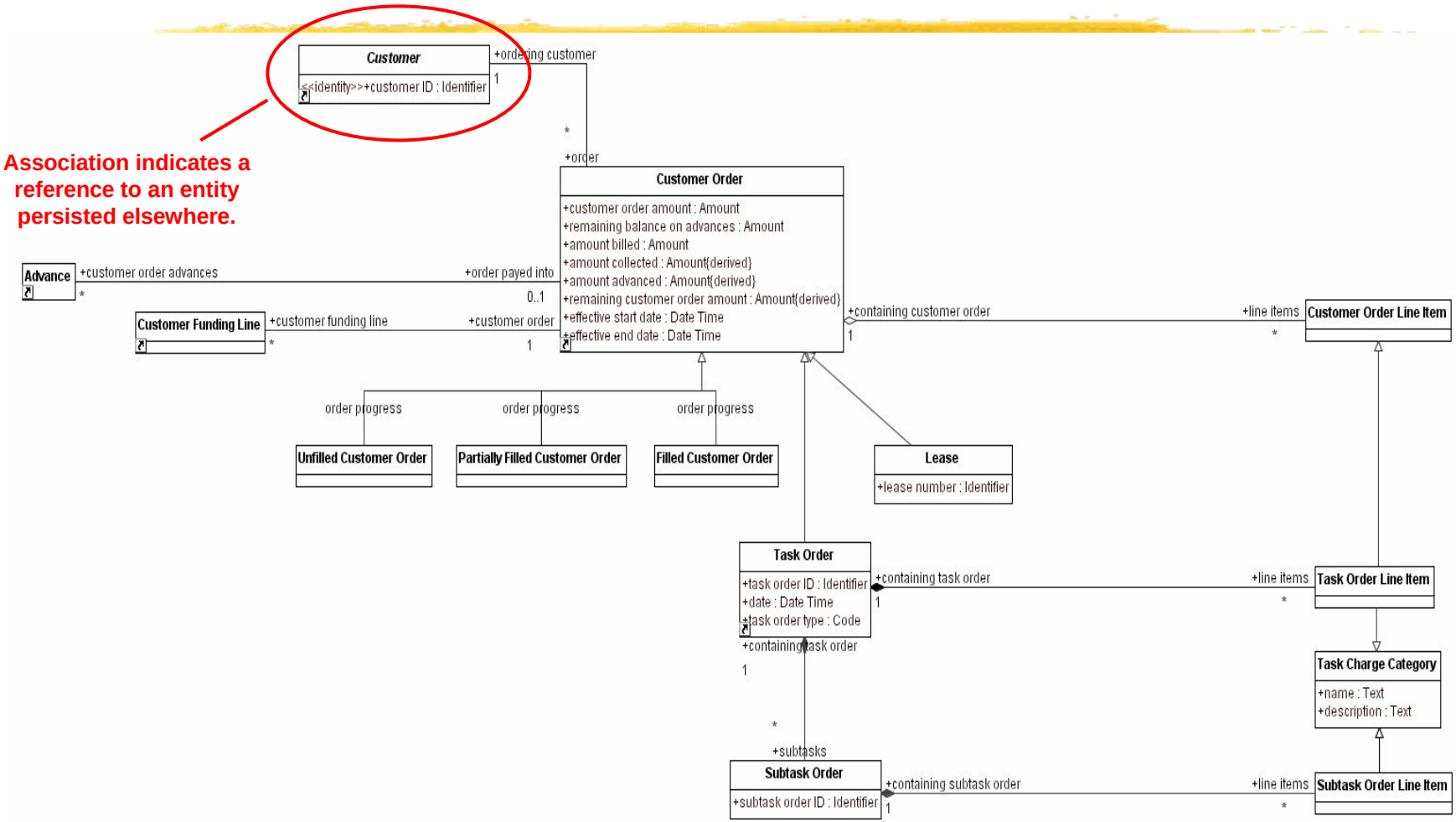


Messaging

Note; Not expecting anyone
To really read this

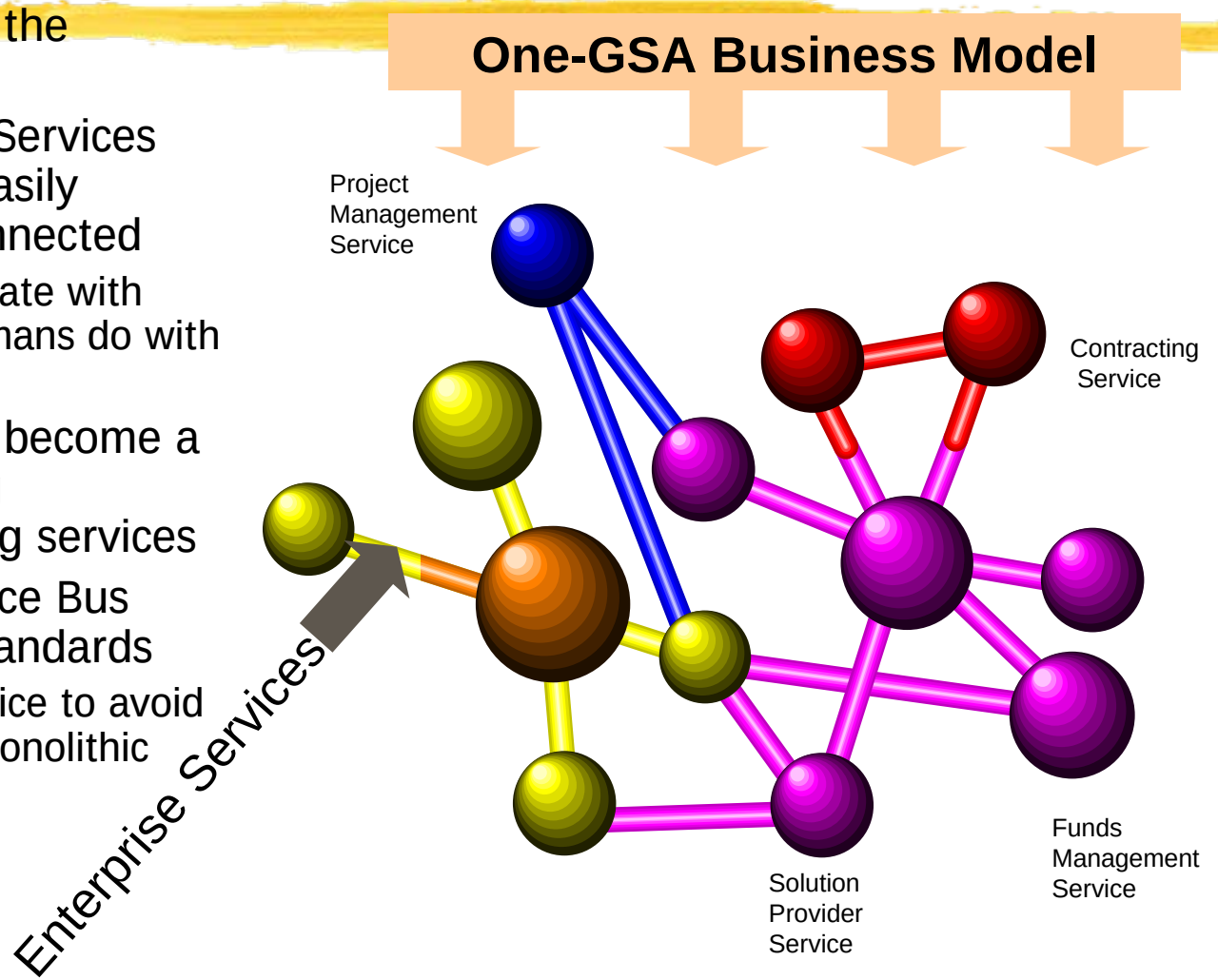


Persistence Model

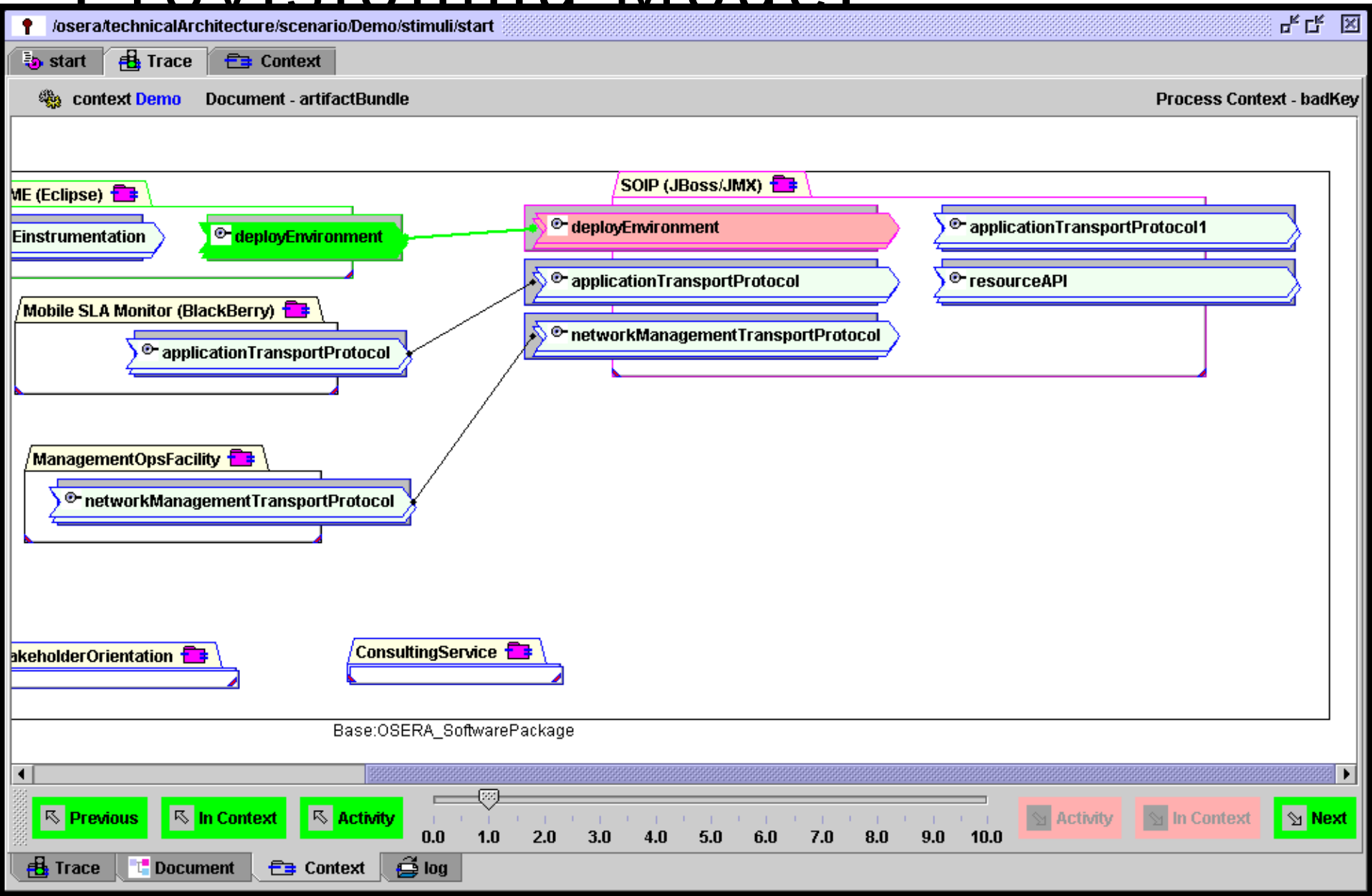


Enterprise Service Bus to Enable Target State

- Services driven from the business model
- Reusable Enterprise Services are independent & easily adapted and interconnected
  - Services communicate with each other like humans do with email
- Information systems become a lattice of cooperating components providing services
- SOA/Enterprise Service Bus using commercial standards
  - Industry best practice to avoid developing large monolithic applications



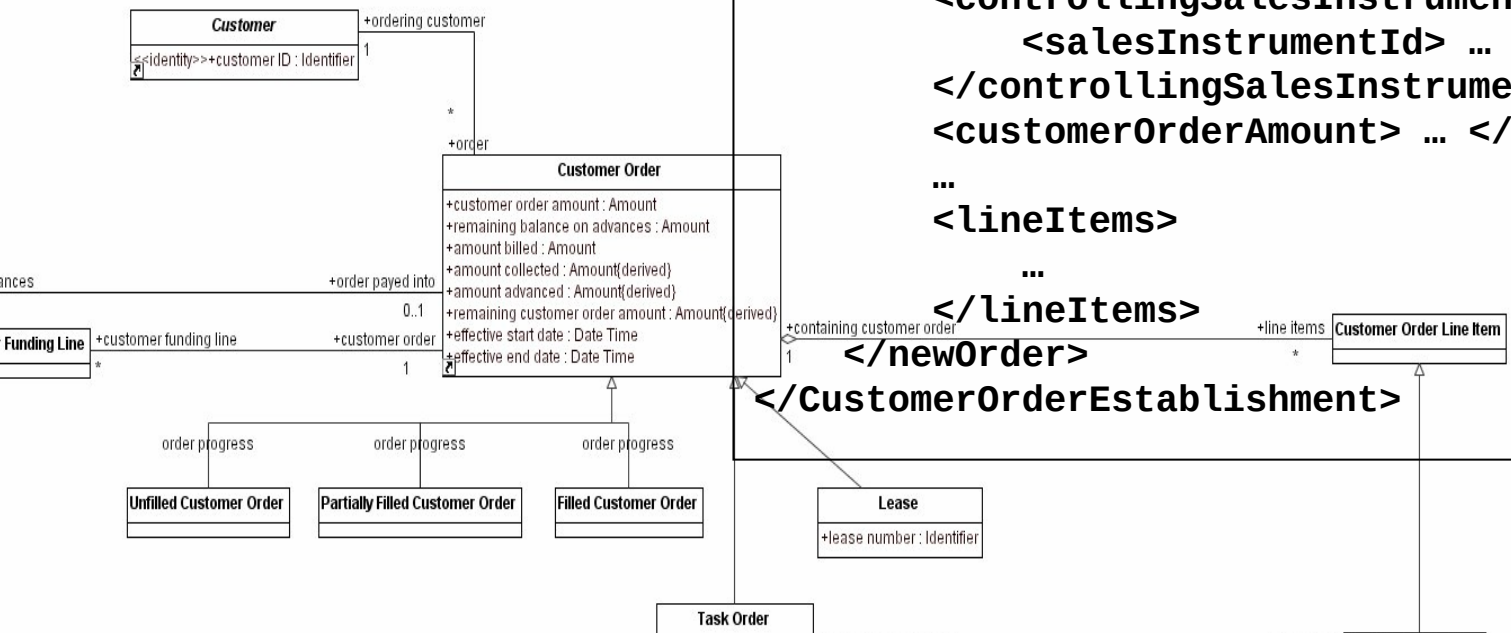
Provisioning Model



Example of XML provisioned from model

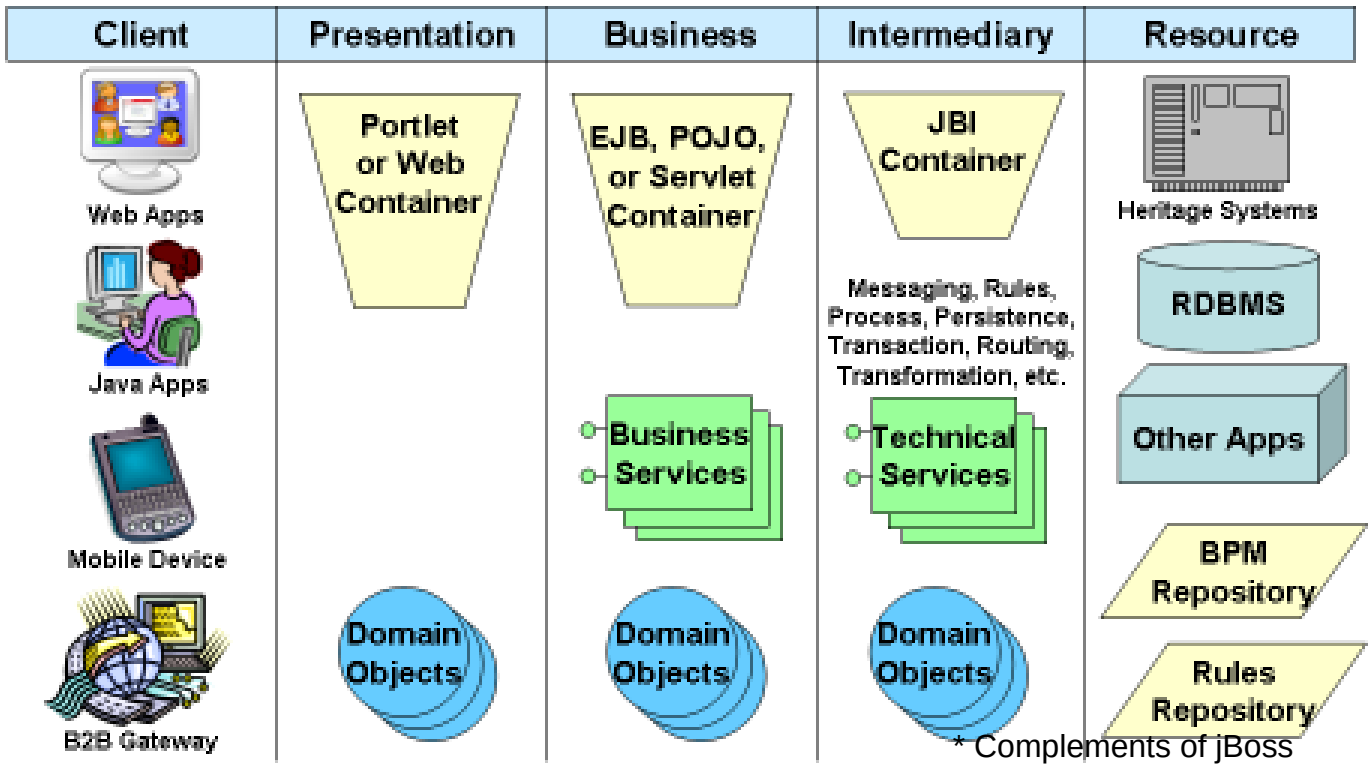
Note; Don't have to really read this either!

```
<CustomerOrderEstablishment>
    <Inter-Work-RoleTransaction>
        <inter-work-roleTransactionID> … </inter-wor
        …
    </Inter-Work-RoleTransaction>
    <newOrder>
        <orderingCustomer>
            <customerID> … </customerID>
        </orderingCustomer>
        <controllingSalesInstrument>
            <salesInstrumentId> … </salesInstrumentI
        </controllingSalesInstrument>
        <customerOrderAmount> … </customerOrderAmoun
        …
        <lineItems>
            …
        </lineItems>
    </newOrder>
</CustomerOrderEstablishment>
```

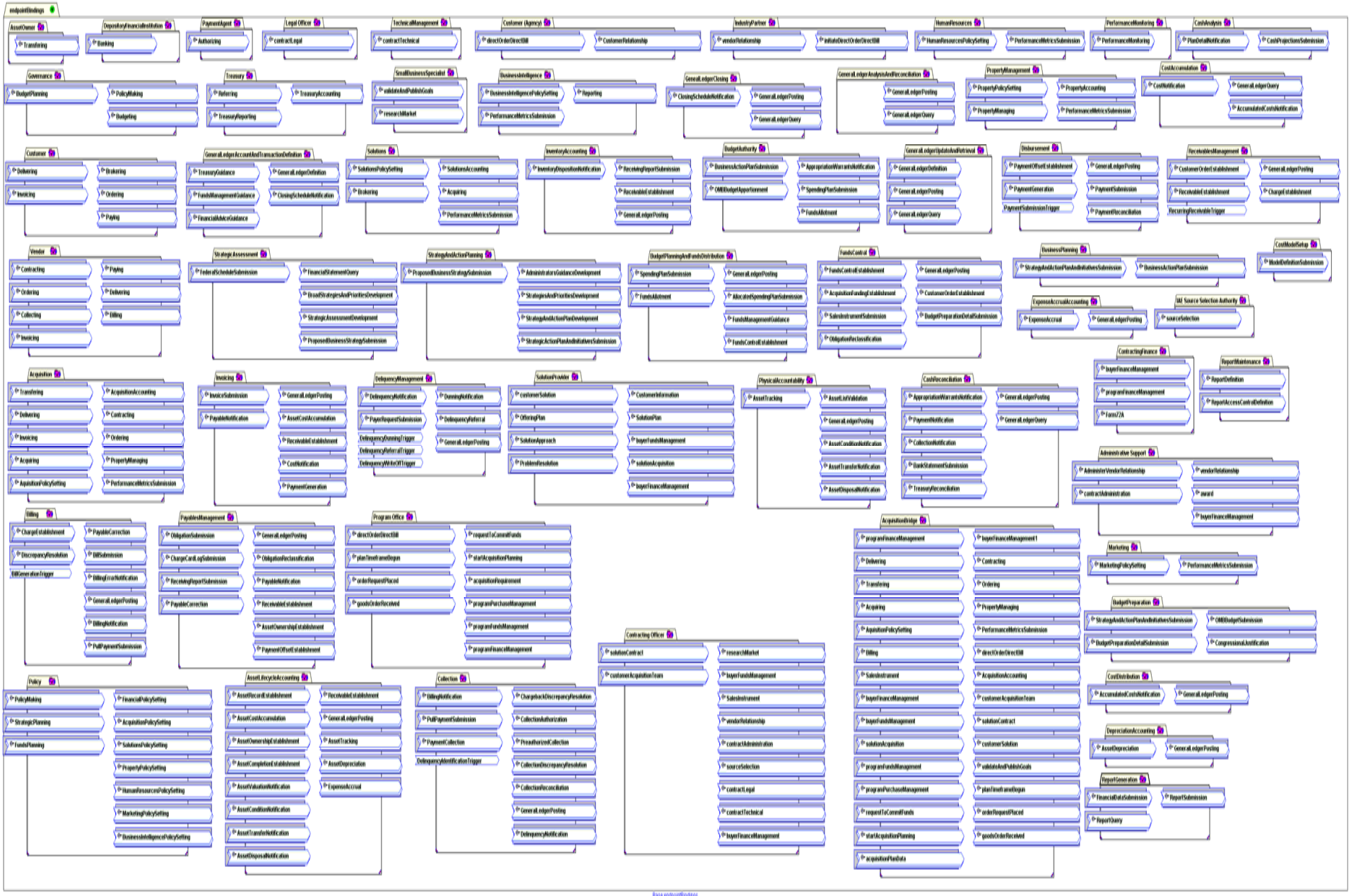


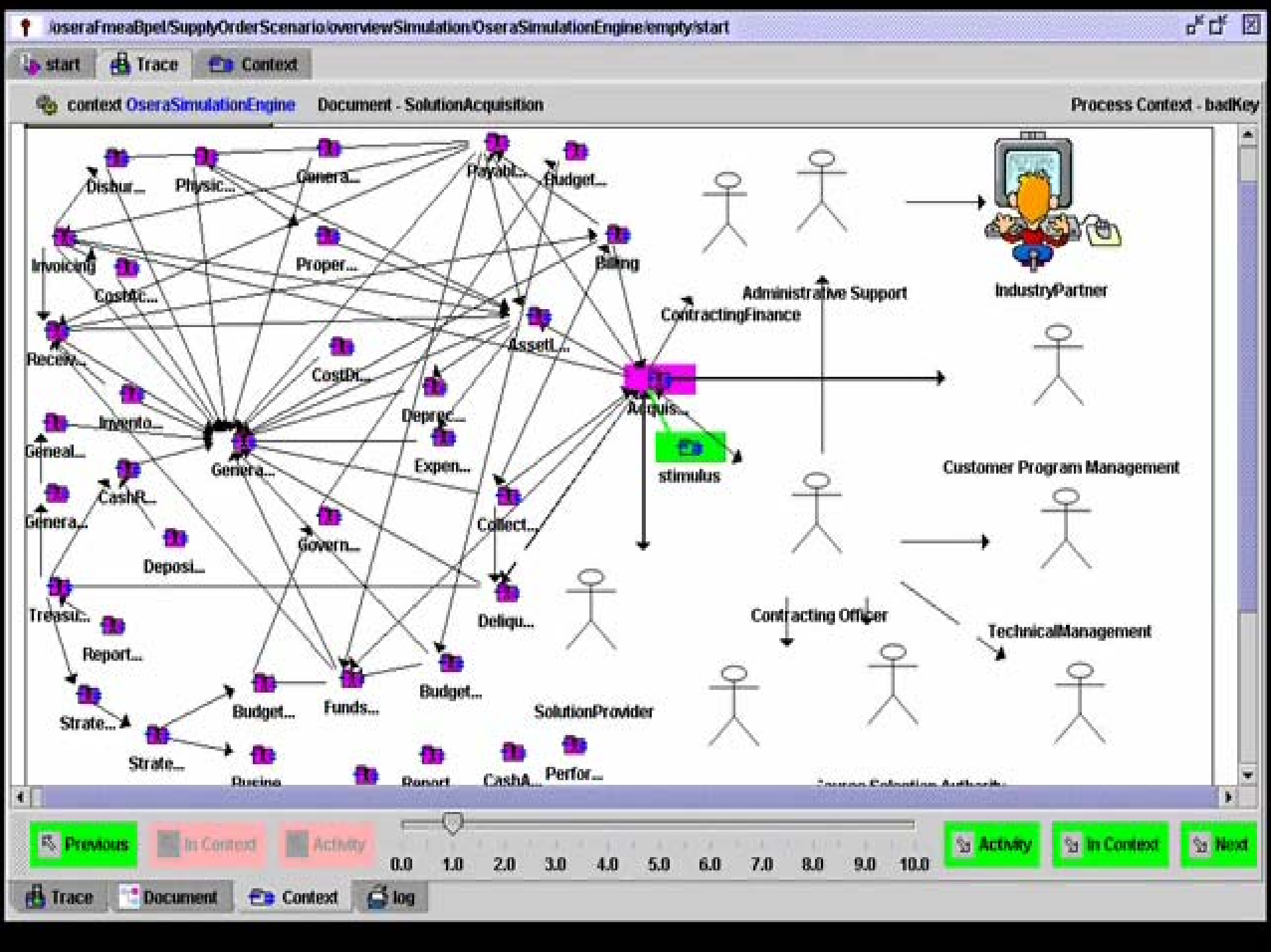
Enterprise Service Bus

Logical SOA Tiers and Components

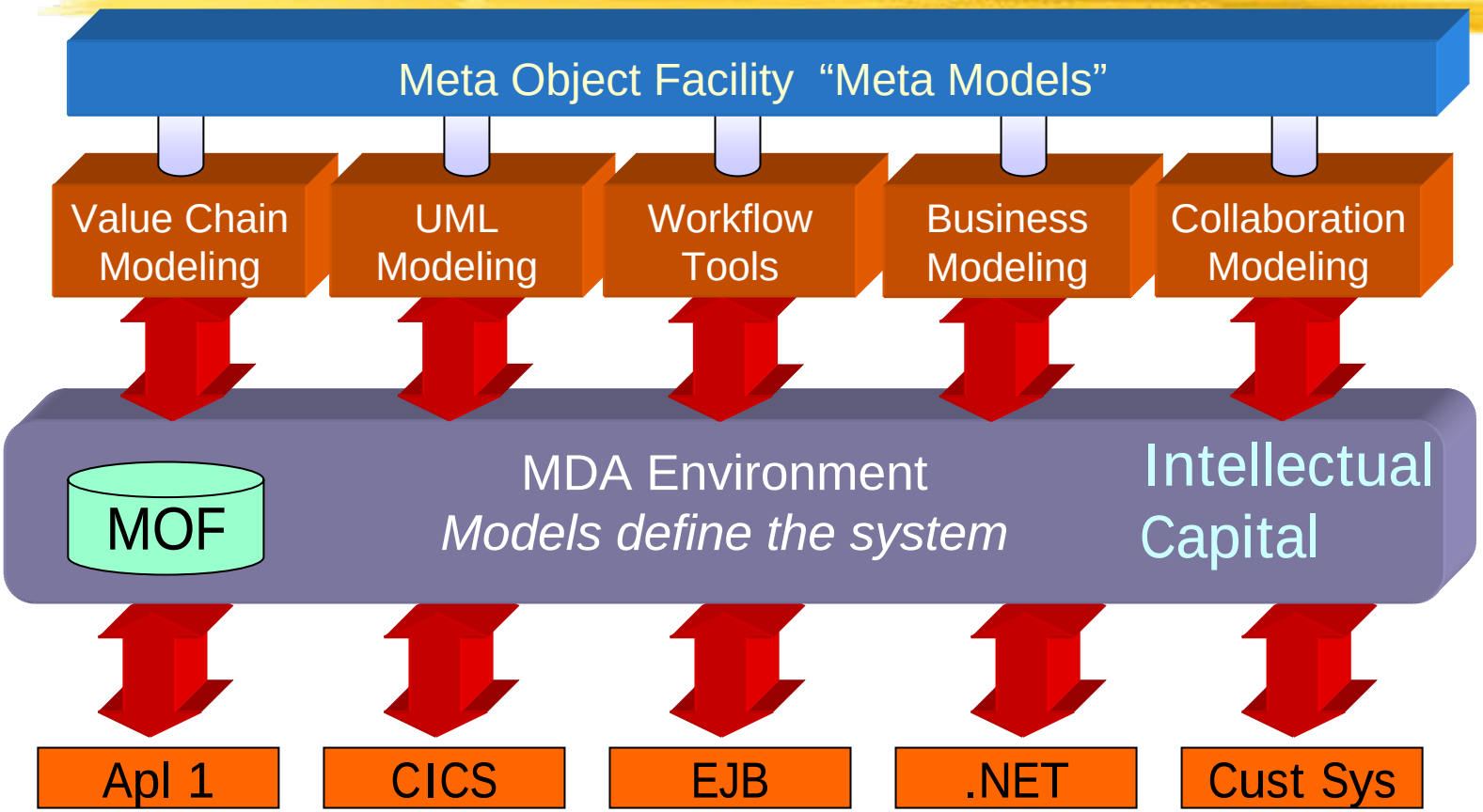


Many BPEL Processes support the CIM




/oseraFmeaBpel/SupplyOrderScenario/overviewSimulation/OseraSimulationEngine/empty/start
start
Trace
Context
context OseraSimulationEngine
Document - SolutionAcquisition
Process Context - badKey
Dishur...
Physic...
Genera...
Payabl...
Budget...
Invoicing
Proper...
Billing
Costdc...
Recein...
AssetI...
CostDr...
Inventa...
Deprec...
Acquis...
Geneal...
Genera...
Expen...
stimulus
CashR...
Genera...
Collect...
Govern...
Deposi...
Treasu...
Deliqu...
Report...
Budget...
Funds...
Budget...
Strate...
SolutionProvider
Strate...
Perfor...
CashA...
Administrative Support
ContractingFinance
IndustryPartner
Customer Program Management
Contracting Officer
TechnicalManagement
Previous
In Context
Activity
0.0
1.0
2.0
3.0
4.0
5.0
6.0
7.0
8.0
9.0
10.0
Activity
In Context
Next
Trace
Document
Context
log

Common Environment for Intellectual Capital



Integration of infrastructure

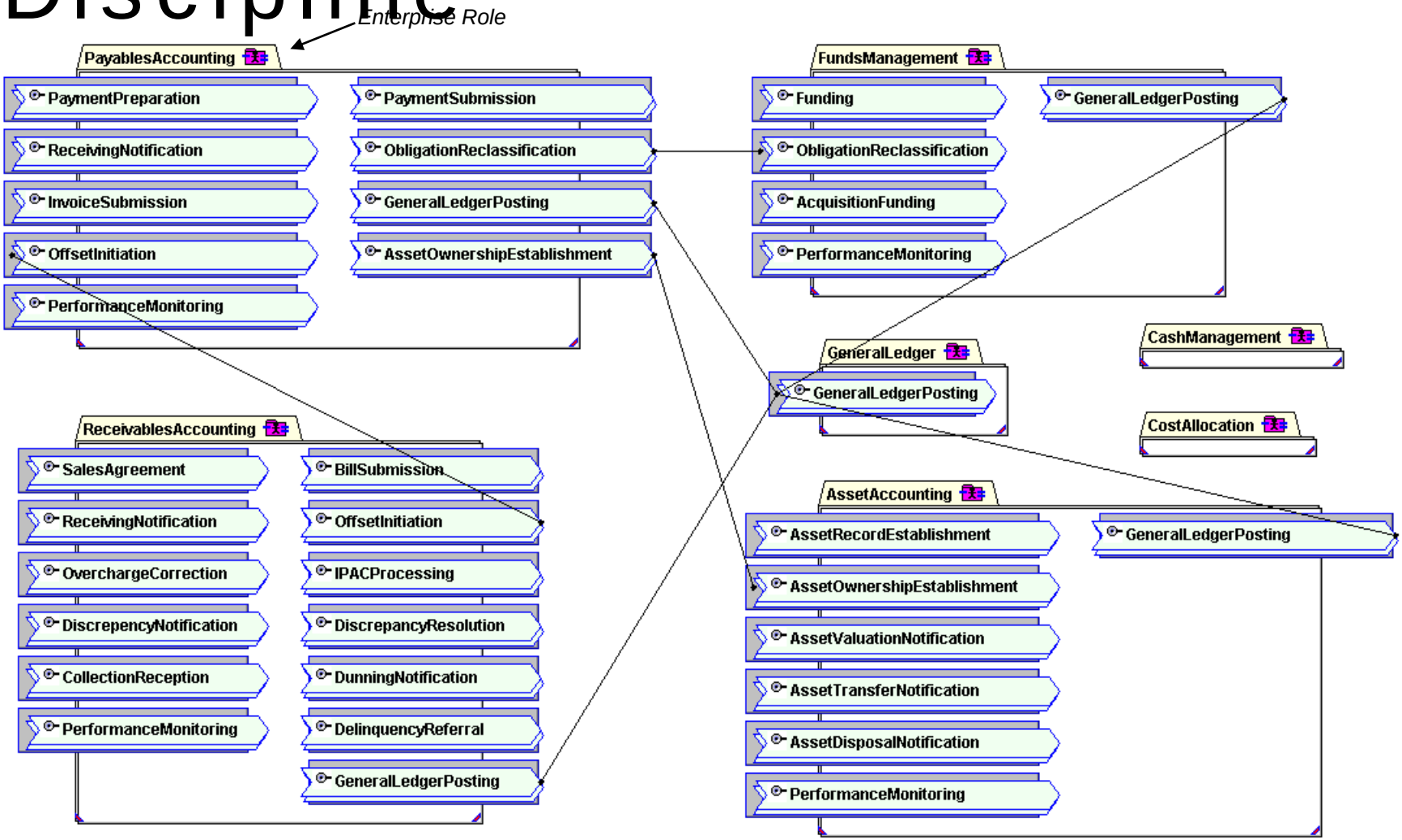
Net Effect of Enterprise MDA

- Clear path from needs to running technology
- Integrate business driven solutions with capital planning & the FEA
- Interoperable component architecture based on SOA
- Integrate legacy, COTS, GOTS and new development into a coherent solution
- Strategic evolution
- Reduced time, costs & risk

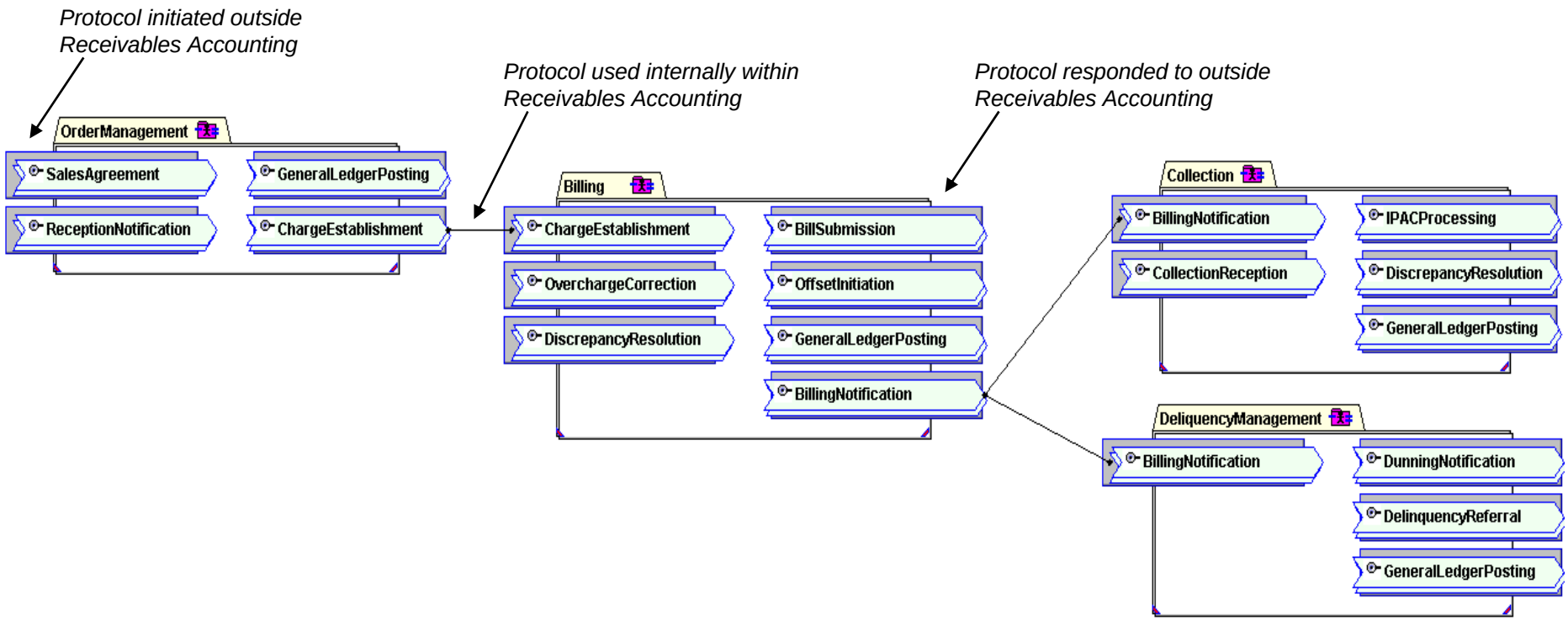
Business Model (CIM) Terminology

- *Role*
  - A specification of the responsibility to perform specific functions in the context of a business process.
  - Work roles may be nested in organizing enterprise roles.
- *Activity*
  - A specification of a business function in the context of a role.
  - Activities may be decomposed into subactivities.
- *Protocol*
  - A defined conversation between two roles that may be extended over time (i.e., responses of one party to the other may not be immediate).
  - One role *initiates* and the other *responds* to the protocol, but information may flow *both ways* across the protocol.
- *Flow*
  - An atomic flow of information across a protocol or into or out of an activity.

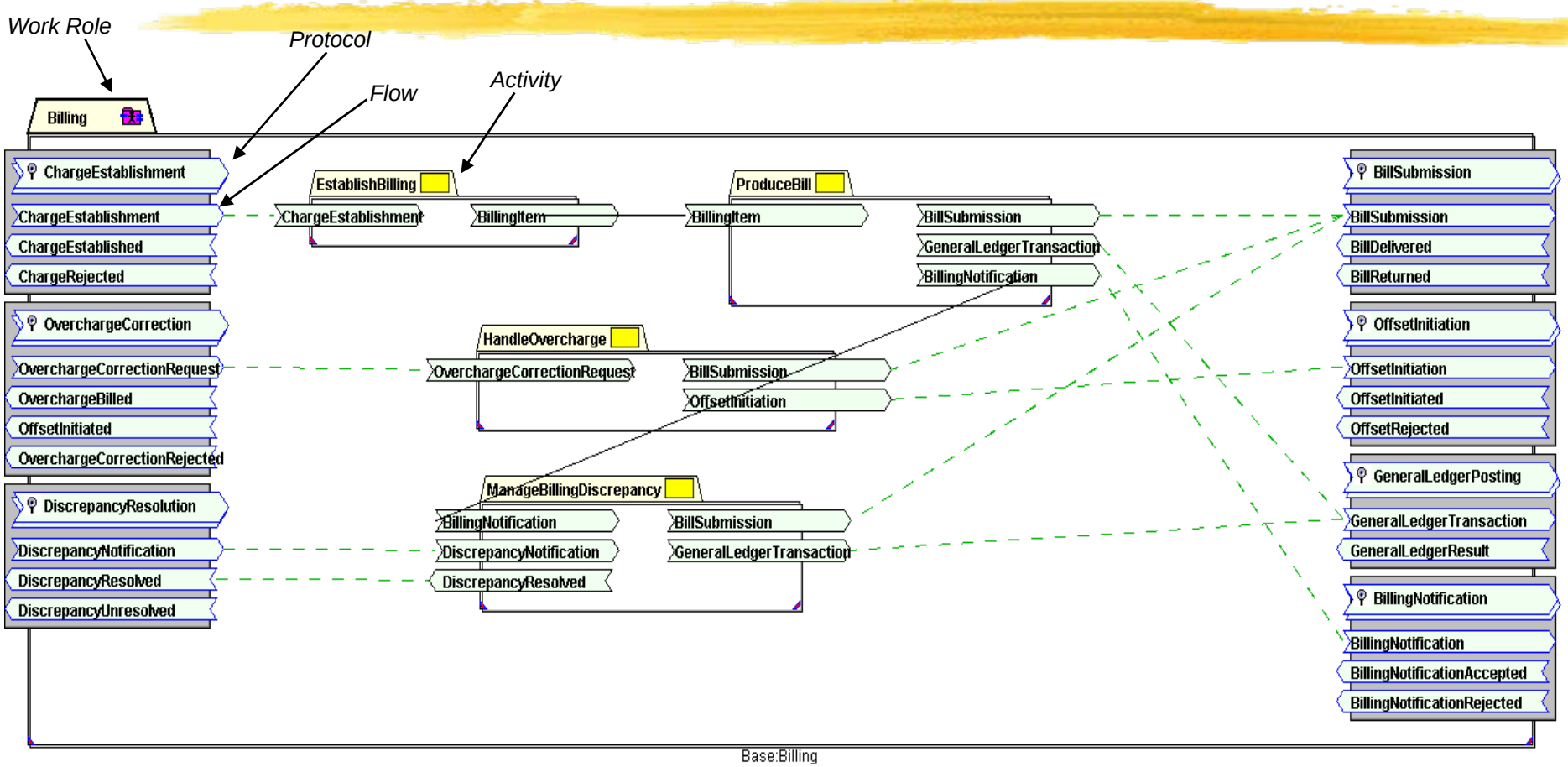
Financial Management Discipline



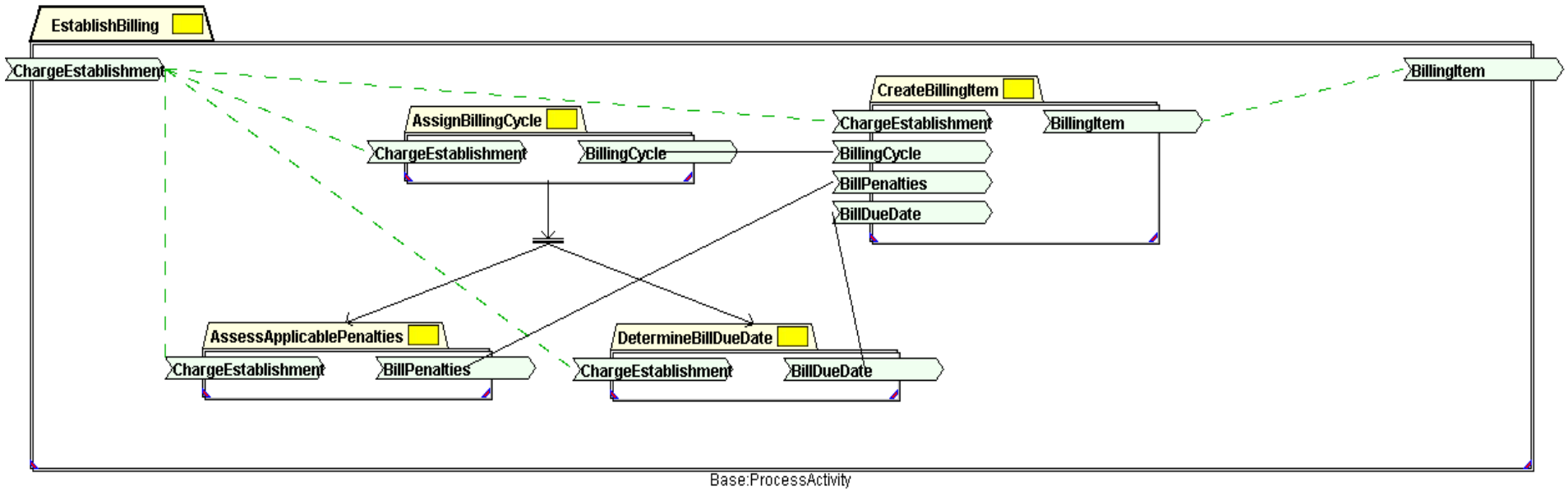
Example: Receivables Accounting Work Roles



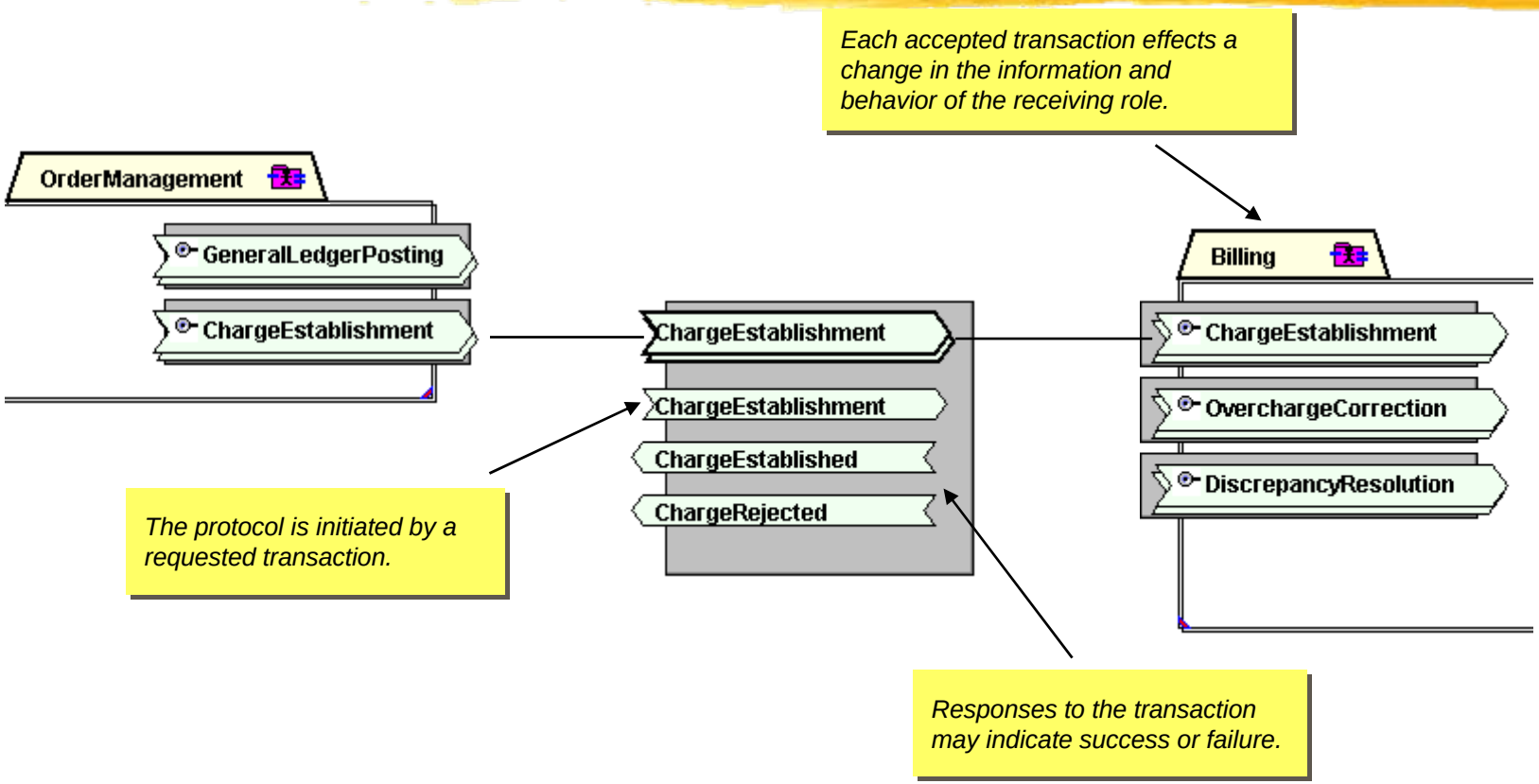
Example: Billing Work Role



Example: Establish Billing Activity

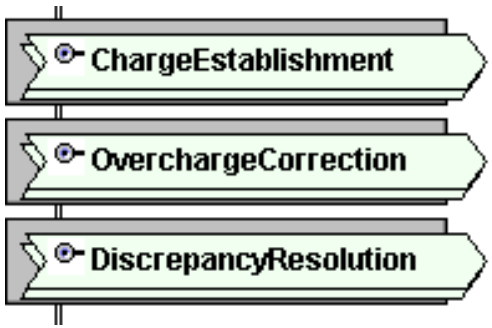


Typical Simple Protocol

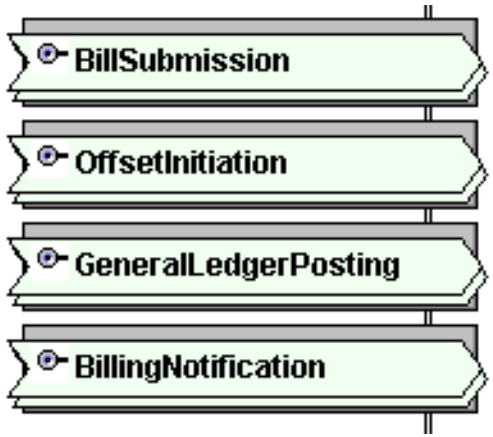


Sample Billing Service Interfaces

Provided Interfaces



Required Interfaces



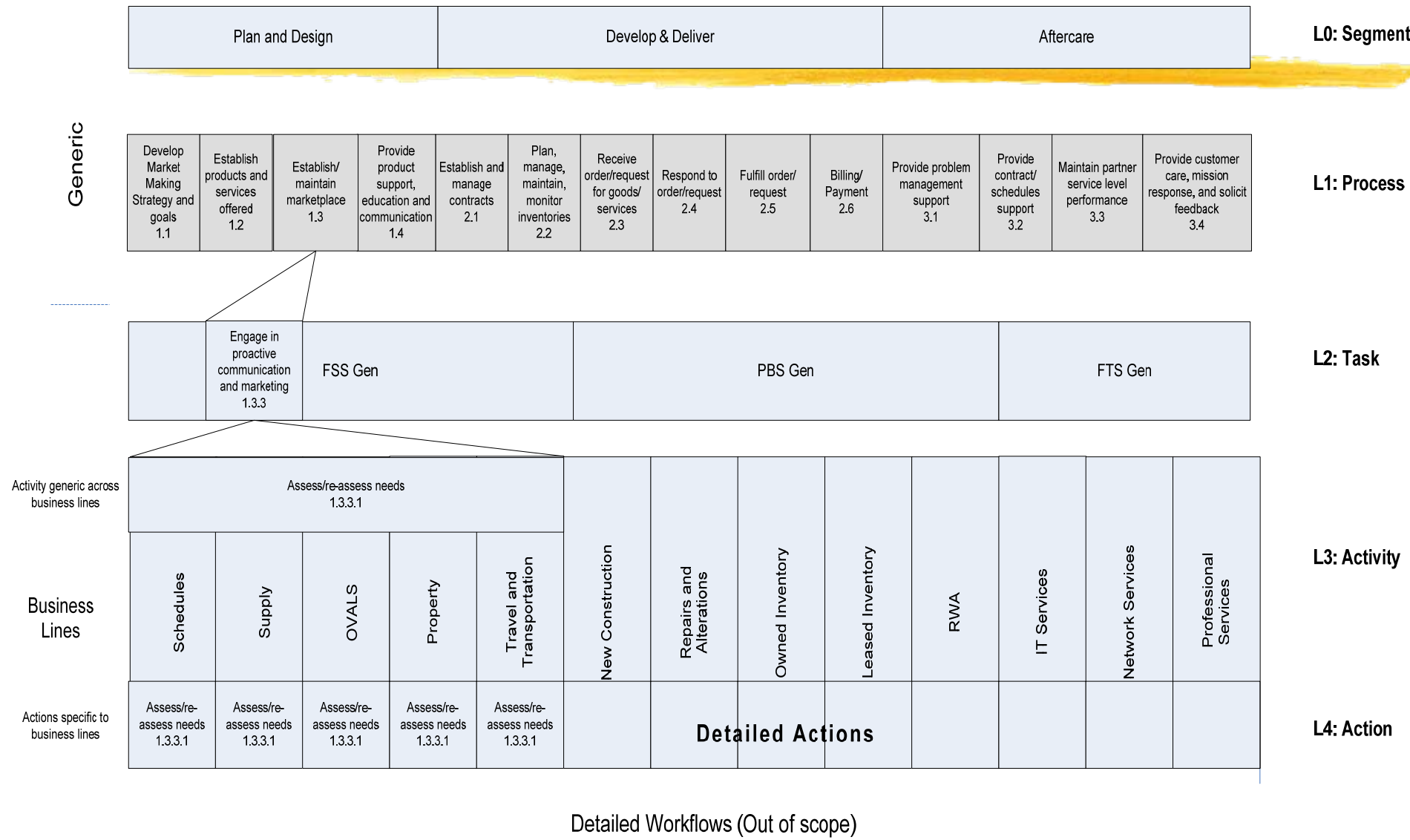
One-GSA Methodology

A simple methodology for creating collaborative business processes

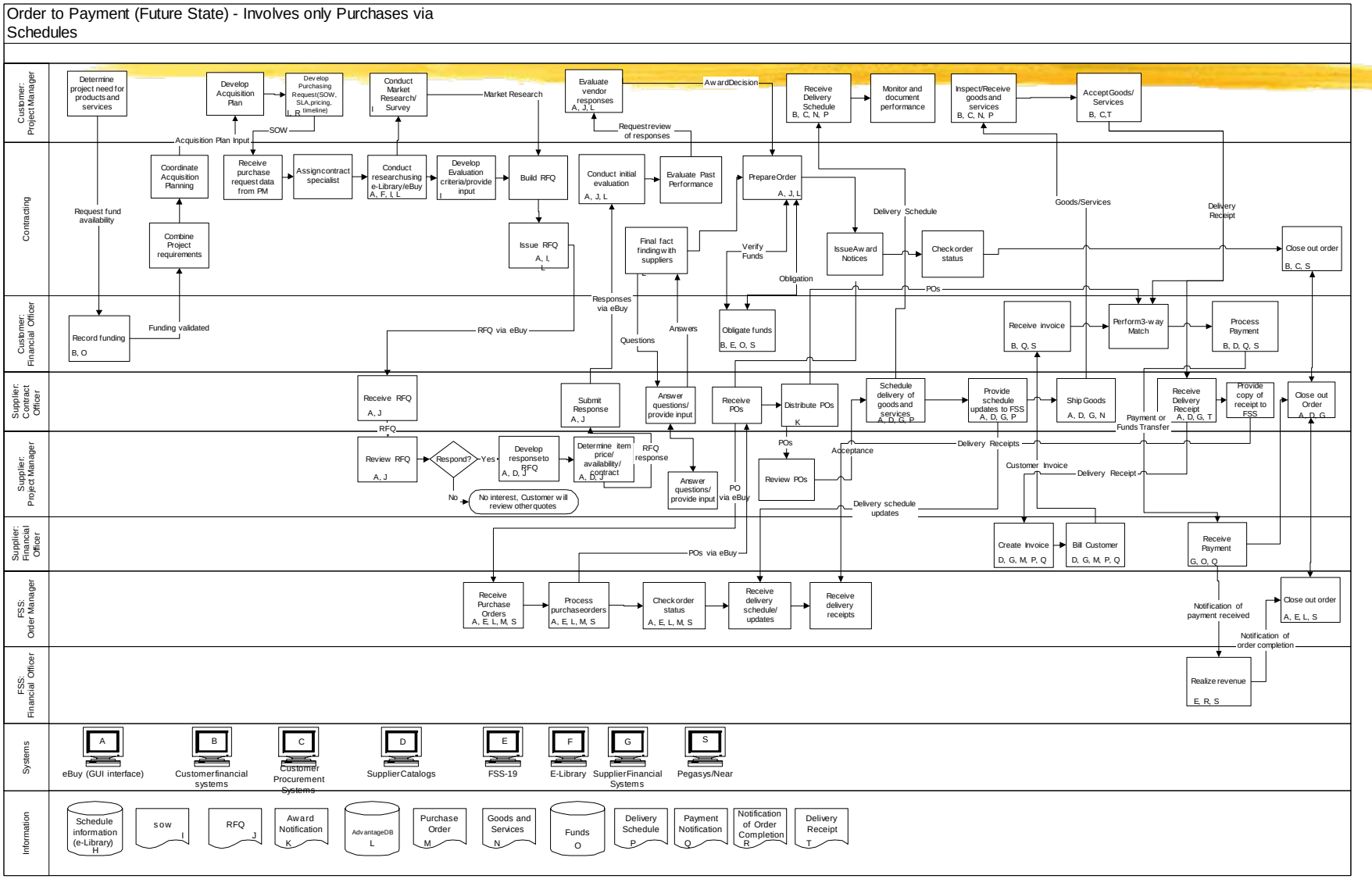
Basic Steps

- Define business goals using Value Chain Analysis
- Refine to high-level activities
- Identify roles and organize roles into collaborations
- Define collaboration documents
- Create basic business transactions
- Organize into protocols and events
- Use protocols to define ports on roles
- Drill-down into role detail
- Use model as basis for acquisition
- Acquire/Implement roles
- Configure implementations for deployment with technology specifics
- Deploy

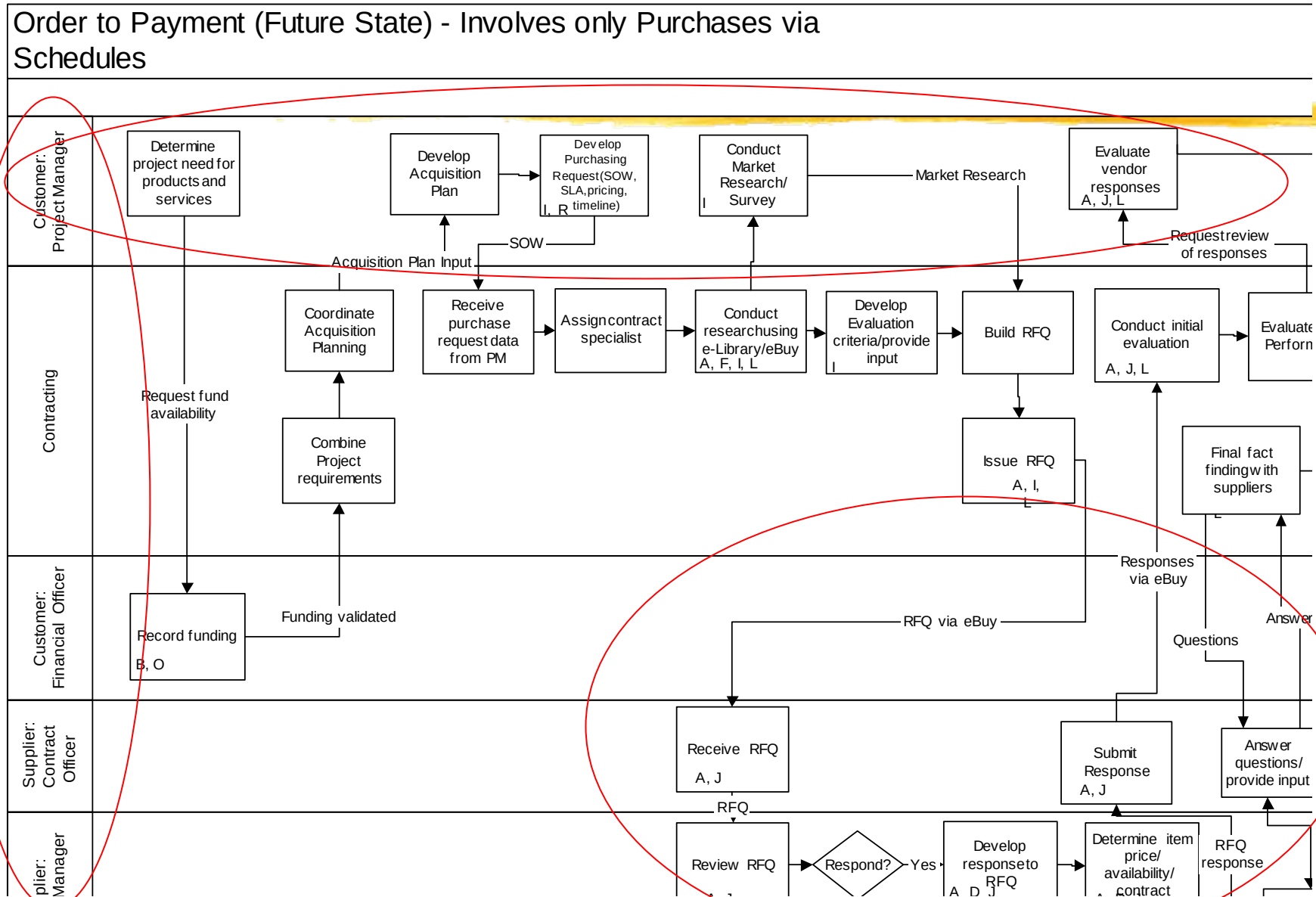
Mission Critical Value Chain



Order to Payment Process Informal Diagram



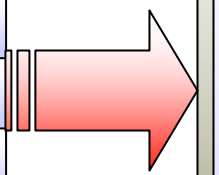
Order to Payment Process Diagram



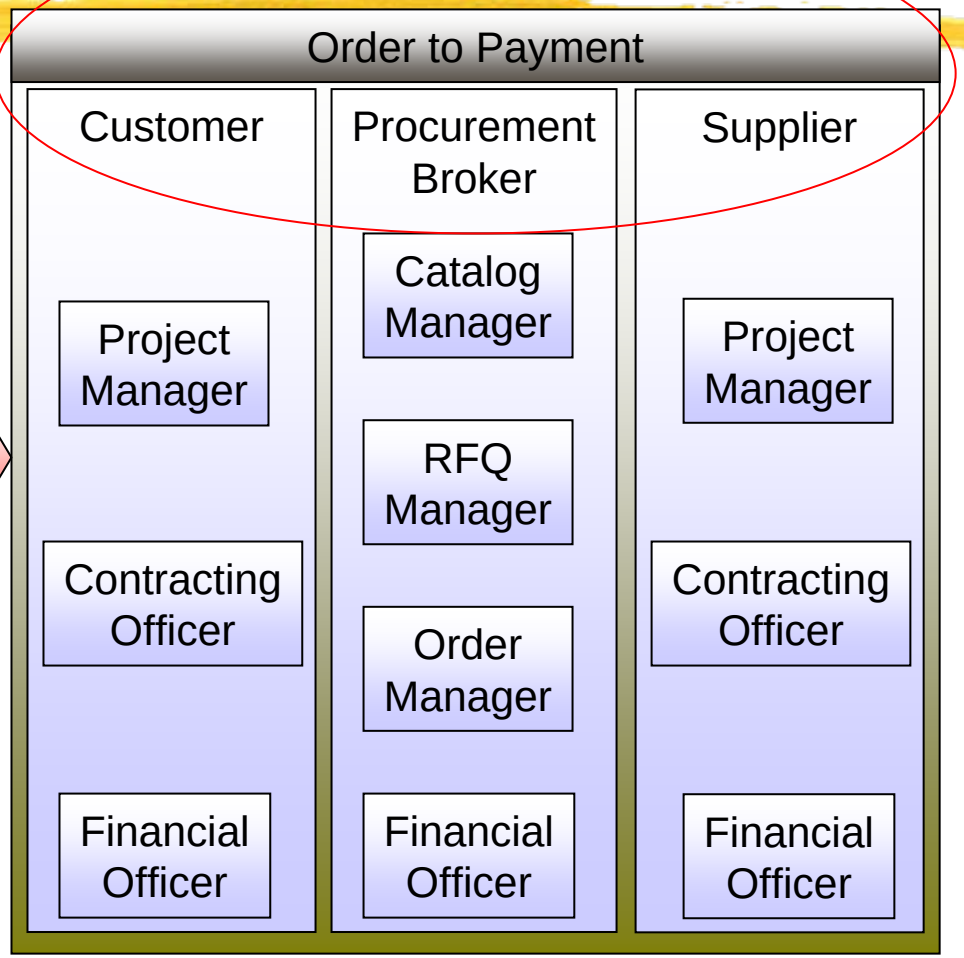
Finding the Roles and Inner Roles

"Swim Lanes"

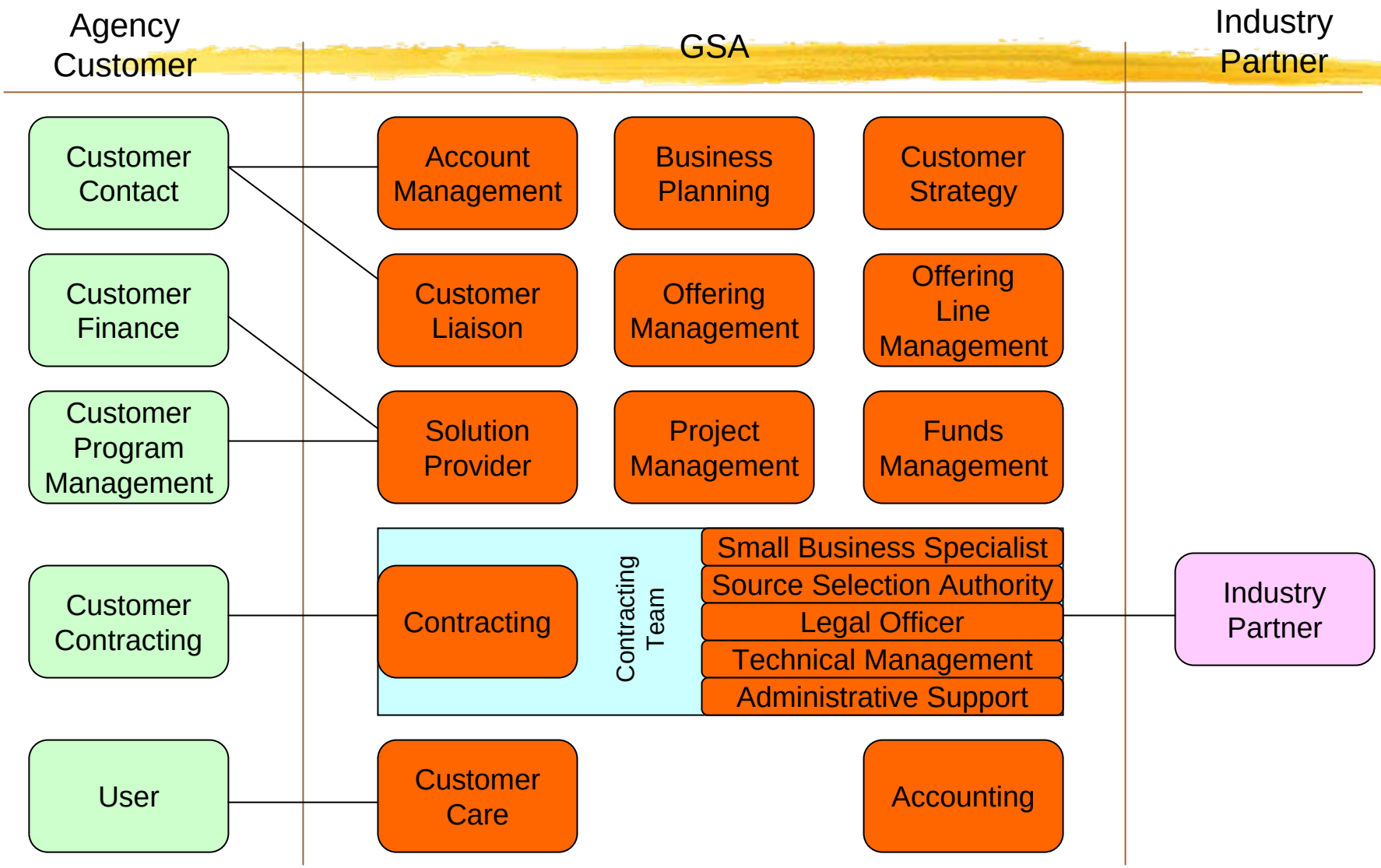
- Customer Project Manager
- Customer Contracting
- Customer Financial Officer
- Supplier Financial Officer
- Supplier Project Manager
- Supplier Contracting Officer
- FSS: Order Manager
- FSS: Financial Officer



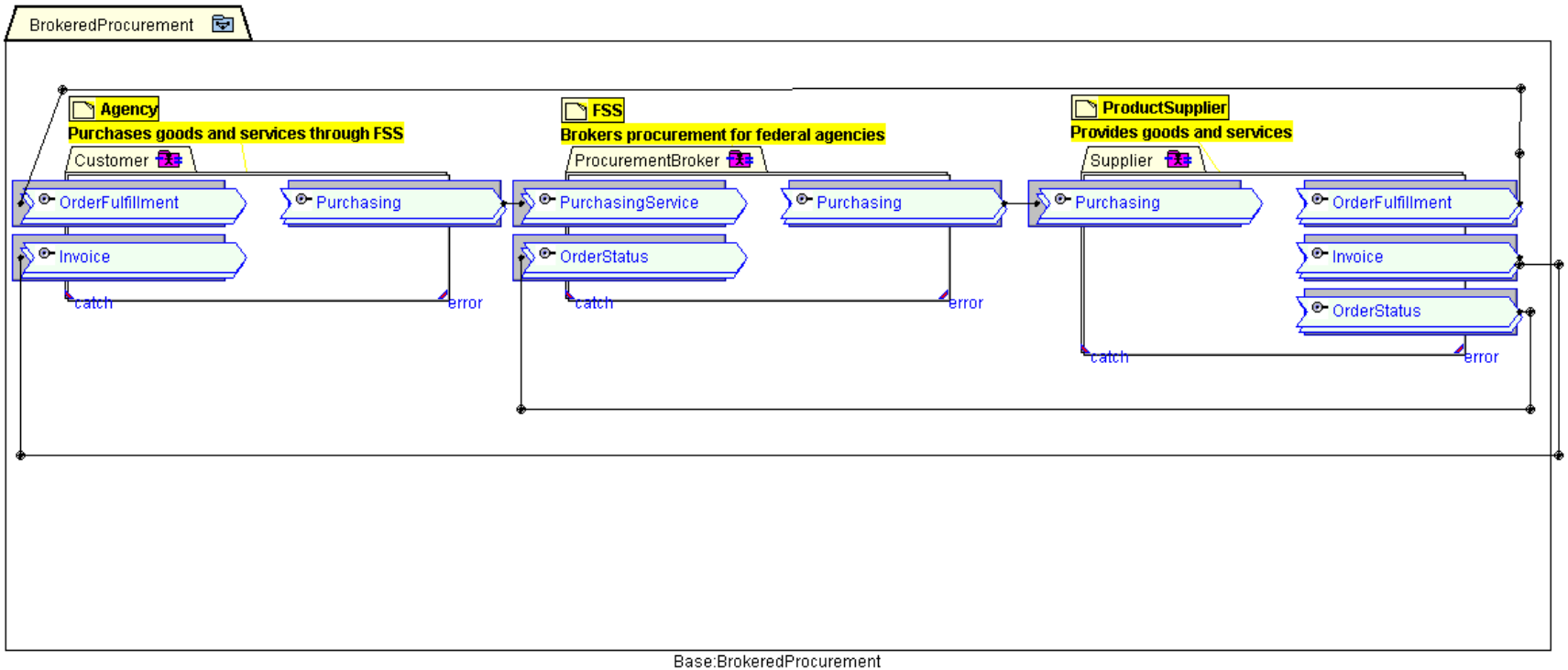
Roles in a Collaboration



High-level role identification

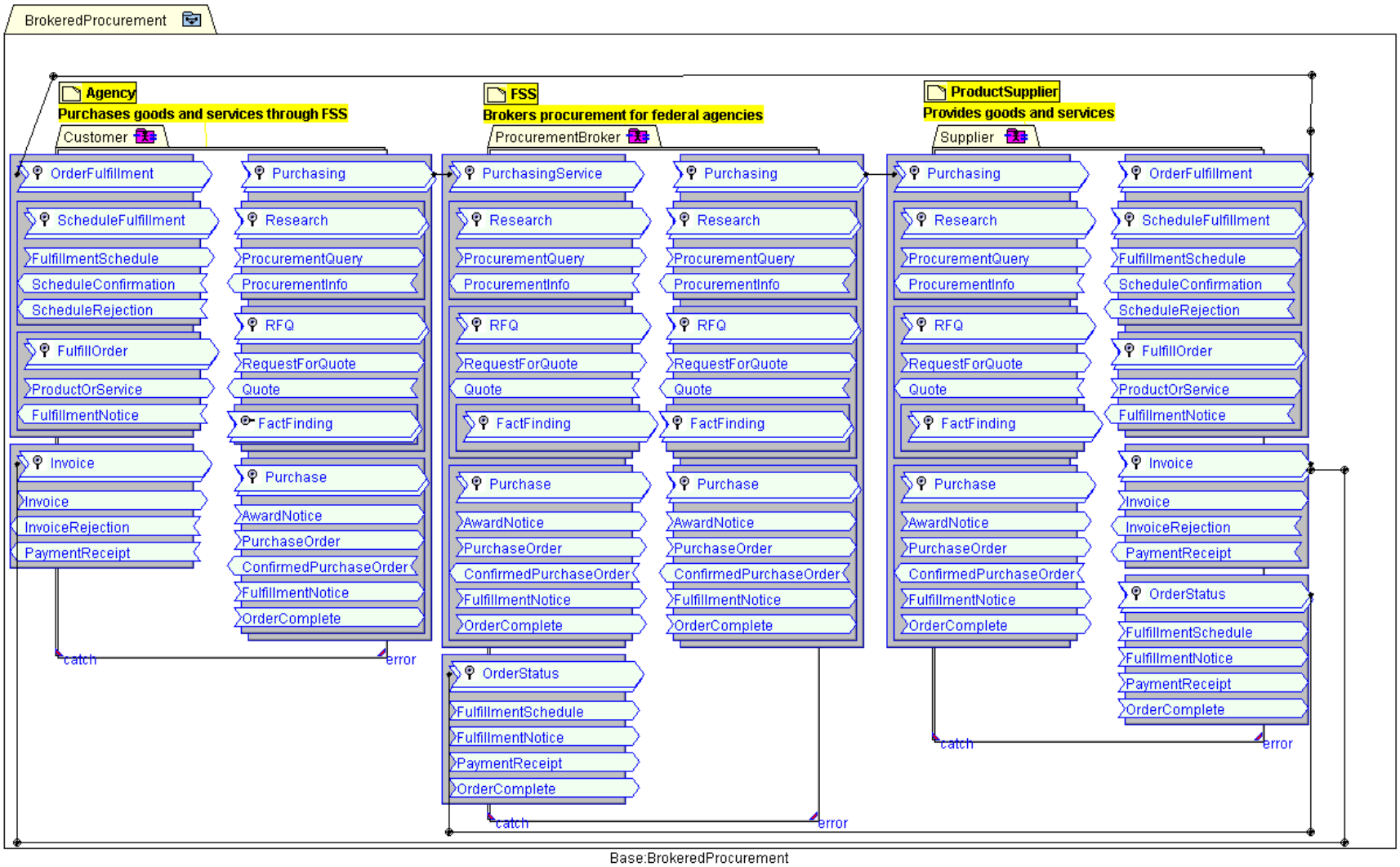


Enterprise Context

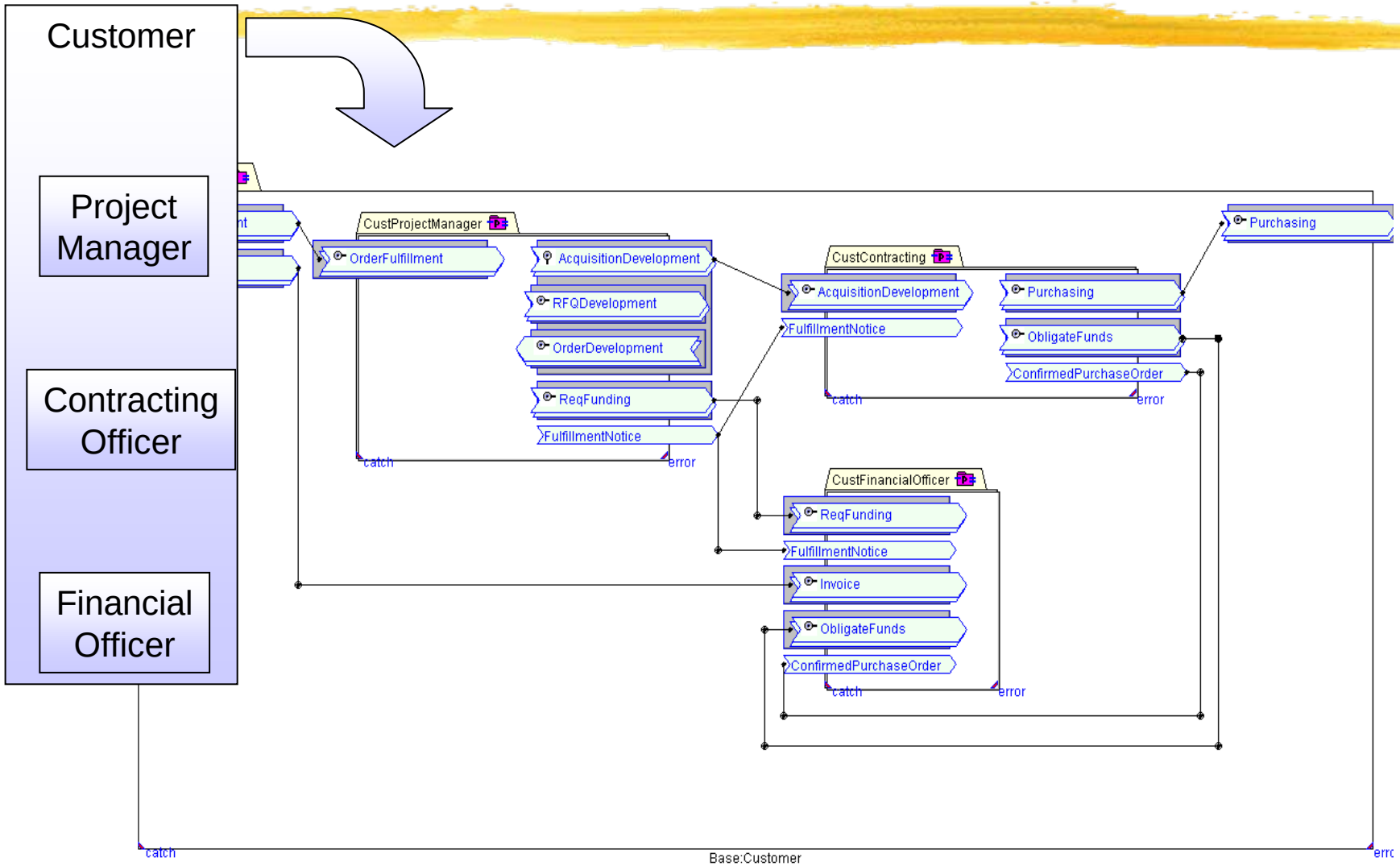


Simplified View - Level of detail is optional

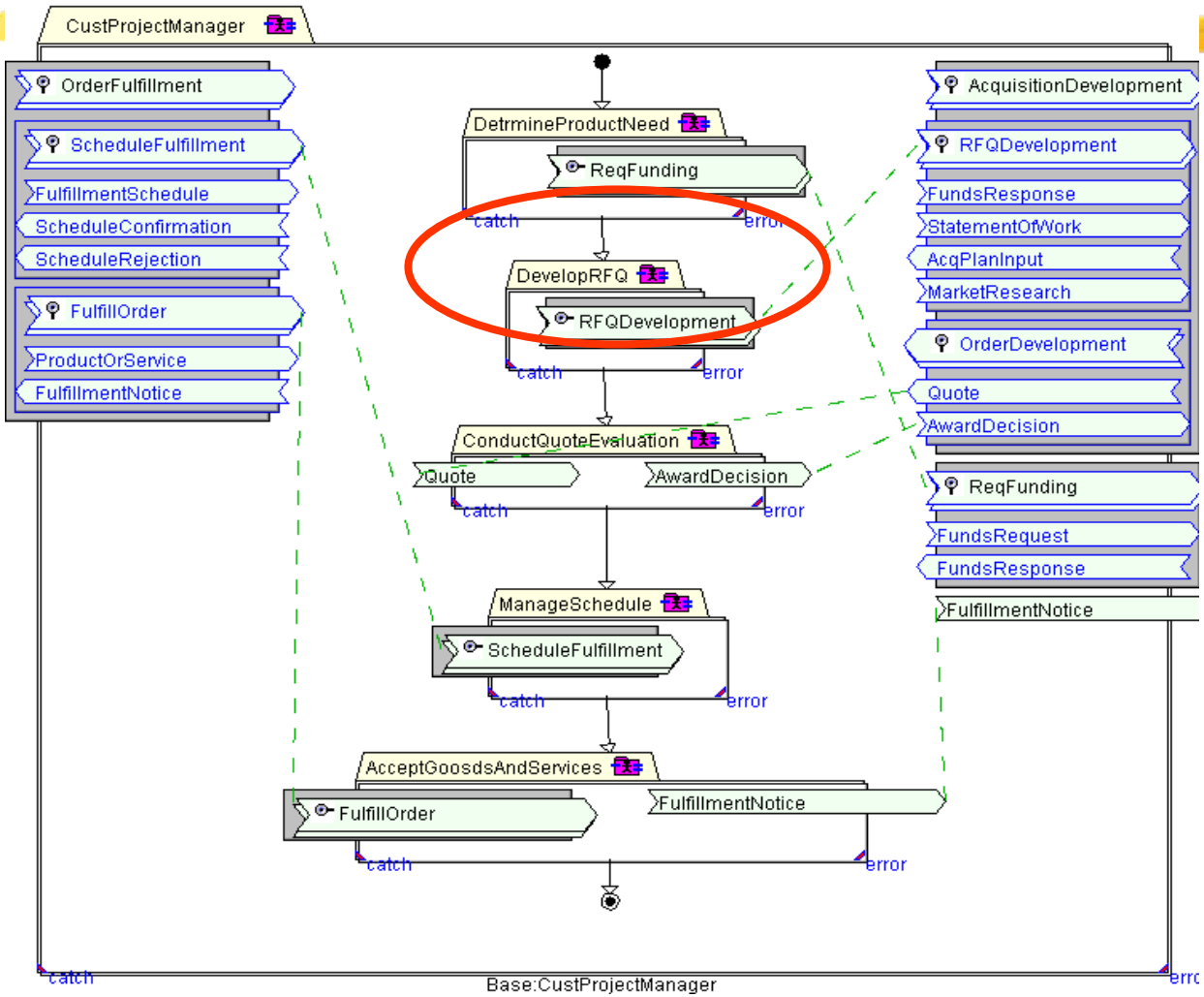
Co-Managed Services Collaboration



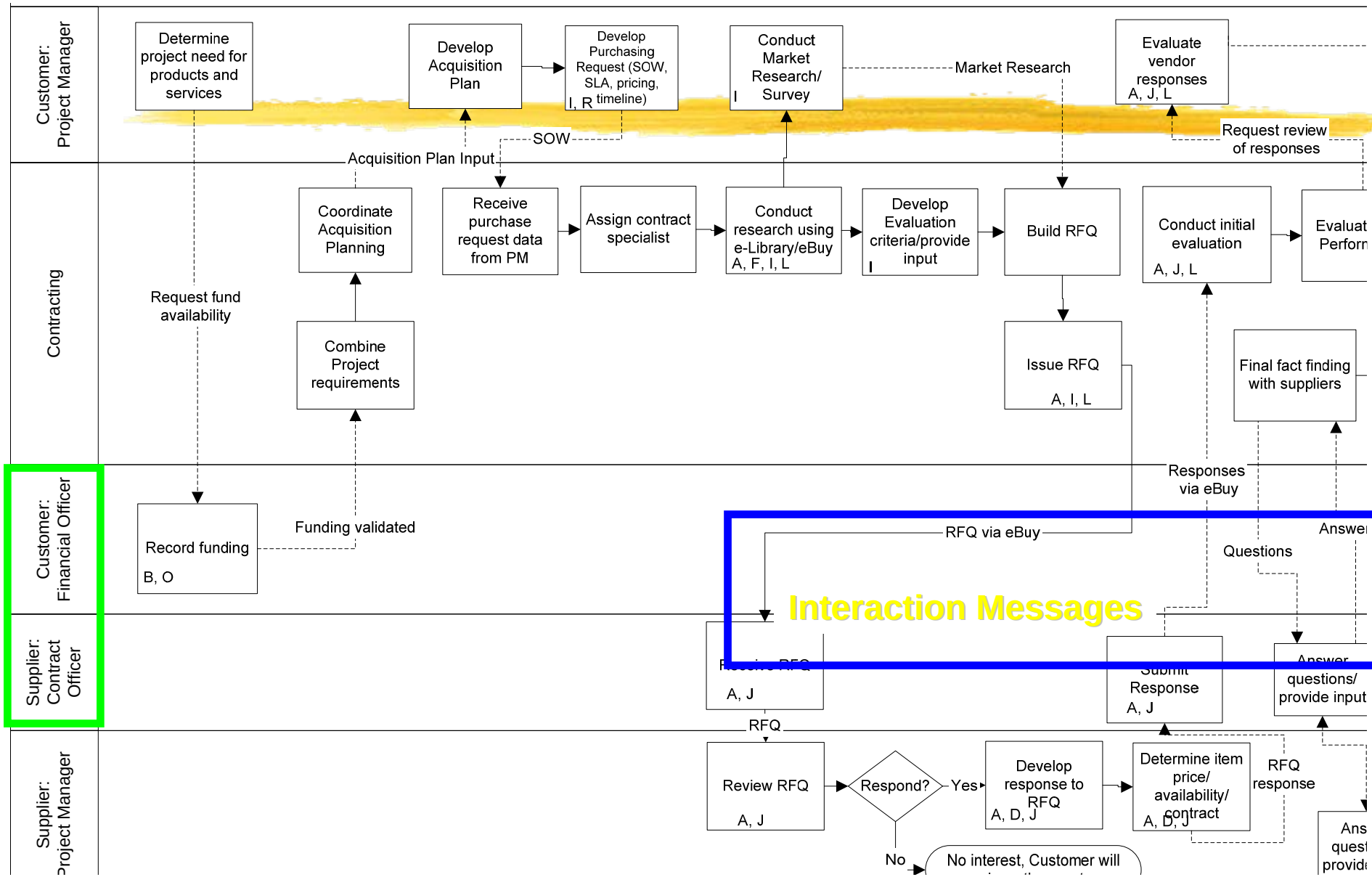
Drilling Down into Customer Detail



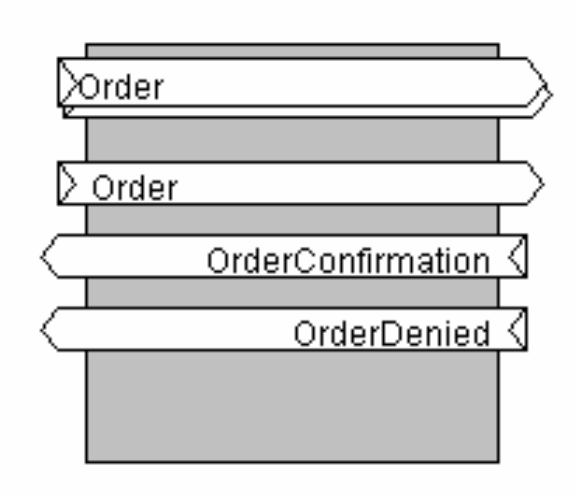
Choreography of Process



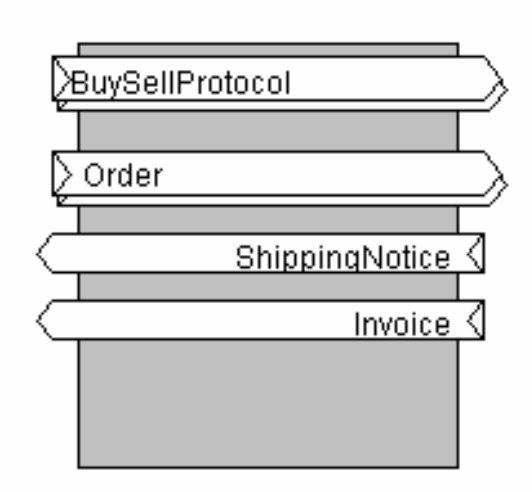
Protocols group Role Interactions into Conversations

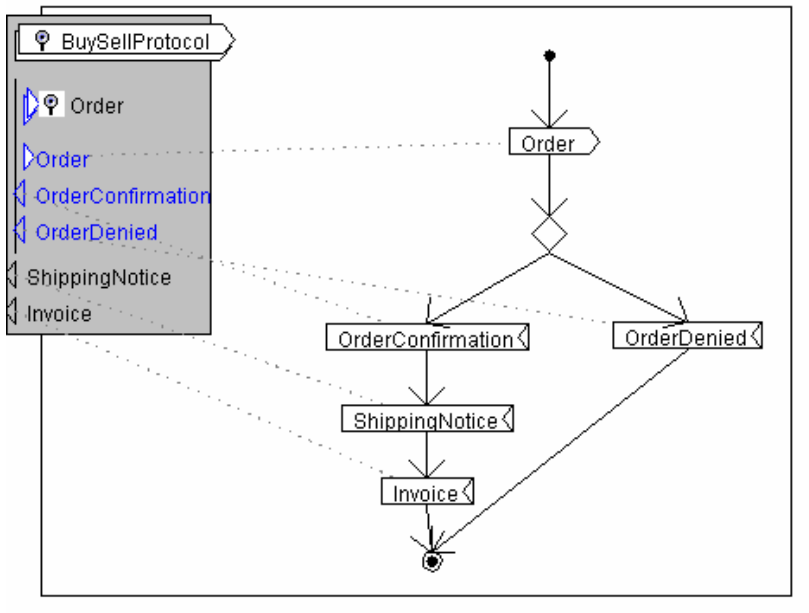


Create Business Transactions



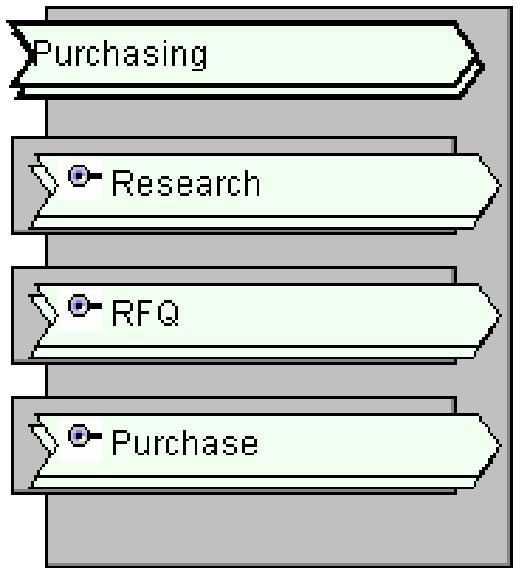
Organize into protocols





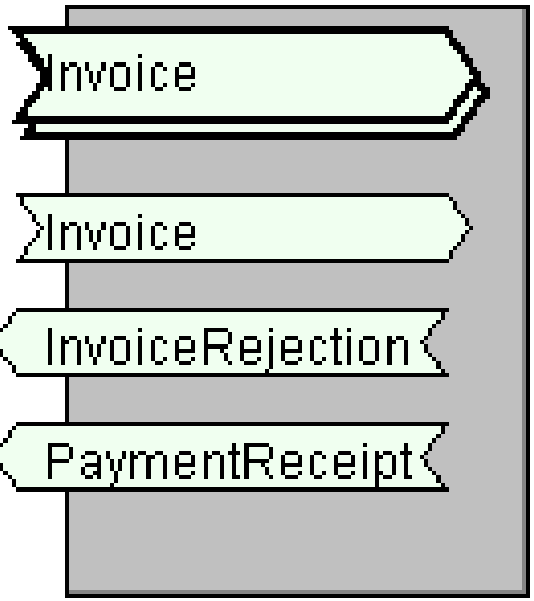
Inner Protocols

- Protocols represent conversations between roles
- Conversations frequently have sub-conversations, detail about a specific subject
- These sub-conversations are inner protocols
- Inner protocols can also be reused in other protocols or even as top-level protocols
- Protocols can “nest” to any level of detail



Operations & Business Transactions

- The highest level of interaction detail is specified as the flow of documents - business information.
- This can be as events or “business transactions”
- Business transactions are a “request/reply” that usually results in creating or satisfying some business commitment - it may take place over an extended time
- We specify abstract document types to represent the information that flows.

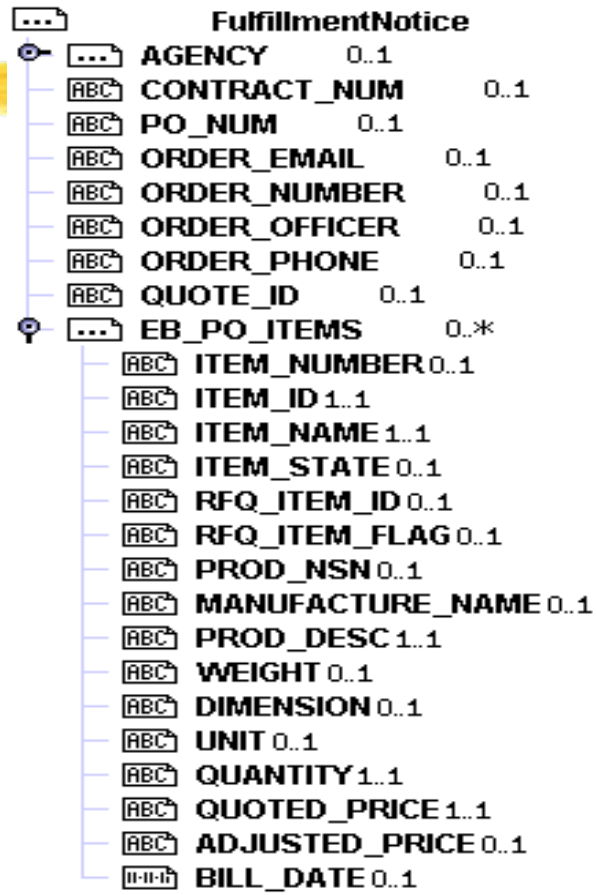


Invoice

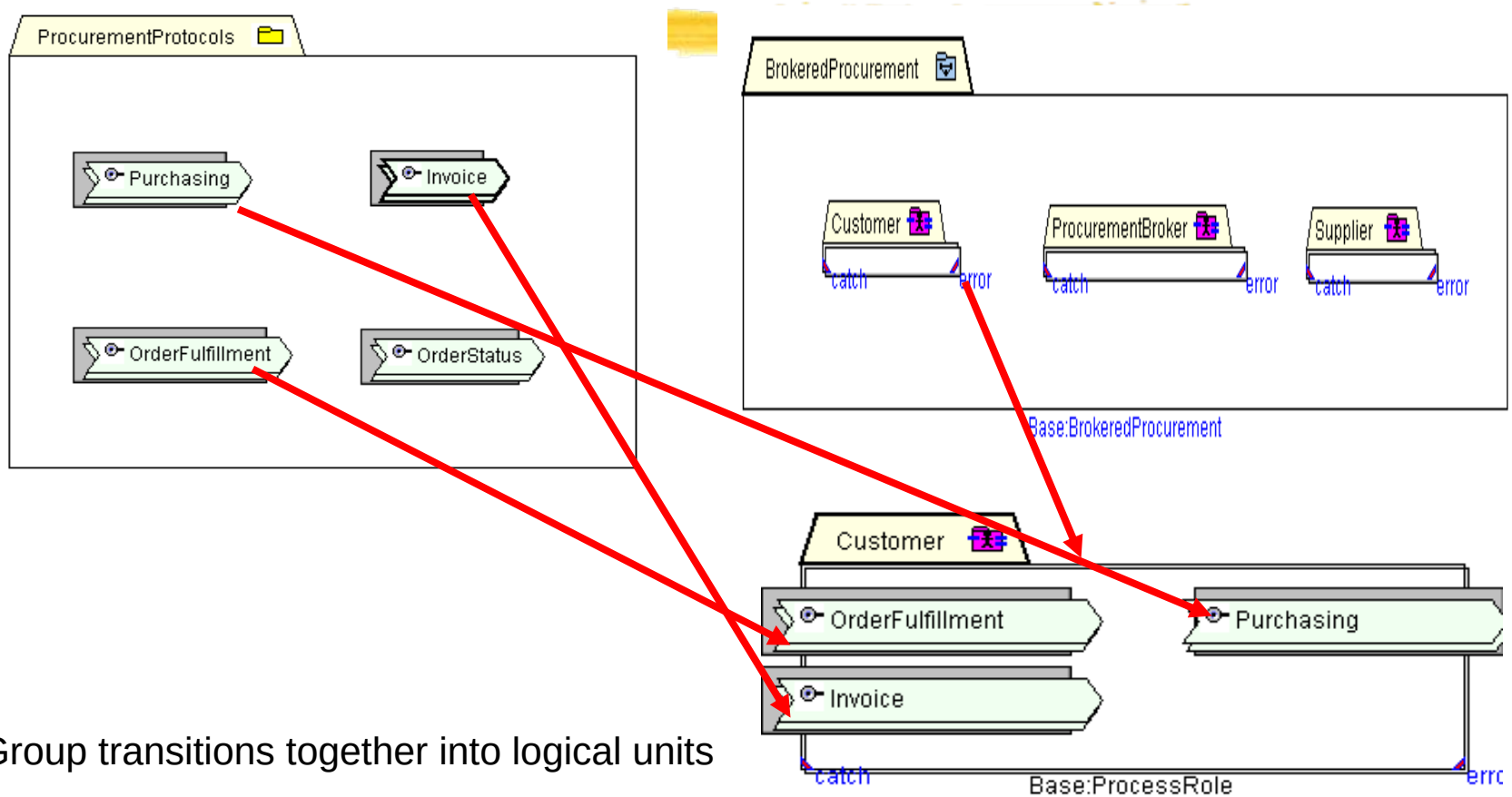
Empty – “Abstract”

Modeling Collaboration Documents

- Fill in details of the documents
- Focus on business information - not technology
- Collaboration - Not an information model
- May be derived from existing sources
- Helps in creating technology mappings - E.G. Web Services
- Includes
  - Composition
  - Type
  - Cardinality



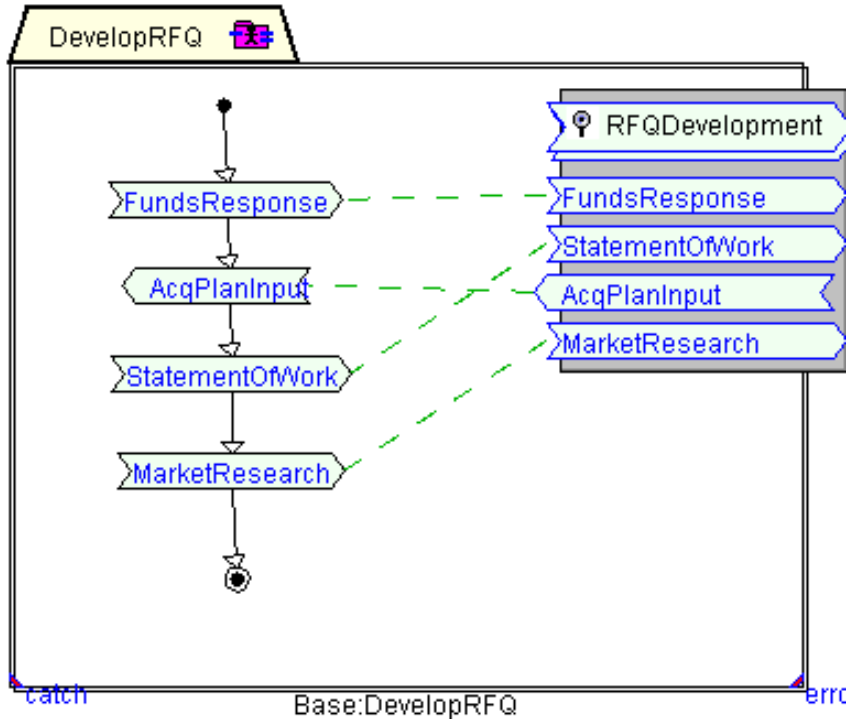
Attach Protocols to Roles as "Ports"



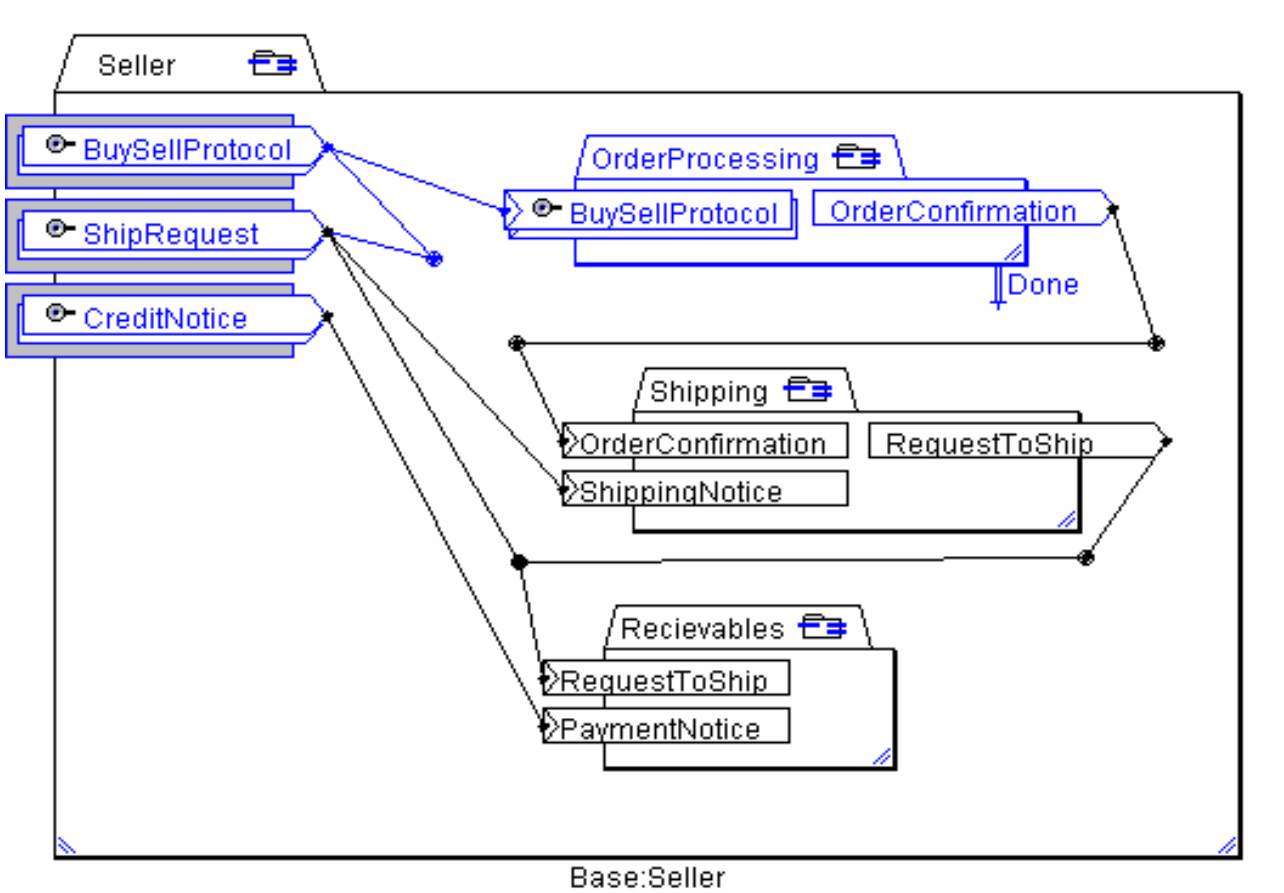
Group transitions together into logical units

Detailed Information Flows

- Inside the activities we can drill down to inner activities or detailed document flows - sending and receiving information
- This is used for the simulation, to validate the the model is correct and ultimately to test the implemented components.

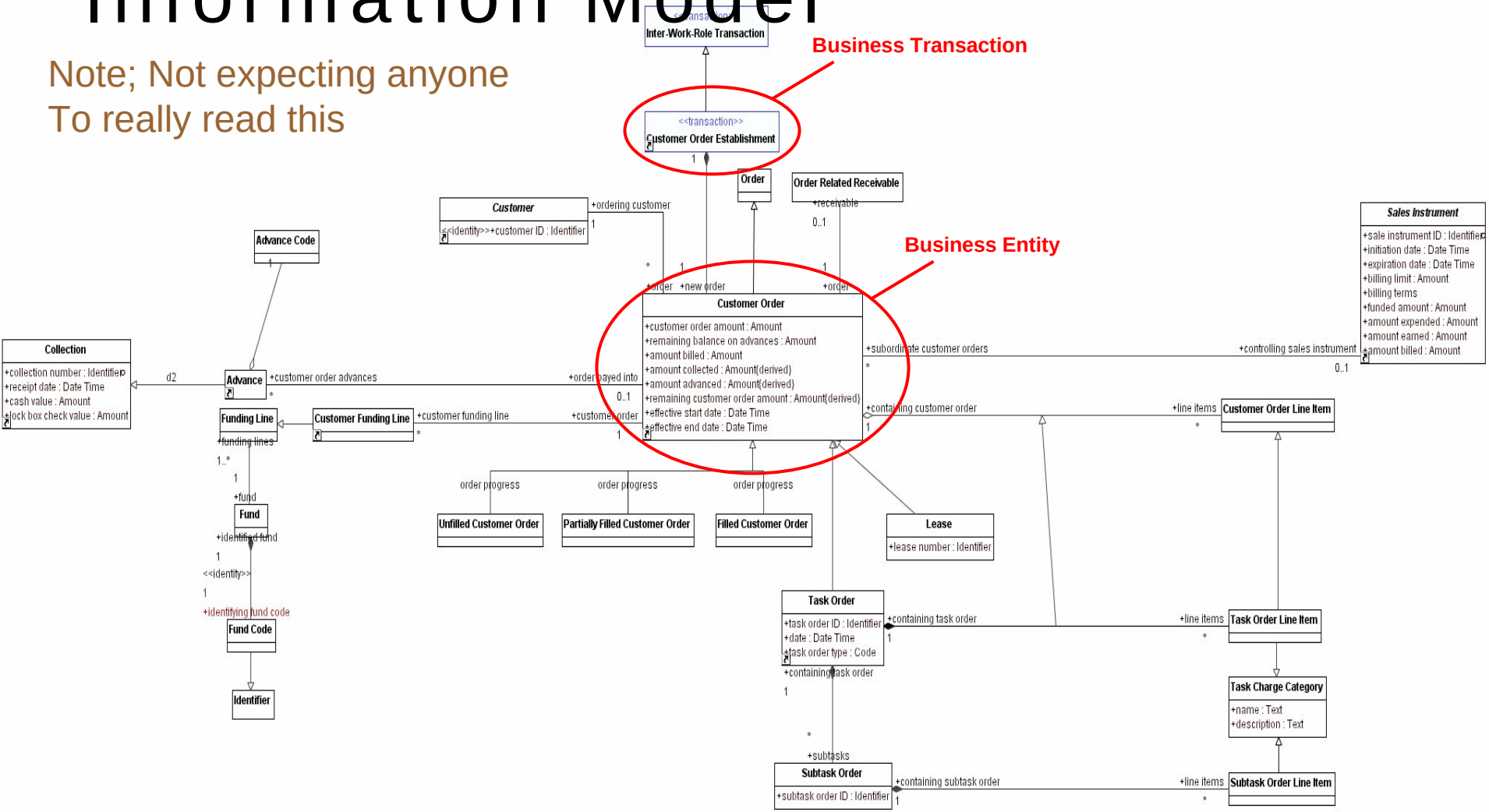


Drill-down



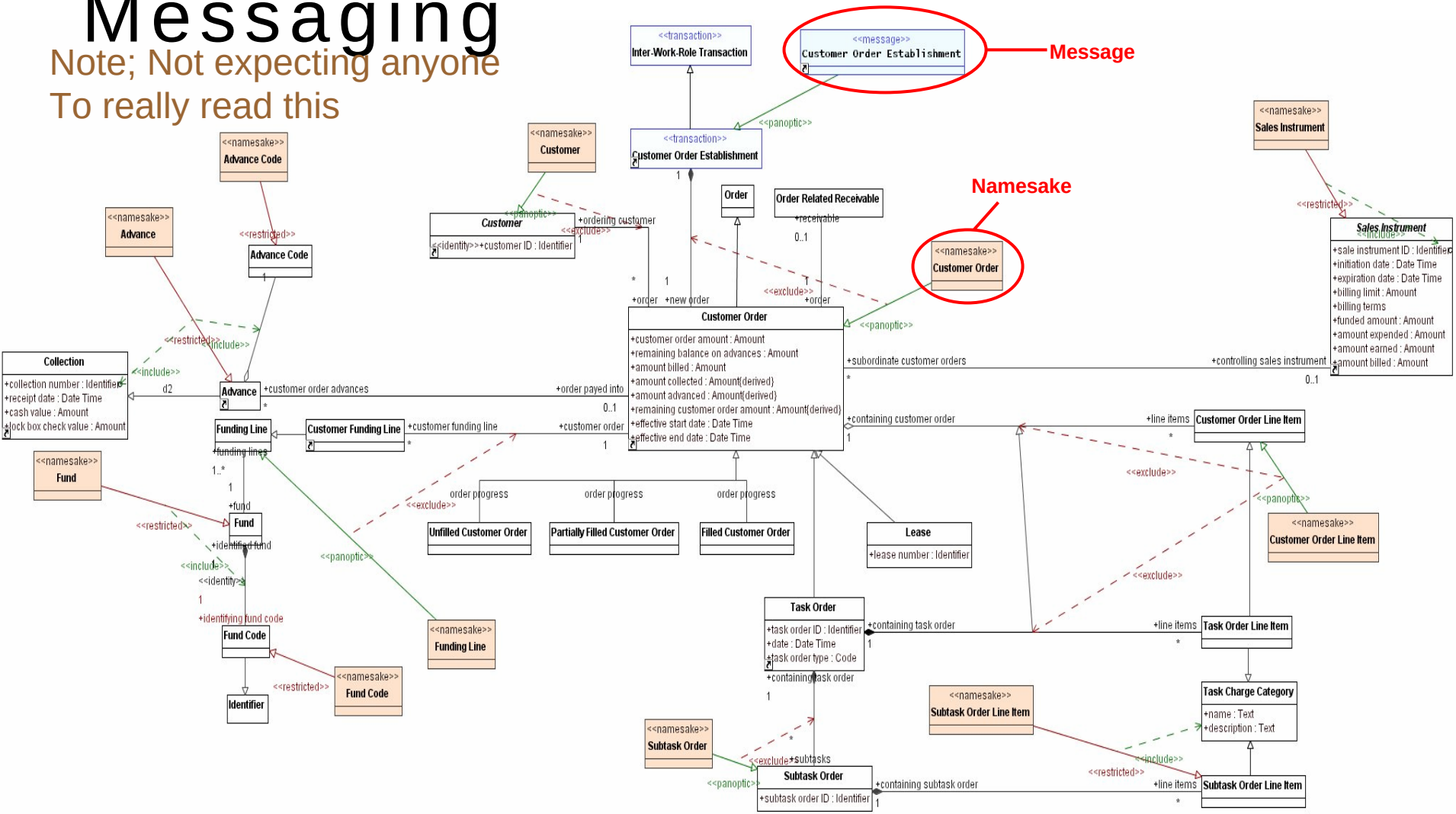
Information Model

Note; Not expecting anyone
To really read this

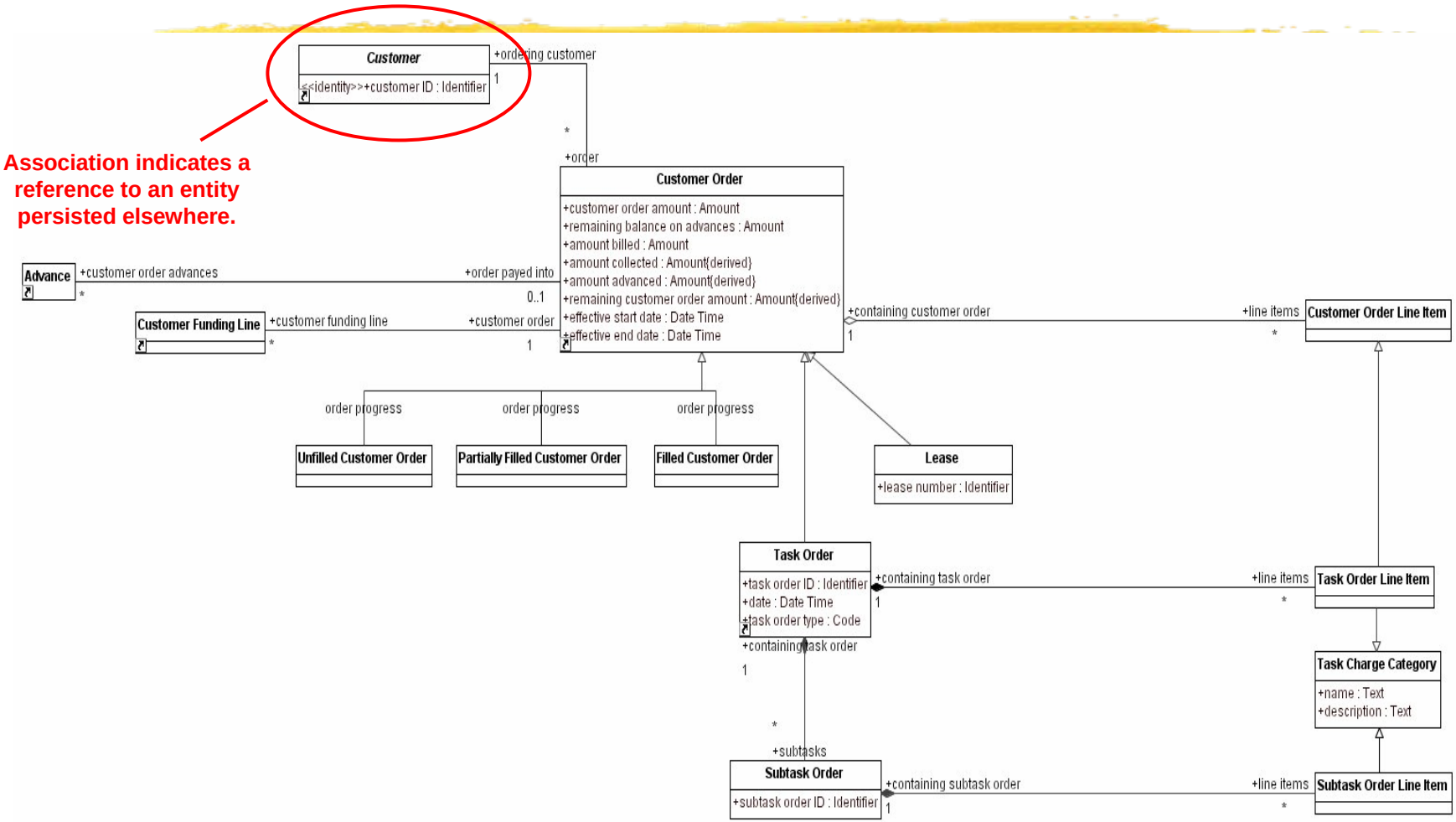


Messaging

Note; Not expecting anyone
To really read this

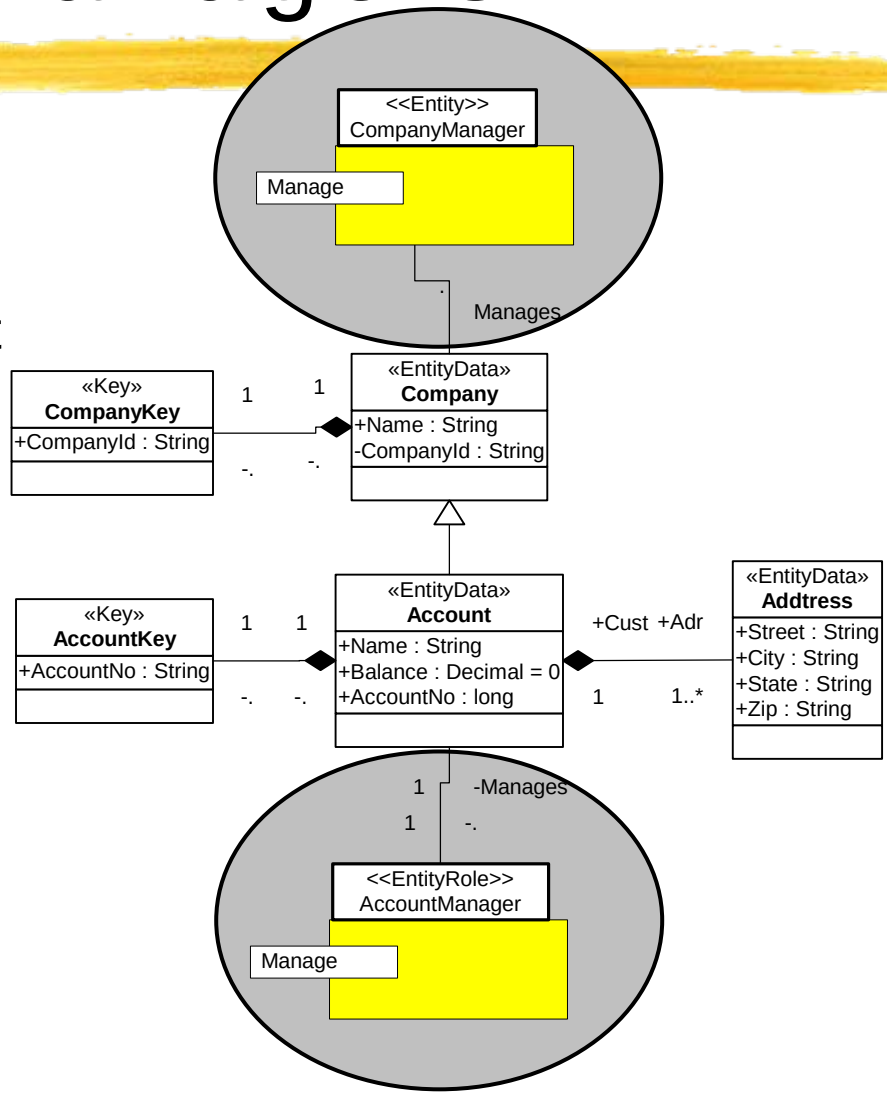


Persistence Model



Adding Data Managers

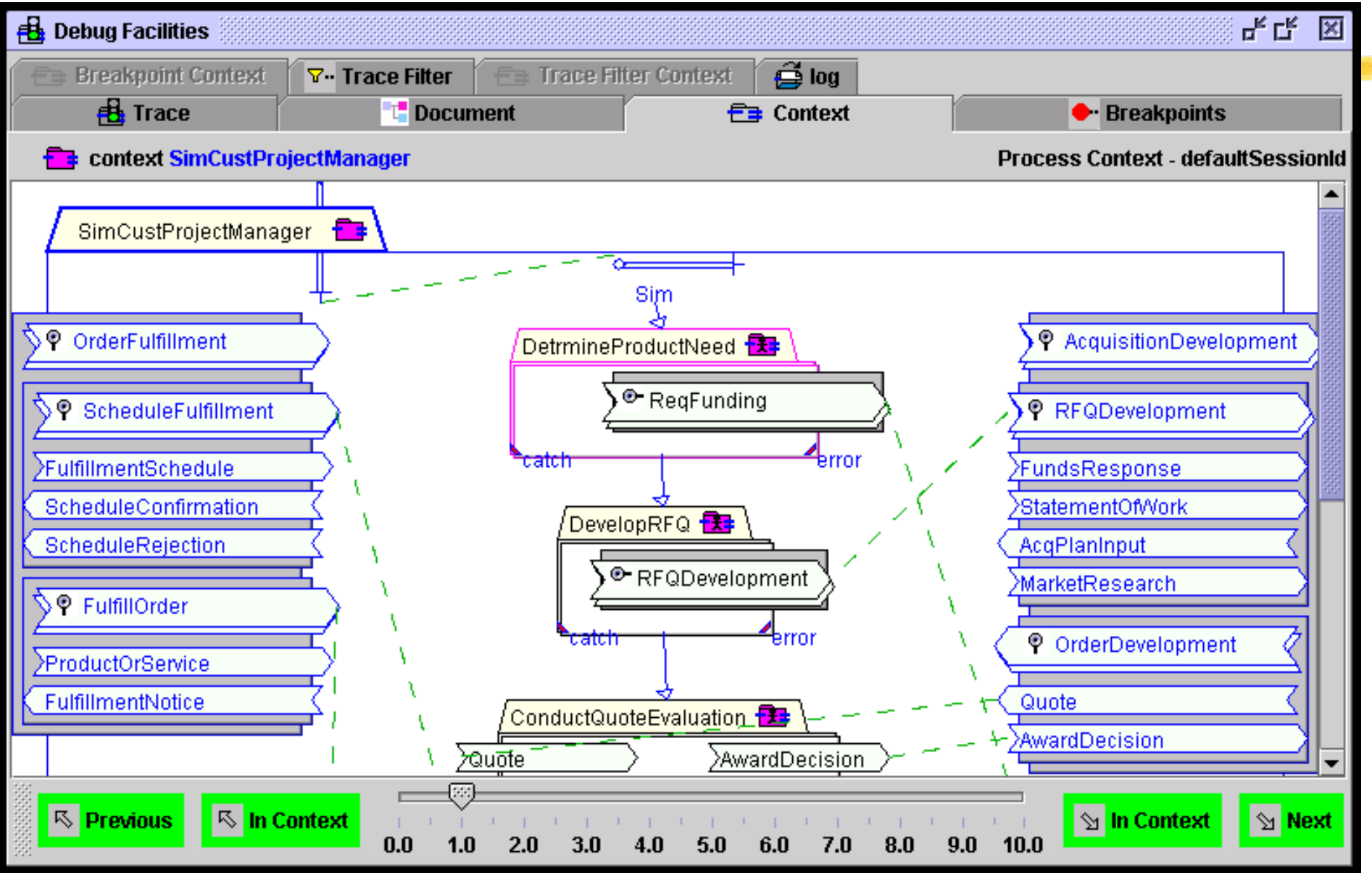
- Entities are added to manage entity data
- Entity Roles are managers that provides a view of the same identity in another context
- The Entities have ports for managing and accessing the entities
- Non-entities which are owned by (aggregate into) an entity are managed by the entity



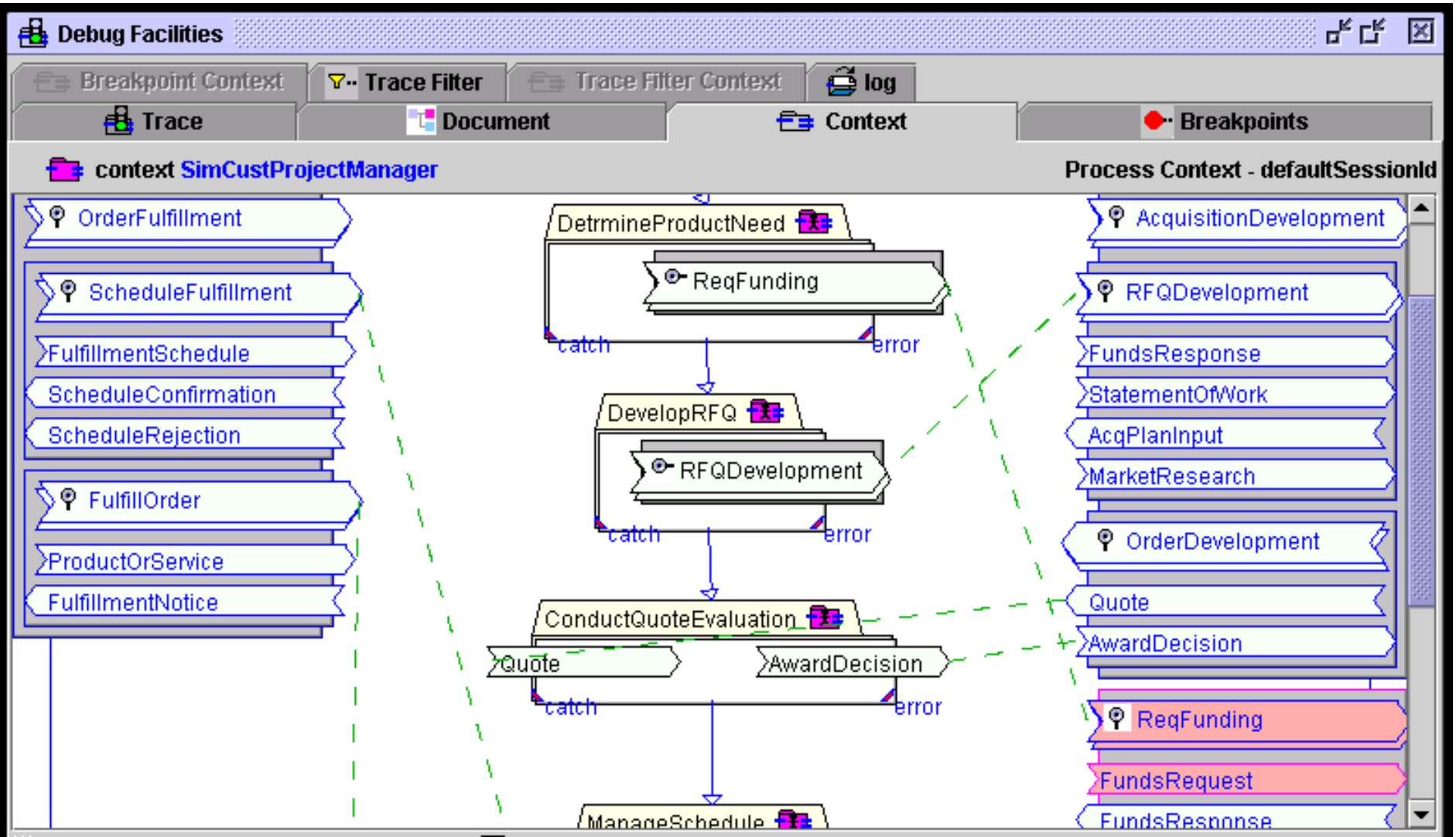
Simulating the Process

- Validation & Buy-in
  - Business stakeholders
  - SMEs
  - Systems Implementers

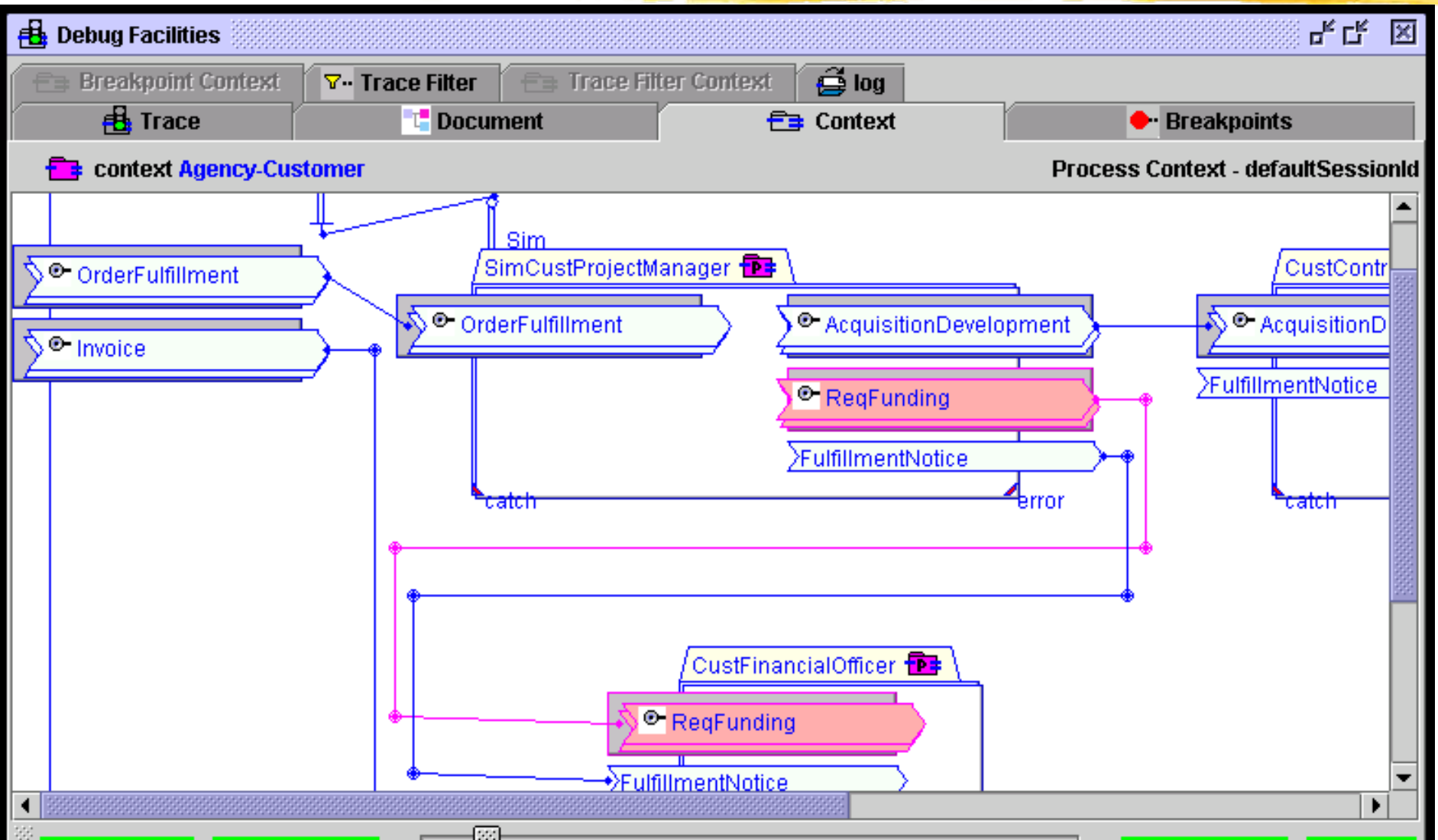
Initiating Activity



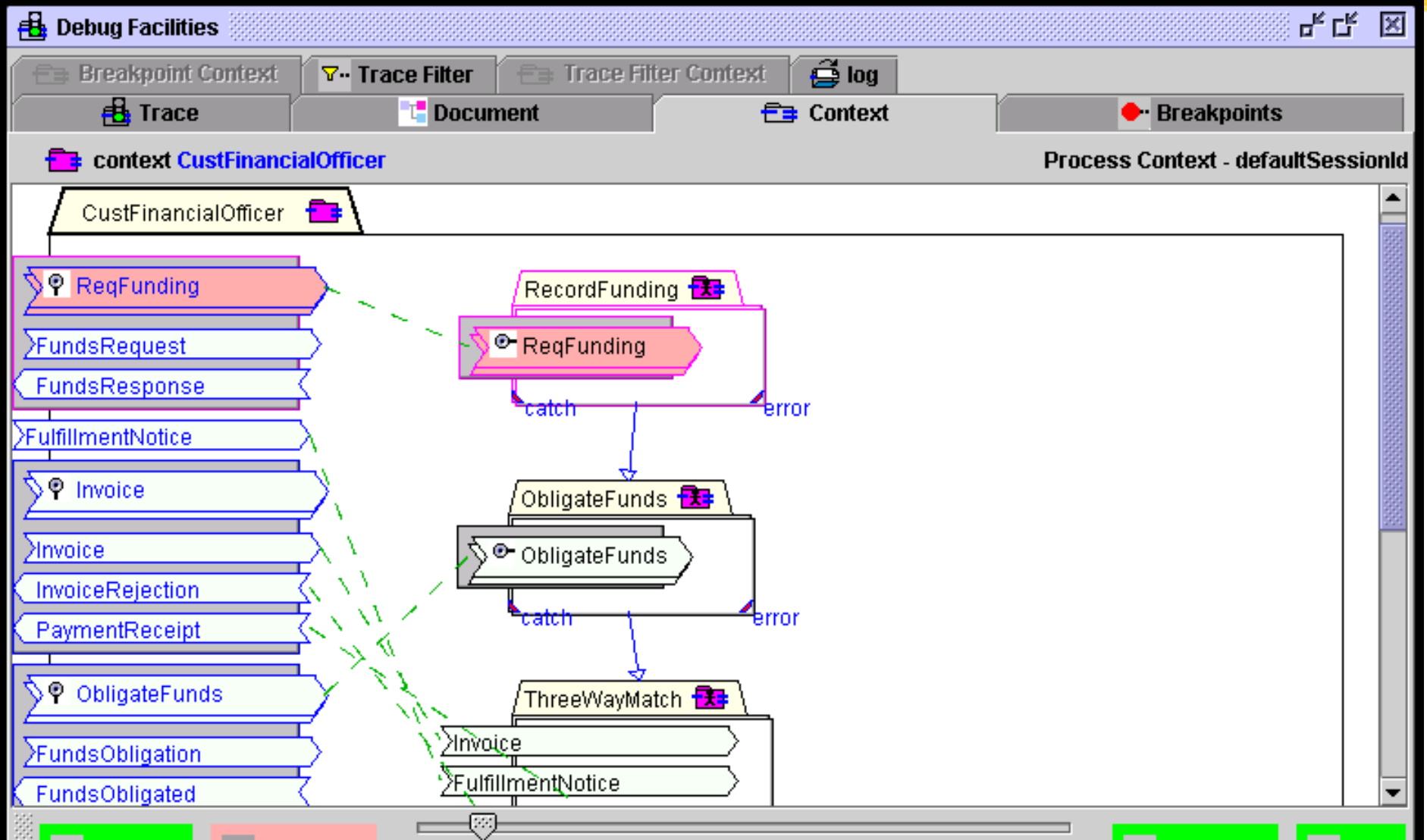
Activity interacting externaly



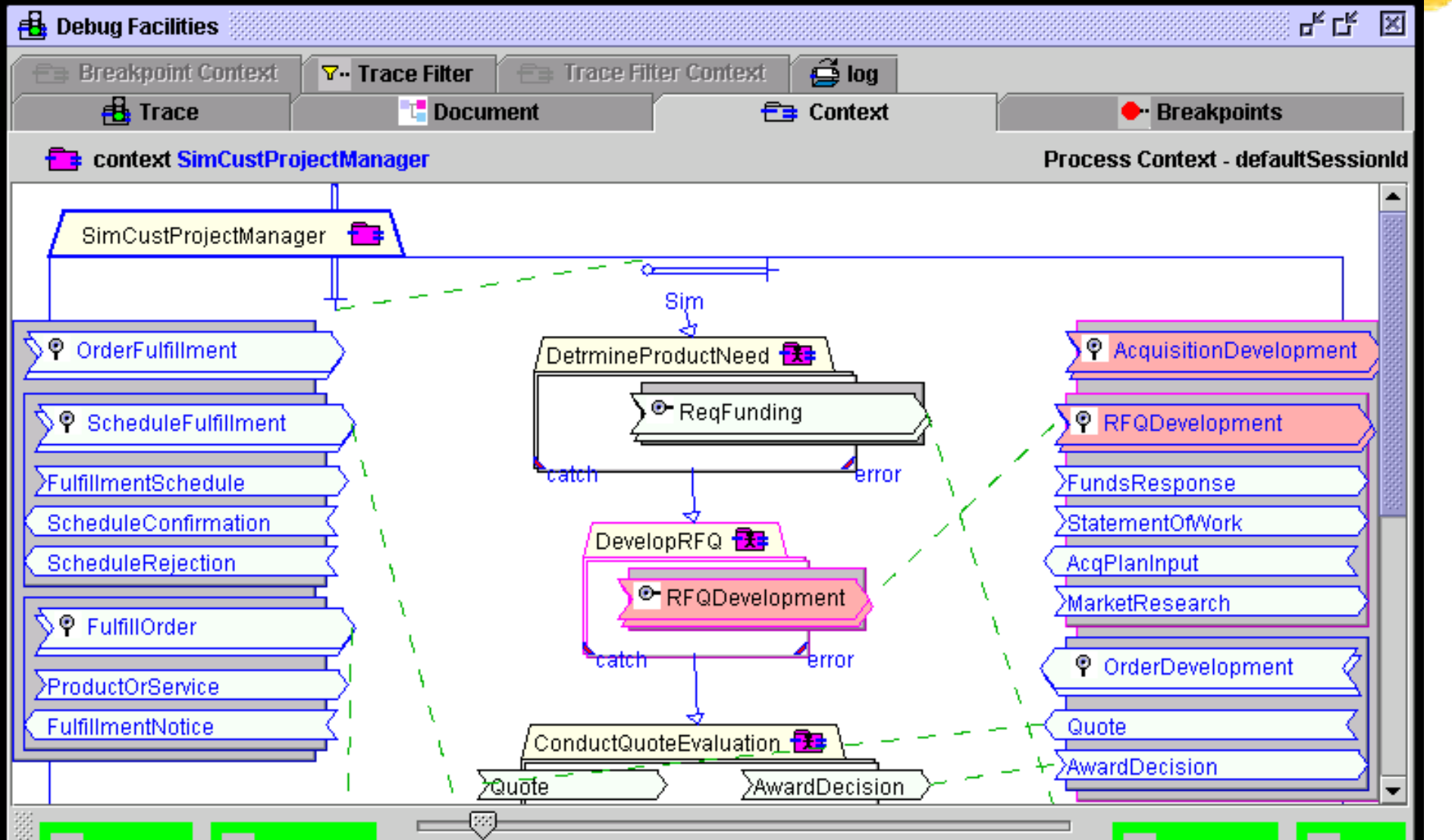
... With financial officer



Who records the funding



And the process returns to the PM



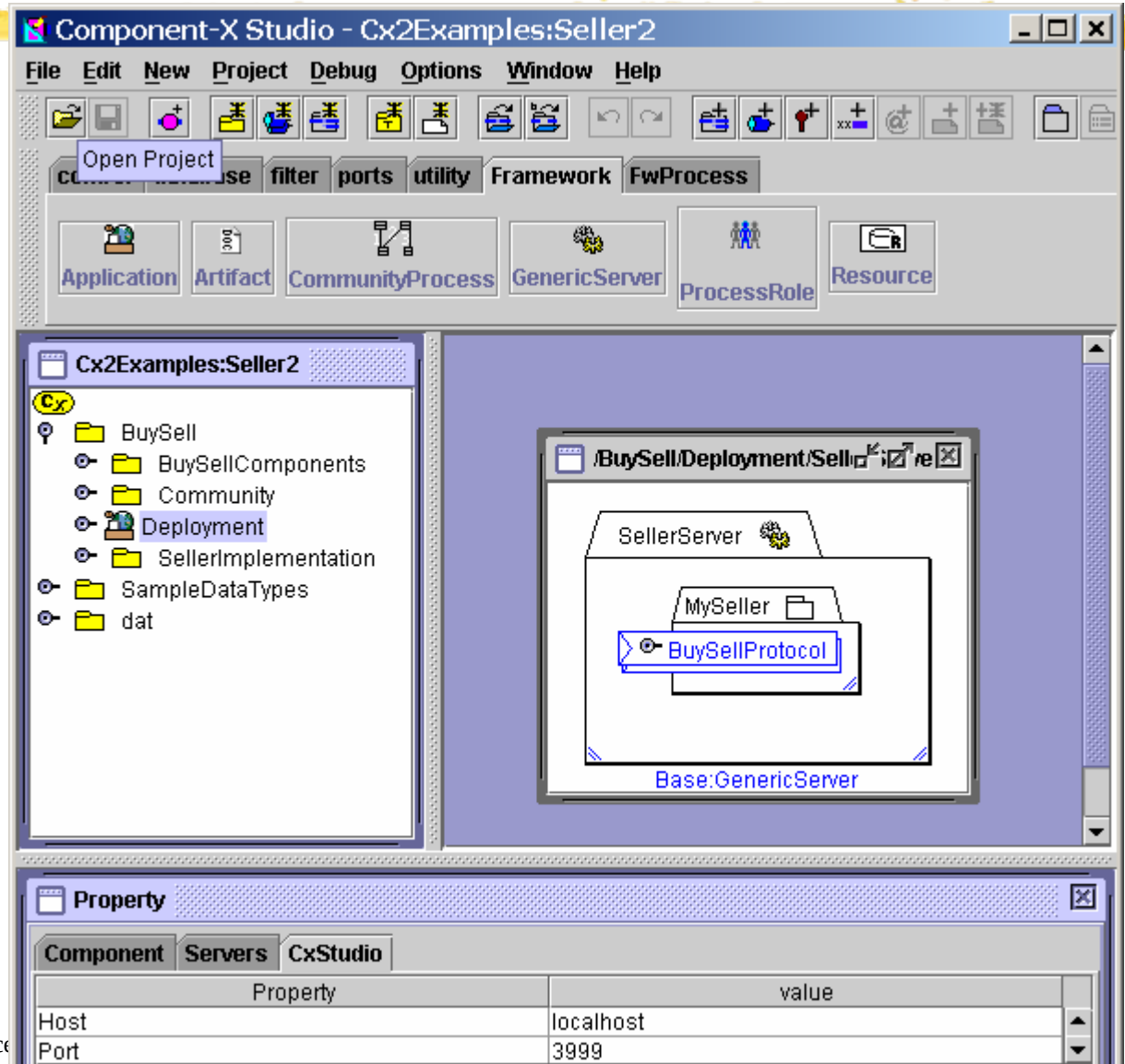
Add implementation

- As component compositions
- In a programming language
- By using an external service
- By Wrapping legacy systems

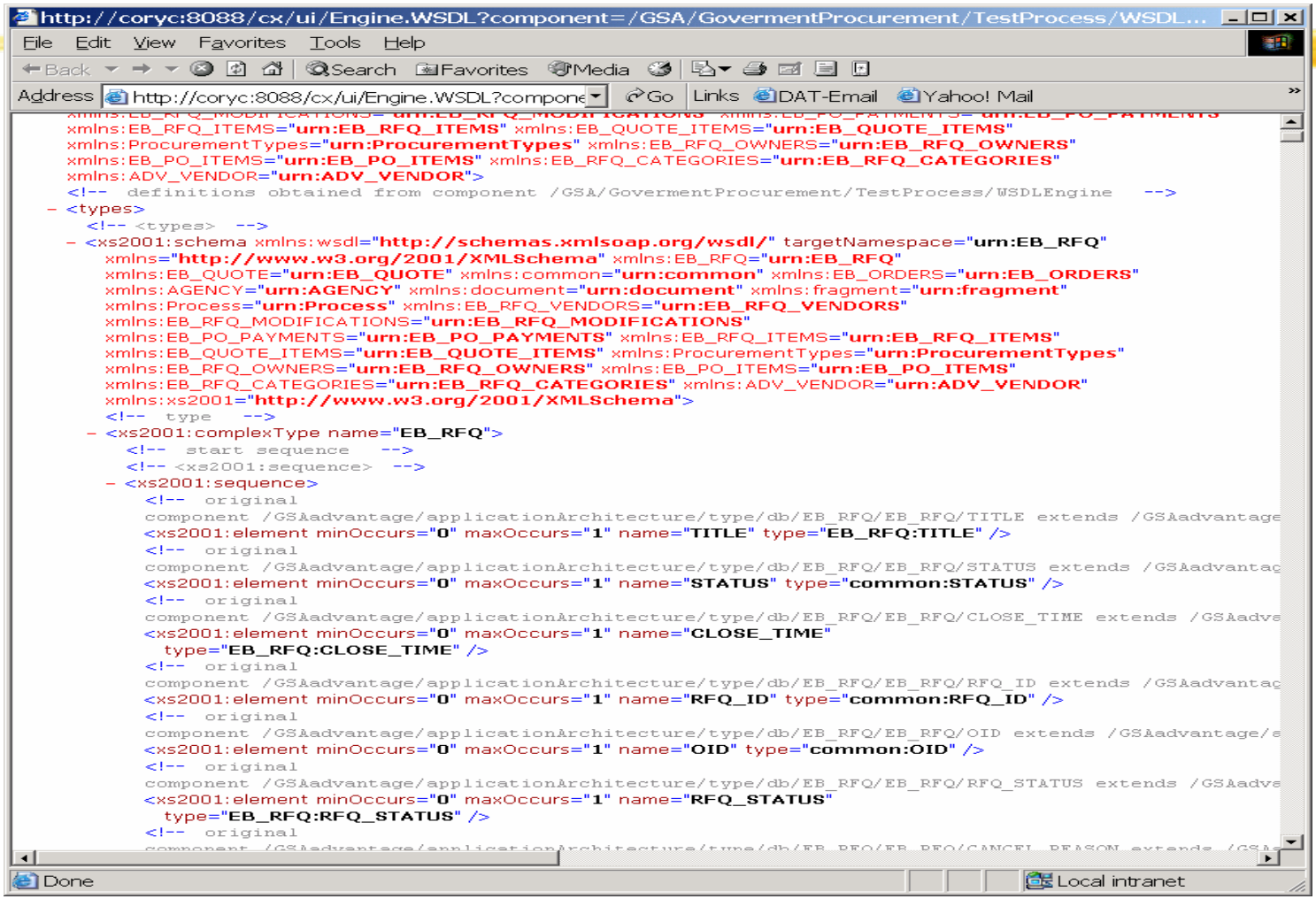
Enterprise Service Bus

- Application Server (jBoss)
- BPEL Engine
- Web Services
- Schema
- J2EE

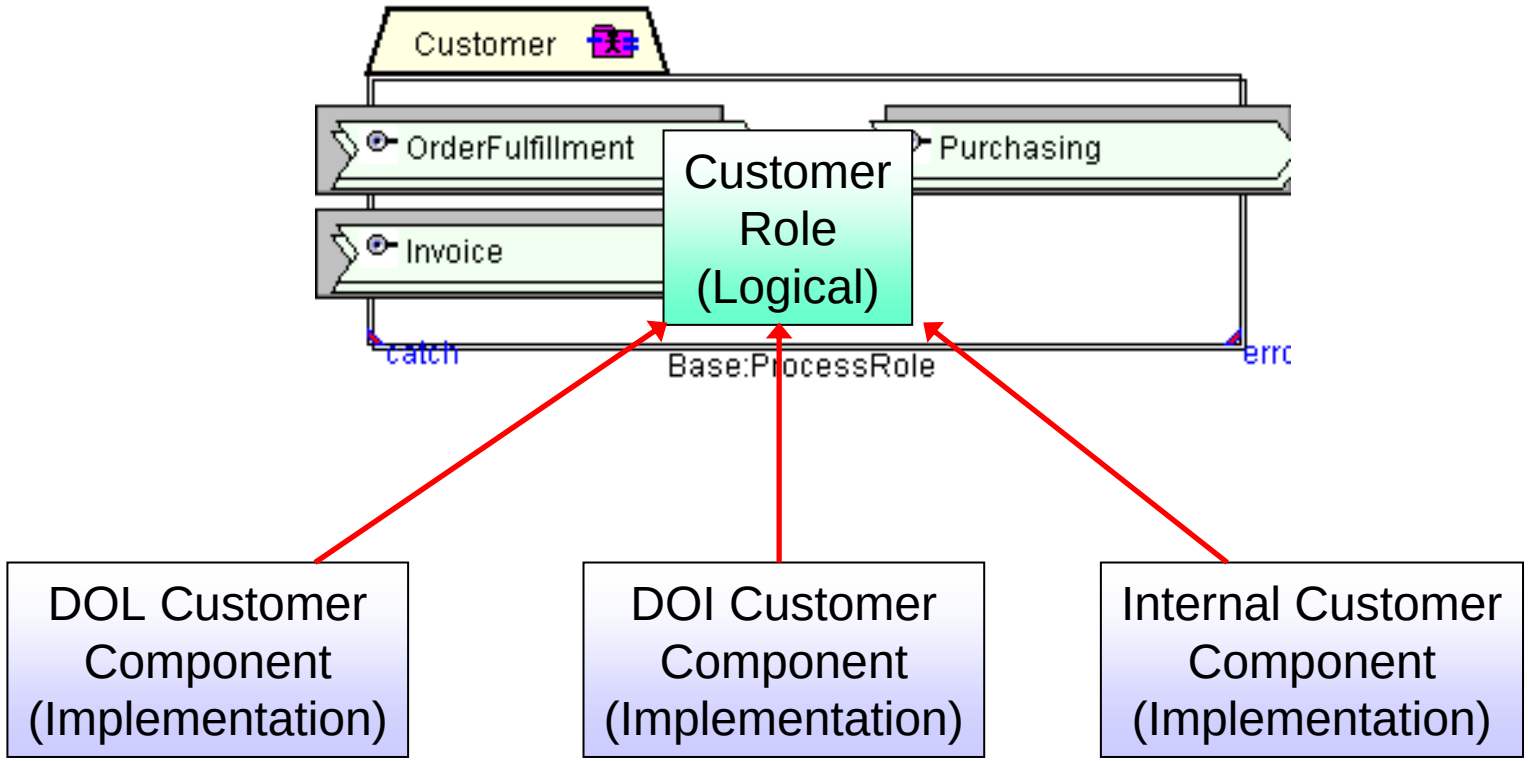
Add technology specifics for deployment



Generated Web Service

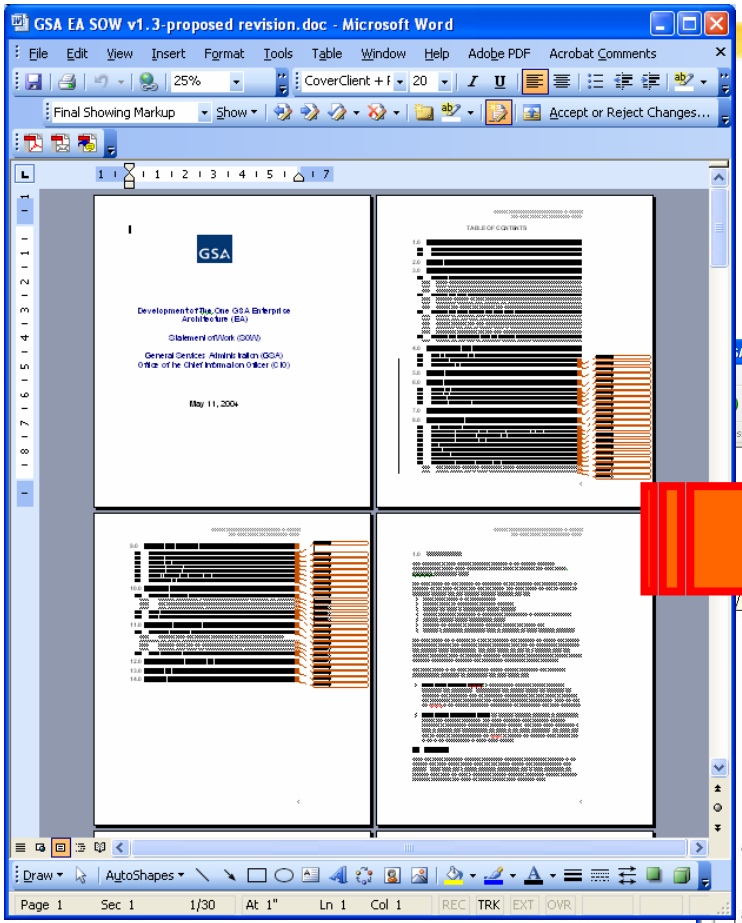


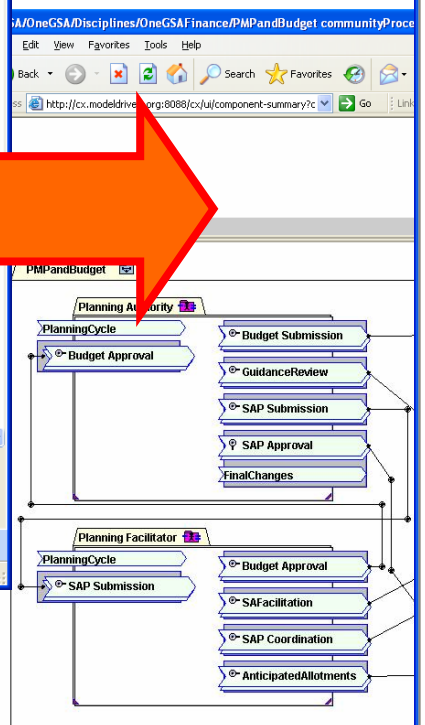
Dealing with Variation Multiple Implementations of a Role

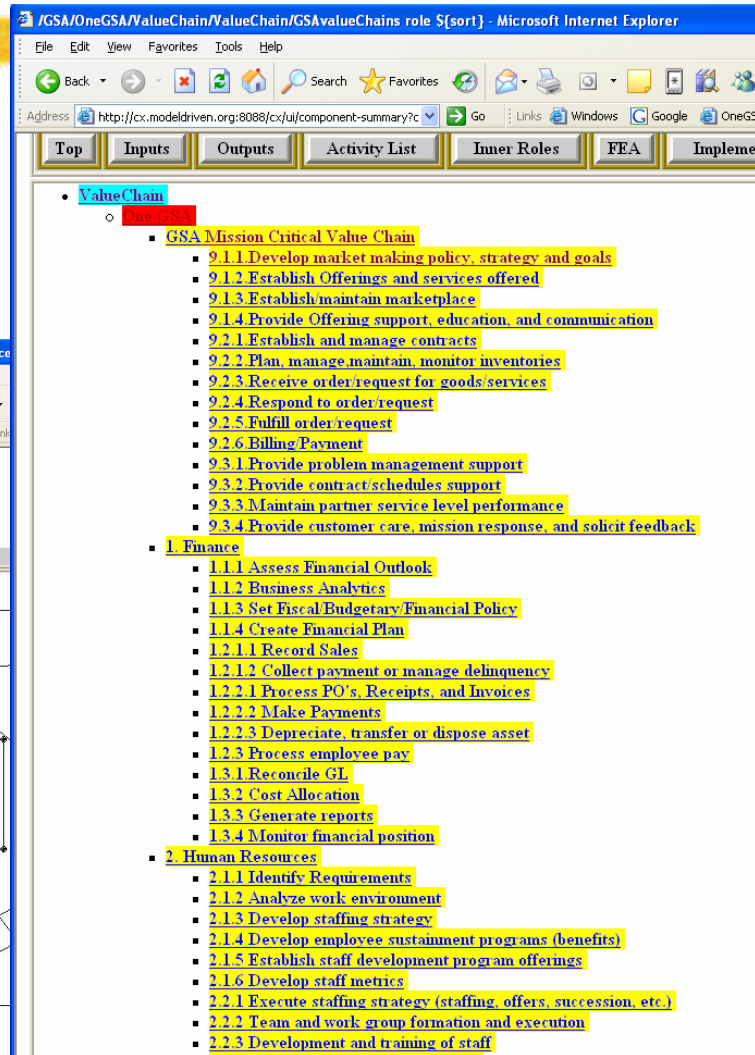


The “Inside” can change as long as the external “contract” is satisfied

Architecture becomes part of Acquisition







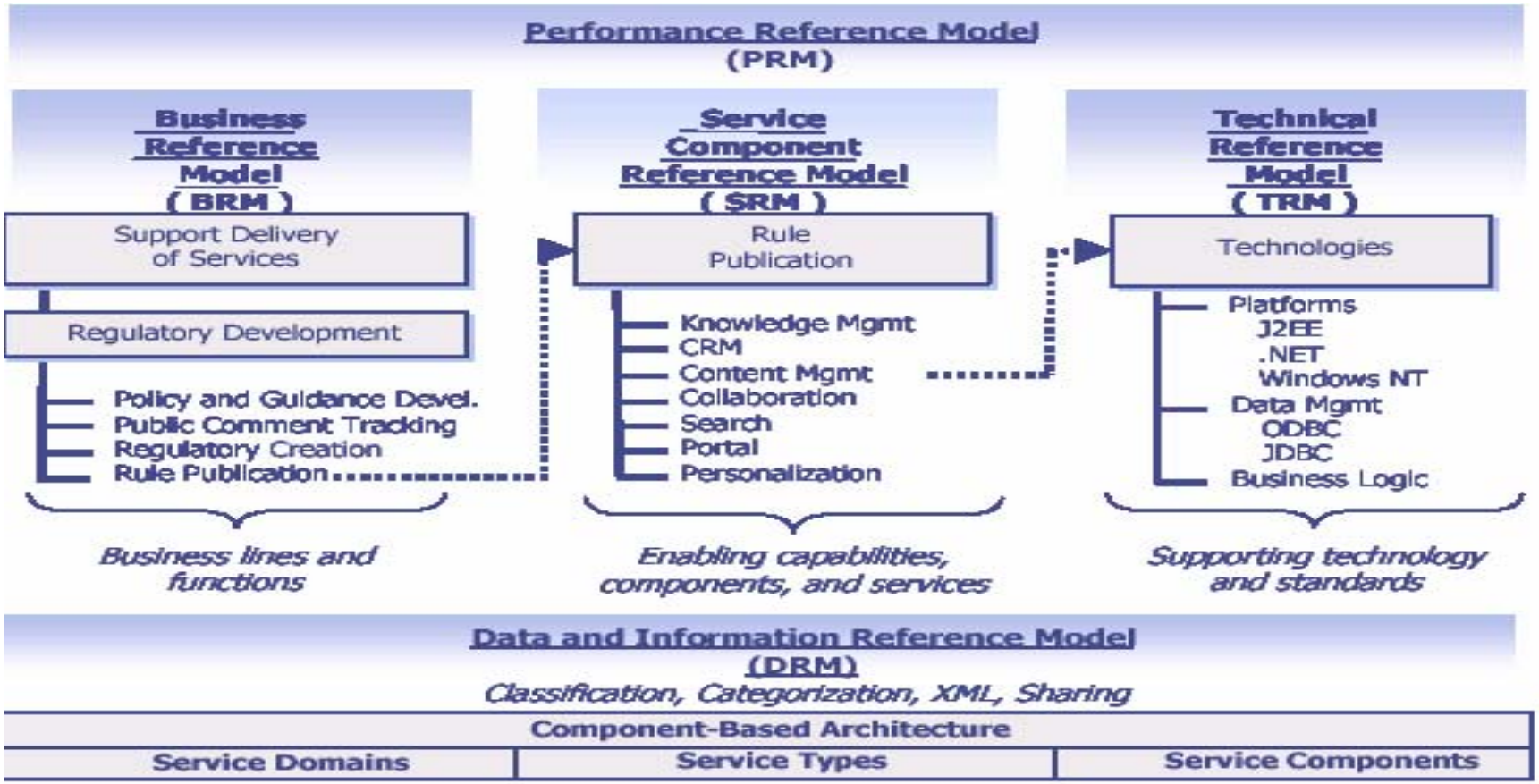
ECA/CCA Implementation at GSA

- Data Access Technologies
  - MDA experts, developers of ComponentX, One GSA EA support
    - enterprise-component.com
  - Creators/contributors to OMG EDOC/ECA/CCA open standards
- ComponentX
  - Implements ECA/CCA, used by GSA EAPMO to create ***collaborative role interaction models***
  - Supports ***'model to integrate',*** combining design-time and run-time tools, with an extensible 'component palette'
  - Supports ***FEA Line of Sight via aspect orientation***
  - Supports 'just in time' model driven generated documentation
- ComponentX is a J2EE application
  - The ***models are executable*** – they're java programs!
  - ***Web enabled simulations integrate with existing IT systems***
- Widely used EA tools (Mettis, Popkin, MS-Office) don't compare!

Federal Enterprise Architecture

Support for the FEA as a view of the enterprise architecture

FEA (from reference)



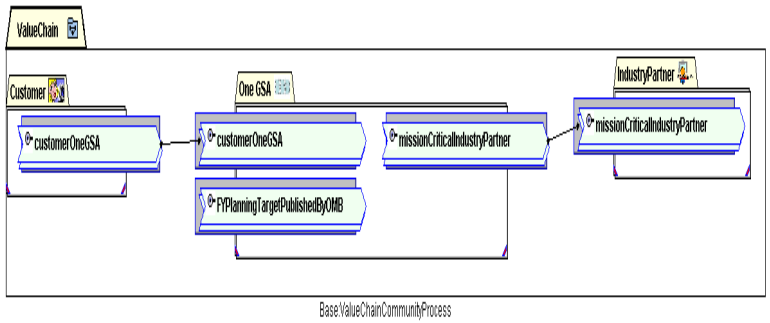
FEA/ComponentX

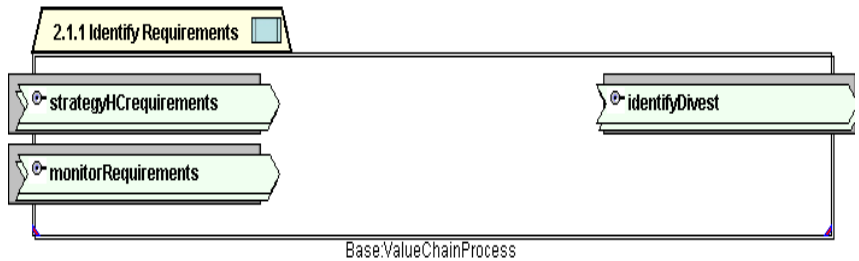
Business Reference Model (BRM)

Community Process

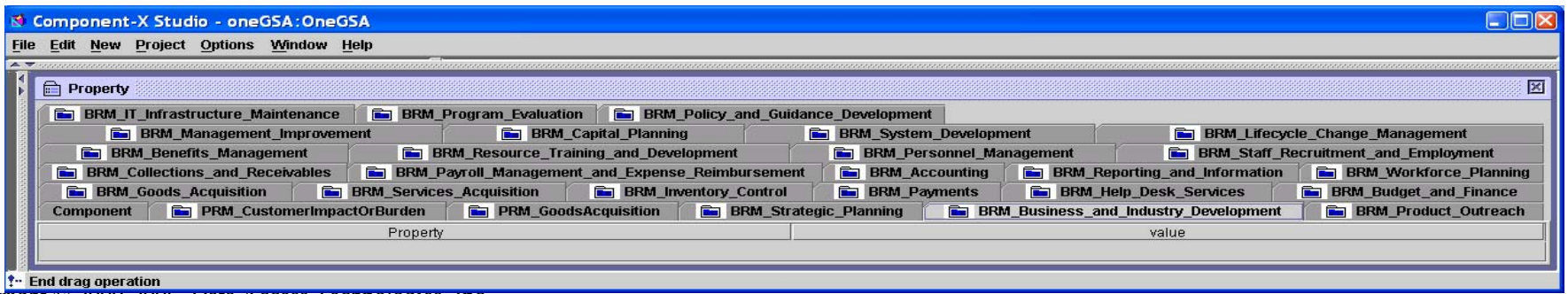
Service Component Reference Model (SRM)

Roles, processes, activities



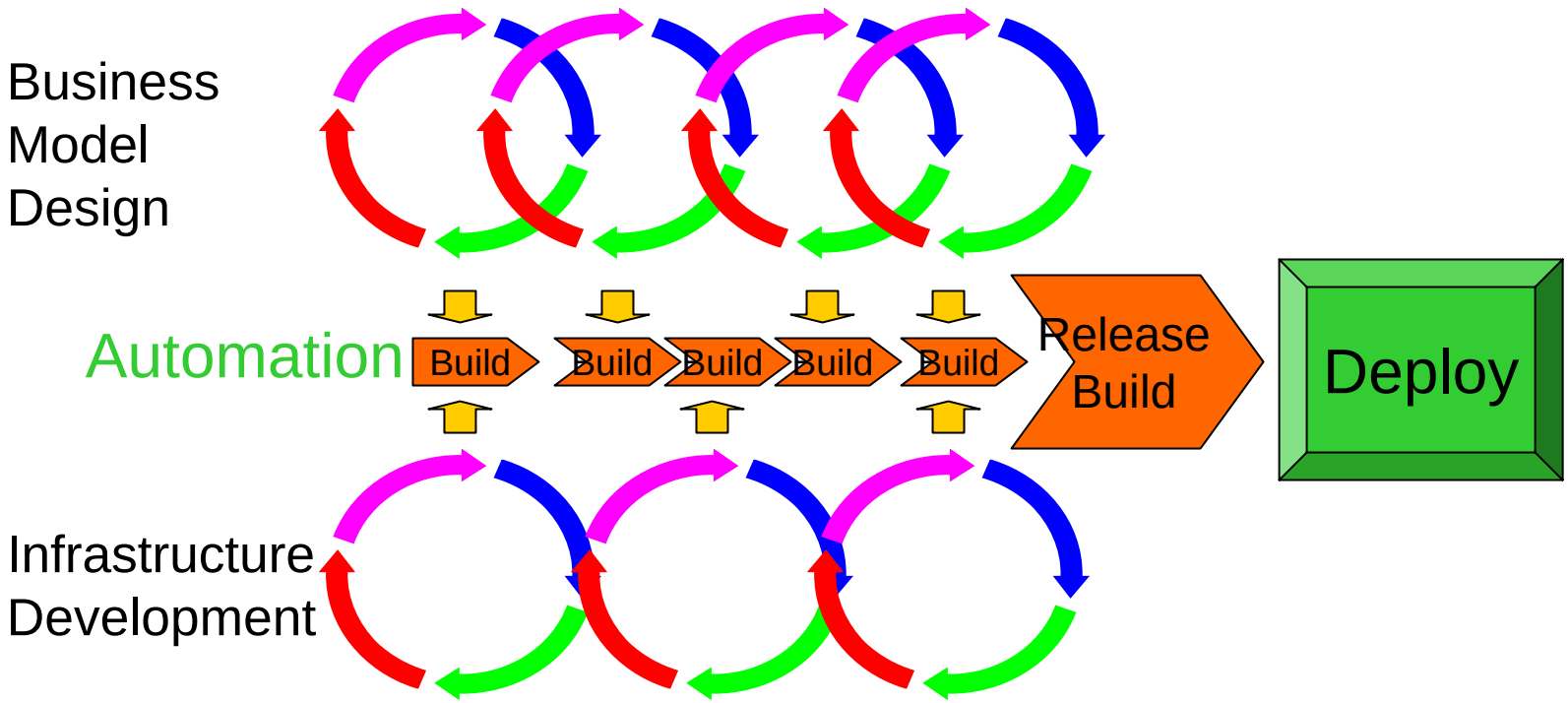


Reference model associations via aspect/properties



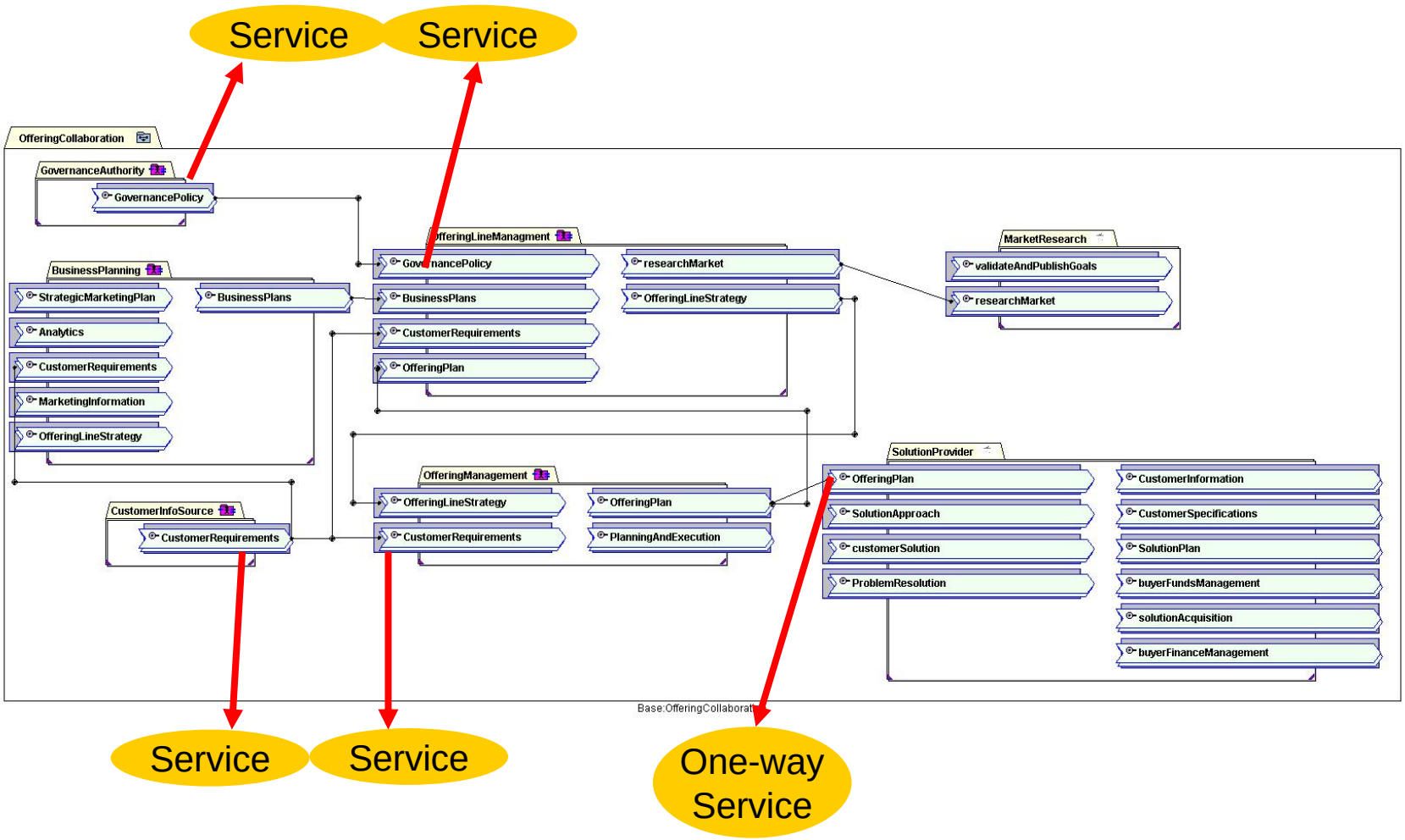
name	baseline	planned	actual	achieved
Financial Avoidance				
Productivity QuantityPerTime	0	10	2	
Productivity ProductsPerFTE				
Productivity PercentResourcesUsed				
Productivity PercentImprovement				
Productivity PercentElectronic	0	100	0.9	
CycleTime ProductionTime	5	0	2.5	
CycleTime CycleToWaitTimeRatio	1	0	0.27999999999	
CycleTime PlannedVersusActual	.8	1	1.1	
Quality EffectivityRate	.8	1	0.99	
Quality ComplaintsPerCustomer	.1	0	0.01	
Management Involvement				
Management PolicyCoverage				
Management ApplicationsRequired	5	1	0	
Management RequirementComplianceExtent				
Management PolicyComplianceExtent				
Management UnidentifiedRiskEvents				

Iterative Development

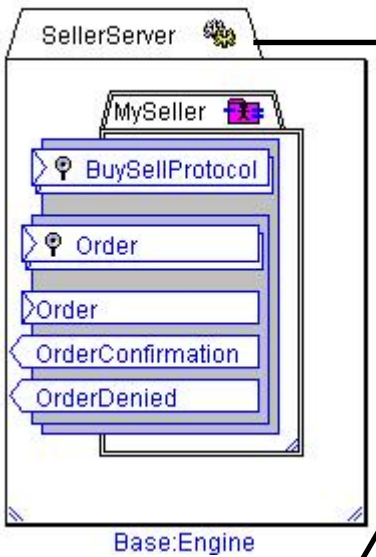


Generating Web Services & BPEL

PSM View - Mapping to [web] Services



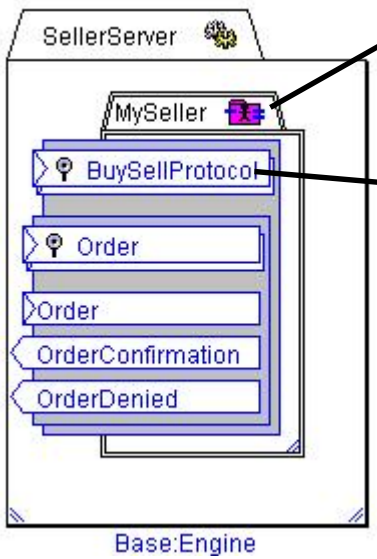
Mapping of a WSDL Engine



- <definitions xmlns="http://schemas.xmlsoap.org/ws
xmlns:soap="http://schemas.xmlsoap.org/wsdl/soa
xmlns:mime="http://schemas.xmlsoap.org/wsdl/mi
xmlns:http="http://schemas.xmlsoap.org/wsdl/http
ENC="http://schemas.xmlsoap.org/soap/encoding/
xmlns:xs2000="http://www.w3.org/1999/XMLSche
xmlns:xs2001="http://www.w3.org/2001/XMLSche
targetNamespace="urn:SellerServer" xmlns:tns="urn:S
xmlns:CoreTypes="urn:CoreTypes" xmlns:Ordering="ur
- <!--
definitions obtained from component /BuySell/Deployment/Selle

Aspects
WSDL
WSDL-SOAP

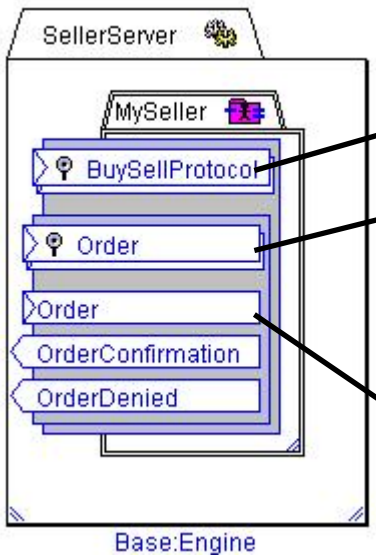
Mapping of an Enterprise Component




```
- <service name="MySeller">
- <!--
    implemented service role
/BuySell/Deployment/SellerServer/MySeller    -->
    <documentation><p> </p></documentation>
  - <port name="BuySellProtocol"
binding="tns:BuySellProtocol">
  - <!--
    original service port was
/BuySell/Deployment/SellerServer/MySeller/BuySellProtoc
ol (extending Component
&lt;/BuySell/SellerImplementation/MySeller/BuySellProtoc
ol&gt; )    -->
    <soap:address
location="http://localhost:8080/cx/app/BuyS
ell/Deployment/SellerServer/MySeller/BuyS
ellProtocol" />
    </port>
```

Aspects
WSDL
WSDL-SOAP

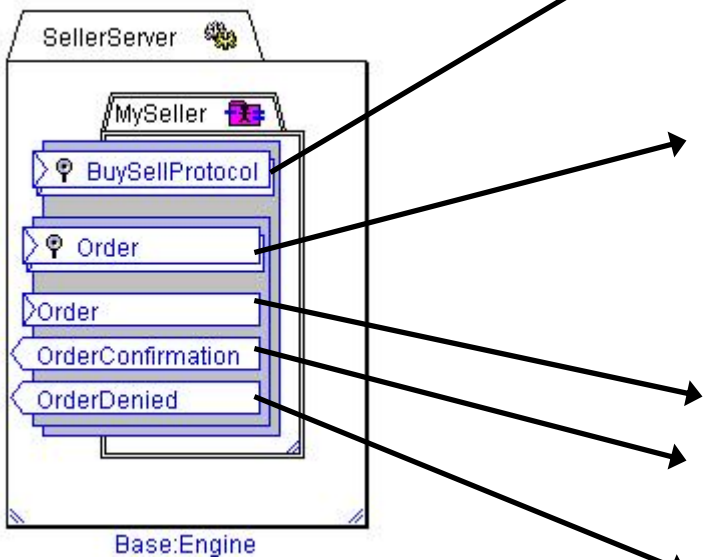
Mapping of a protocol binding



Aspects
WSDL
WSDL-SOAP

```
- <binding name="BuySellProtocol"
  type="tns:BuySellProtocol">
  <soap:binding
      transport="http://schemas.xmlsoap.org/soap/h
      style="rpc" />
- <operation name="Order">
  <soap:operation
      soapAction="urn:/BuySell/Community/BuySellPr
      col/Order" style="rpc" />
- <input name="Order">
  <soap:body use="encoded" namespace="urn:SellerServ
      encodingStyle="http://schemas.xmlsoap.org/soa
      encoding/" />
```

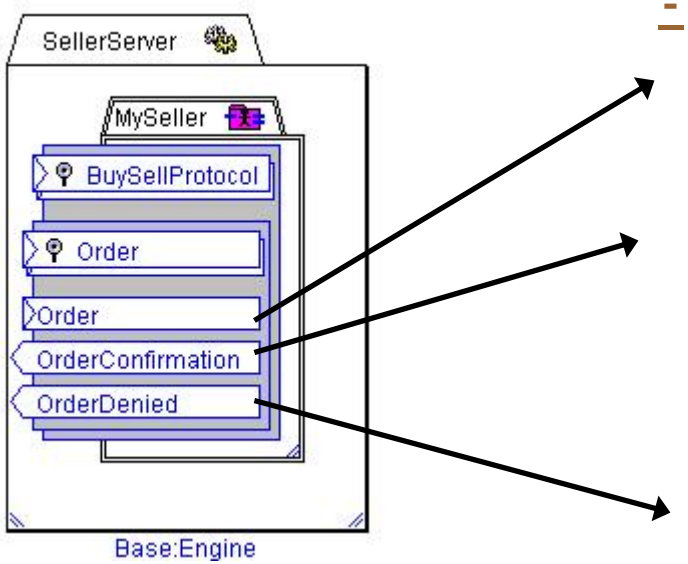
Mapping of a protocol




```
- <portType name="BuySellProtocol">
- <!--
   original cx operation =
/BuySell/Community/BuySellProtocol/Order    -->
- <operation name="Order">
- <!--
   original cx flow port =
/BuySell/Community/BuySellProtocol/Order/Order    -->
   <input name="Order" message="tns:Order" />
   <output name="OrderConfirmation"
message="tns:OrderConfirmation" />
   <fault name="OrderDenied"
message="tns:OrderDenied" />
   </operation>
   </portType>
```

Aspects
WSDL
WSDL-SOAP

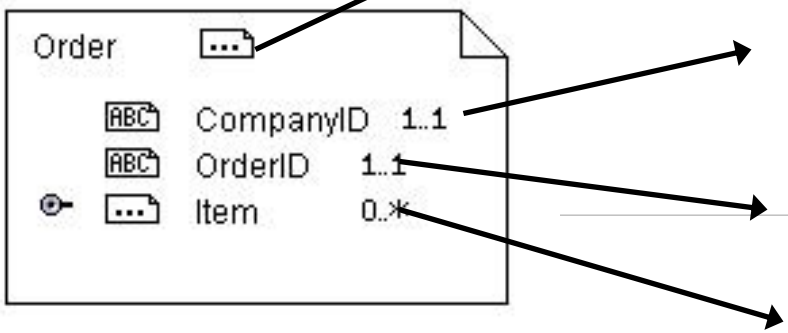
Mapping of message types



Aspects
WSDL
WSDL-SOAP

```
- <message name="Order">
    <part name="Order" type="Ordering:Order"
<message name="OrderConfirmation">
    <part name="OrderConfirmation"
  type="Ordering:OrderConfirmation" />
    </message>    </message>
- <message name="OrderDenied">
    <part name="OrderDenied"
  type="Ordering:OrderDenied" />
    </message>
```

Mapping of data types



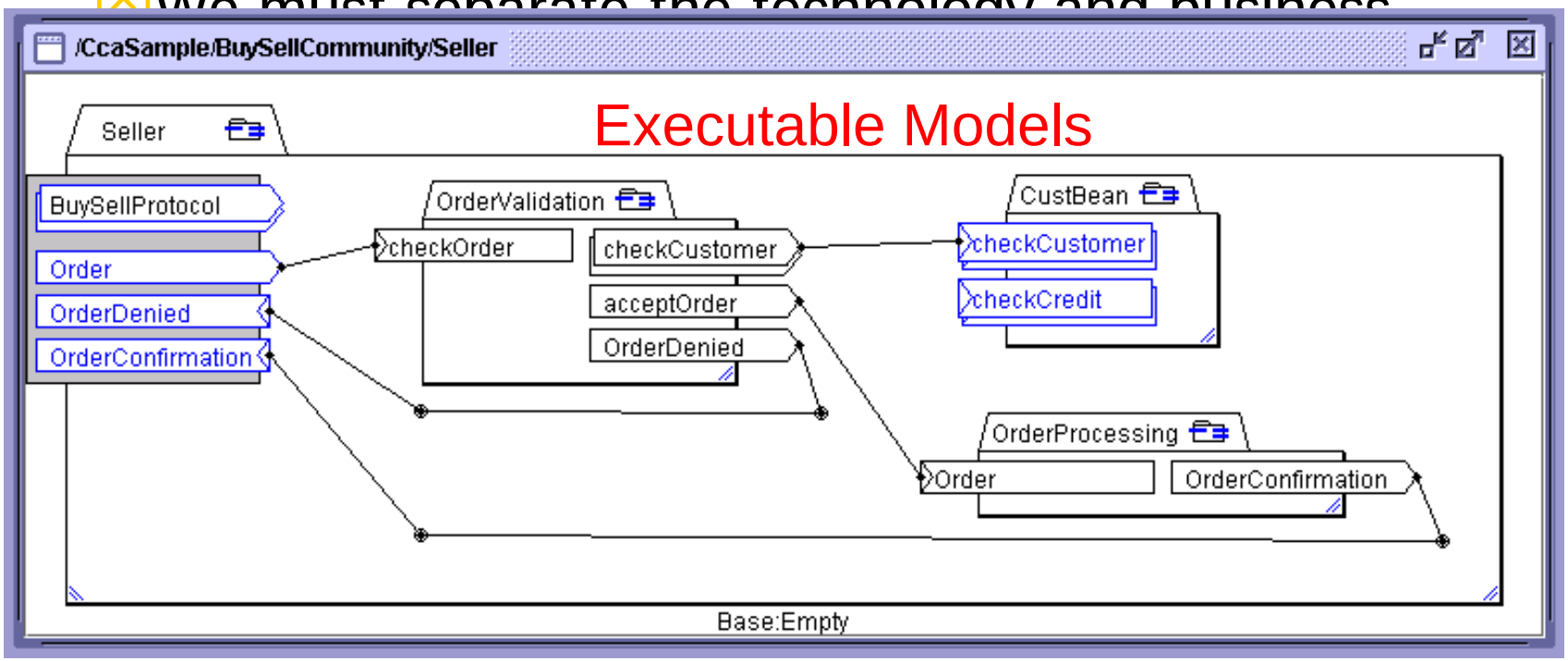

```
- <xs2001:complexType name="Order">
-
- <xs2001:sequence>
    <xs2001:element minOccurs="1"
  maxOccurs="1" name="CompanyID"
  type="CoreTypes:CompanyID" />
    <xs2001:element minOccurs="1"
  maxOccurs="1" name="OrderID"
  type="Ordering:OrderID" />
    <xs2001:element minOccurs="0"
  maxOccurs="unbounded" name="Item"
  type="Ordering:Item" />
  </xs2001:sequence>
  </xs2001:complexType>
```

High level tooling & infrastructure

- MUST BE SIMPLE!
  - We must be able to create better applications faster
  - We must separate the technology and business concerns, enable the user
- Tooling + Infrastructure
  - Executable models are source code
  - Tooling must be technology aware
  - Infrastructure must support tooling, not manual techniques
- Model based component architectures

High level tooling & infrastructure

- MUST BE SIMPLE!
  - We must be able to create better applications faster
  - We must separate the technology and business



Net effect

- Using these open standards and automated techniques we can;
  - 80% Reduction in complexity (Conservative)
  - Achieve the strategic advantage of an open and flexible enterprise
  - Produce and/or integrate these systems FASTER and CHEAPER than could be done with legacy techniques
  - Provide a lasting software asset that will outlive the technology of the day

Sample Applications

- Financial Management Enterprise Architecture, and
- One-GSA Executable Enterprise Architecture for the General Services Administration
- Enterprise Component Architecture for U.S. Army PEO-STRI
- Intelligence application for Raytheon & DARPA
- Collaboration Architecture for Kaiser Permanente

Contact

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