Quelques exemples d'utilisation des outils d'IS de Rational

Lors de cette session, nous vous présentons des cas d'utilisation des outils d'ingénierie Systèmes de Rational, en particulier pour la gestion des exigences et la modélisation : quels outils, pour quoi faire ? Nous vous rendons aussi compte des témoignages que des clients ont fait lors de notre conférence annuelle en juin en Floride, USA.

[redacted]c, philippe.leblanc@fr.ibm.com

[redacted]nnovate[redacted]
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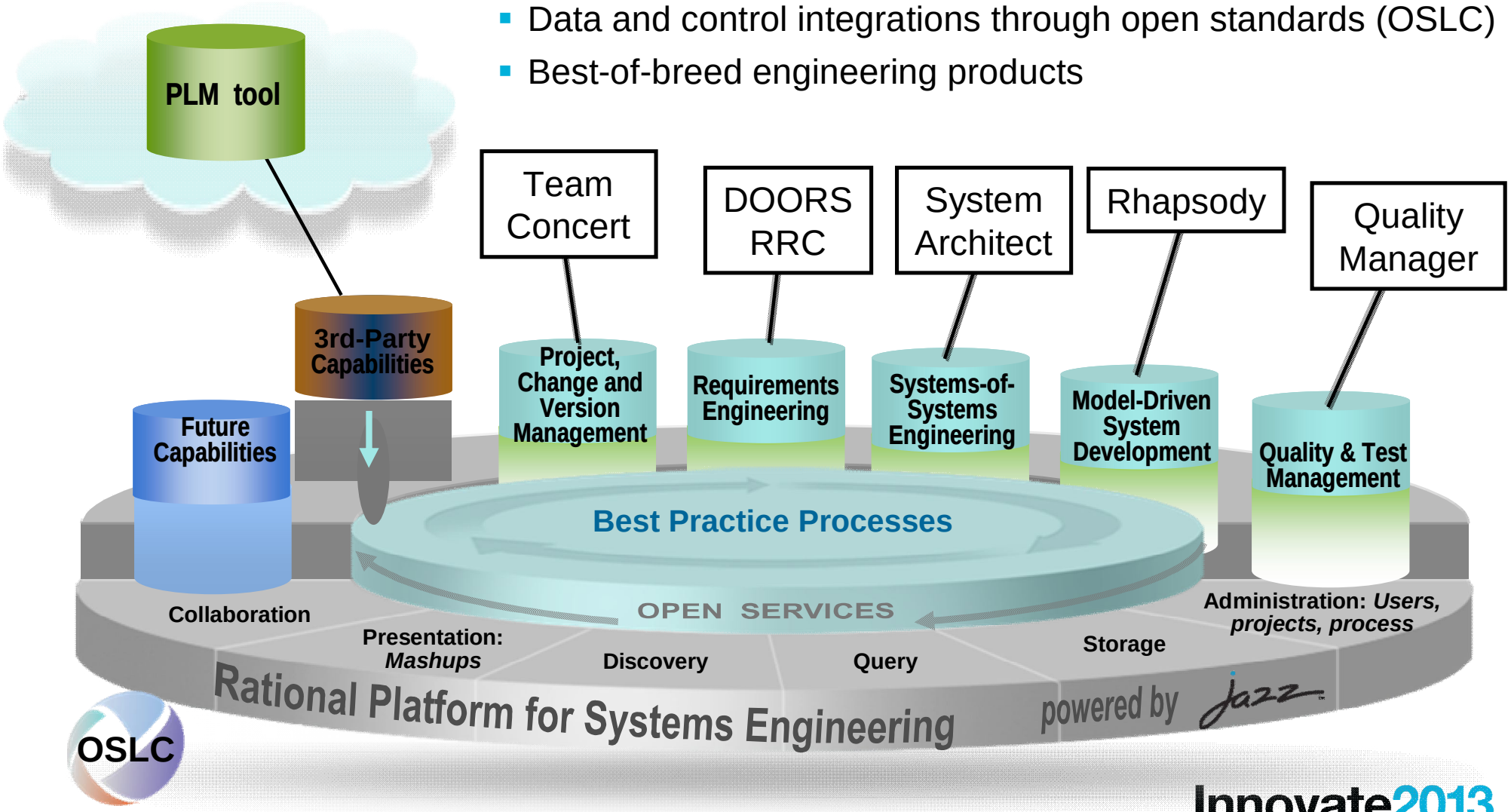
L’atelier Systems and Software Engineering (SSE)

- Set of advanced services for team collaboration, data management, security and process support
- Data and control integrations through open standards (OSLC)
- Best-of-breed engineering products



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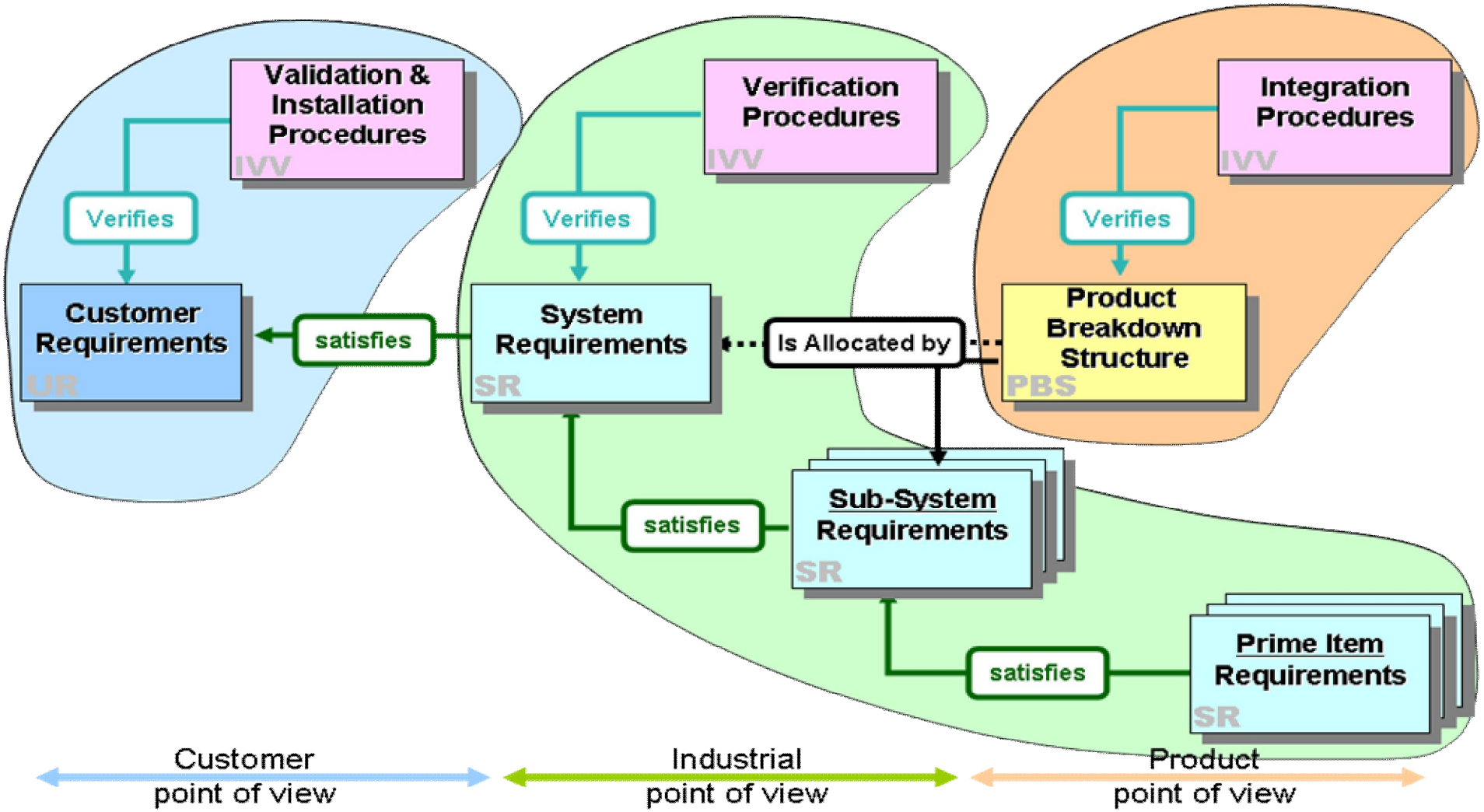
Gestion des exigences :
Utilisation de DOORS pour les systèmes complexes

- Modèle de données multi-niveaux avec traçabilité de bout-en-bout

➢ *Permet de maîtriser la complexité des systèmes de systèmes*



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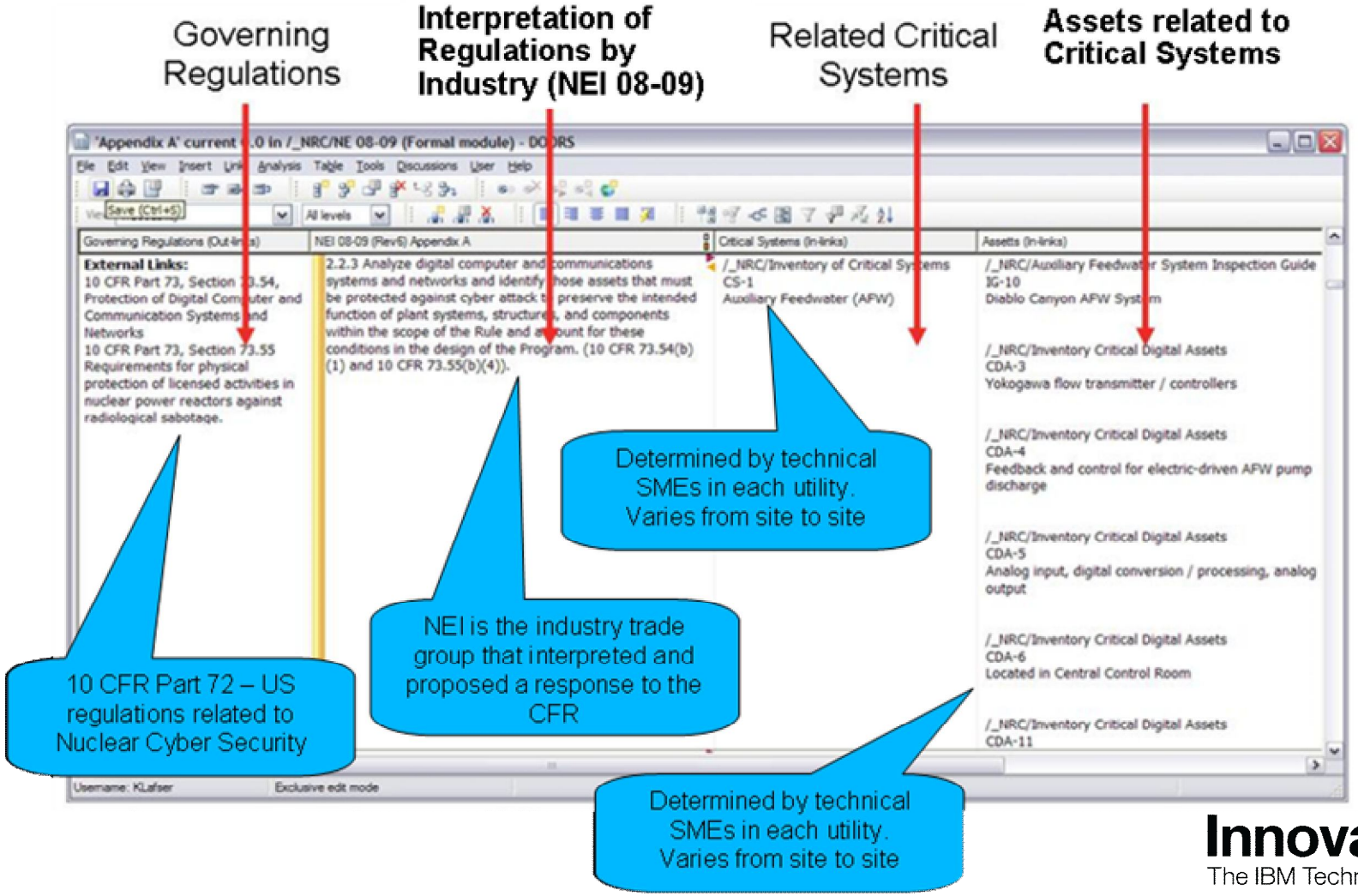
Gestion des exigences :
Utilisation de DOORS dans un contexte réglementaire

- Les règlements sont intégrés dans le référentiel DOORS en tant que modules
- La compatibilité avec les règles est spécifiée par un lien de conformité

➢ *Facilite l'audit et la certification ainsi que l'analyse d'impact*



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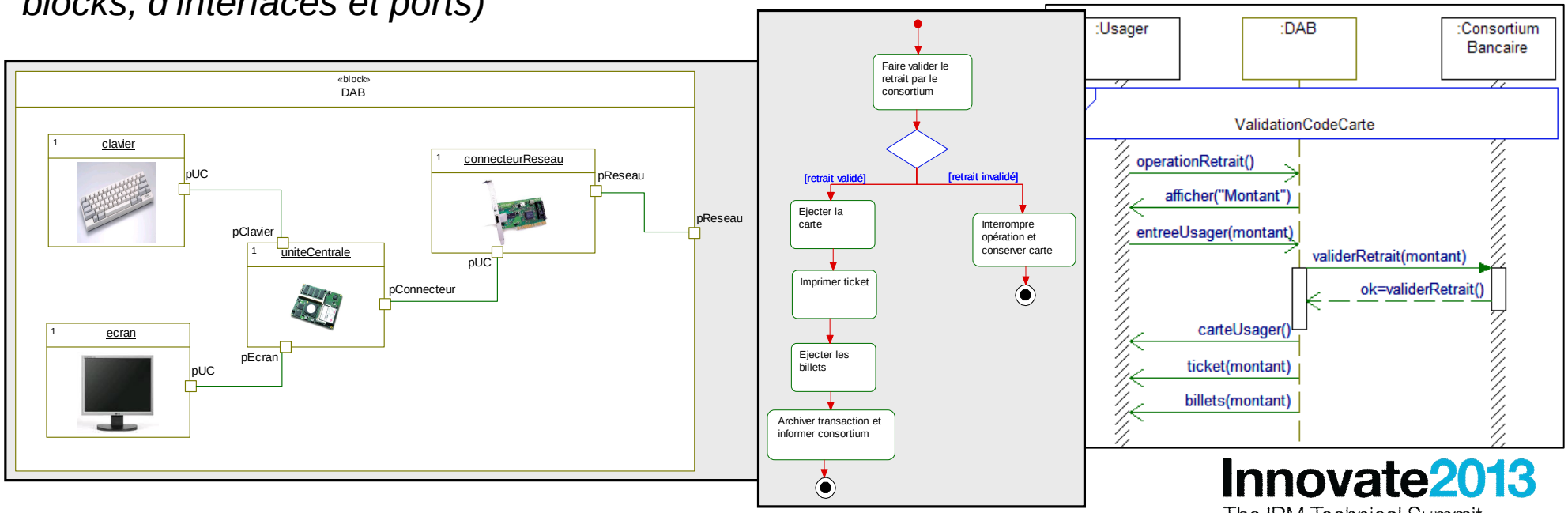
Model-Based System Engineering (MBSE) : Utilisation de Rhapsody pour la modélisation Système

- Utilisation de SysML comme langage de modélisation des architectures de systèmes
- Le comportement peut être décrit :
  - Par l'exemple au moyen de diagrammes de séquence
  - Exhaustivement au moyen de diagrammes d'états et diagrammes d'activité
  - Les modèles comportementaux (états, activités) peuvent être exécutés et peuvent ainsi être vérifiés par rapport à un comportement attendu (séquences)
  - Rhapsody va bientôt supporté le nouveau standard ALF de l'OMG – langage d'action neutre indépendant les langages de programmation

➢ *Facilite l'élaboration d'architectures modulaires évolutives (grâce aux concepts SysML de blocks, d'interfaces et ports)*



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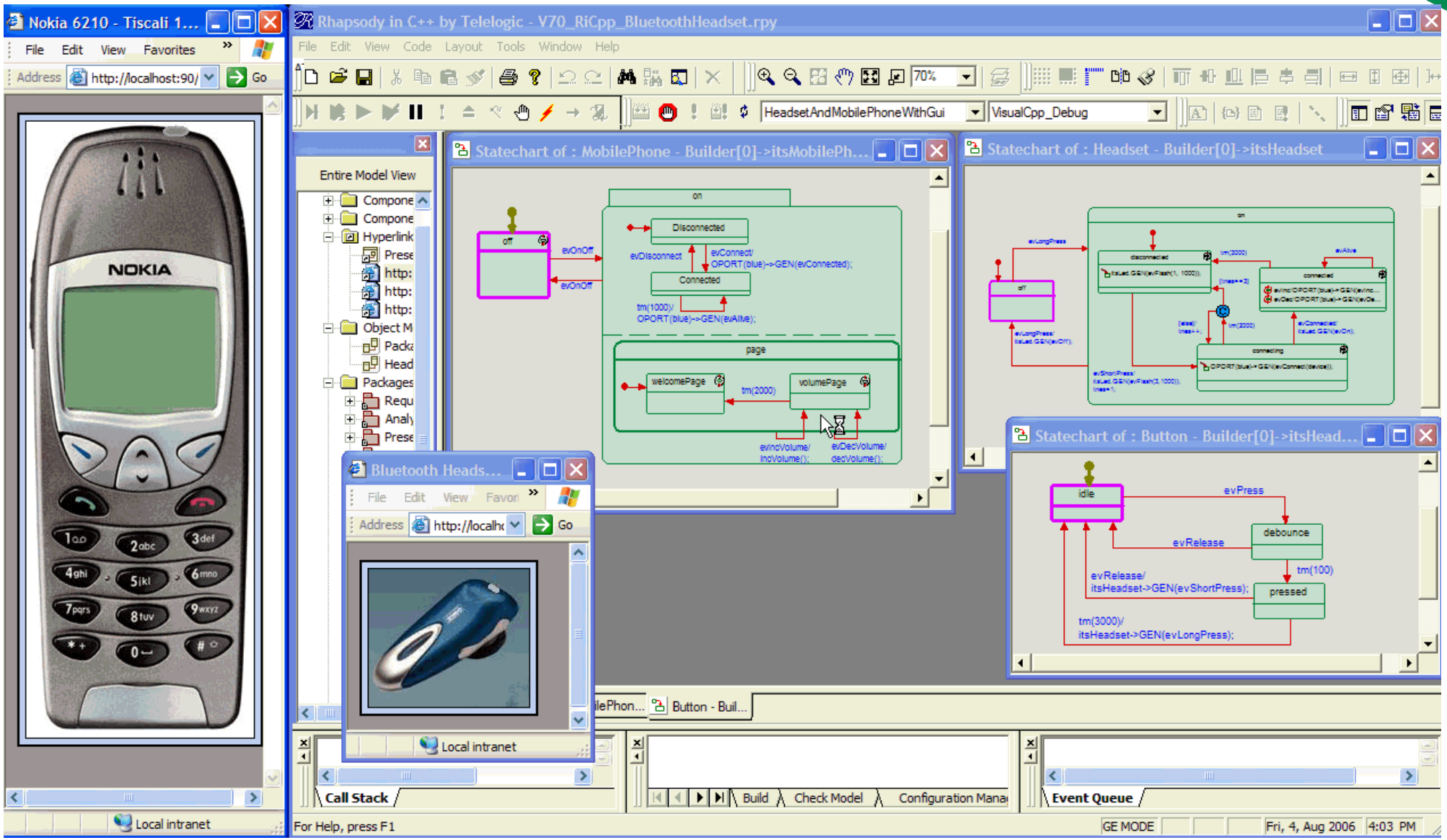
Model-Based System Engineering (MBSE) : Validation de systèmes réactifs avec Rhapsody



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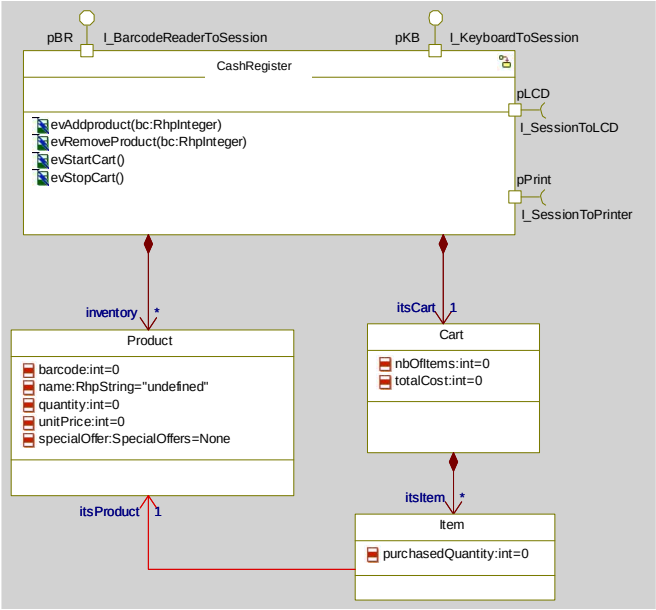
Model-Driven Development (MDD) : Utilisation de Rhapsody pour la génération de code

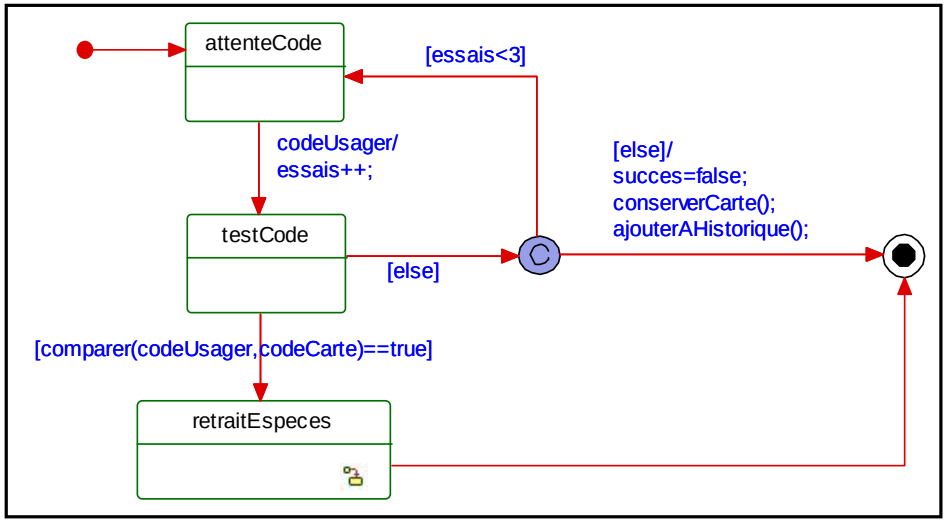
- Utilisation de UML comme langage de modélisation des logiciels embarqués
- Comme en SysML, le comportement peut être décrit au moyen de diagrammes de séquence, diagrammes d'états et diagrammes d'activité (algorithmique graphique)
- Les diagrammes de classe, d'états et d'activités) sont transformés en code lisible et exécutable

➢ Facilite la conception par composants (la conception est visuelle) et la réutilisation (concepts UML d'interfaces et de ports)

➢ Permet de tester le logiciel sur la machine hôte tôt dans le cycle de vie

➢ Facilite une approche agile par cycles courts itératifs





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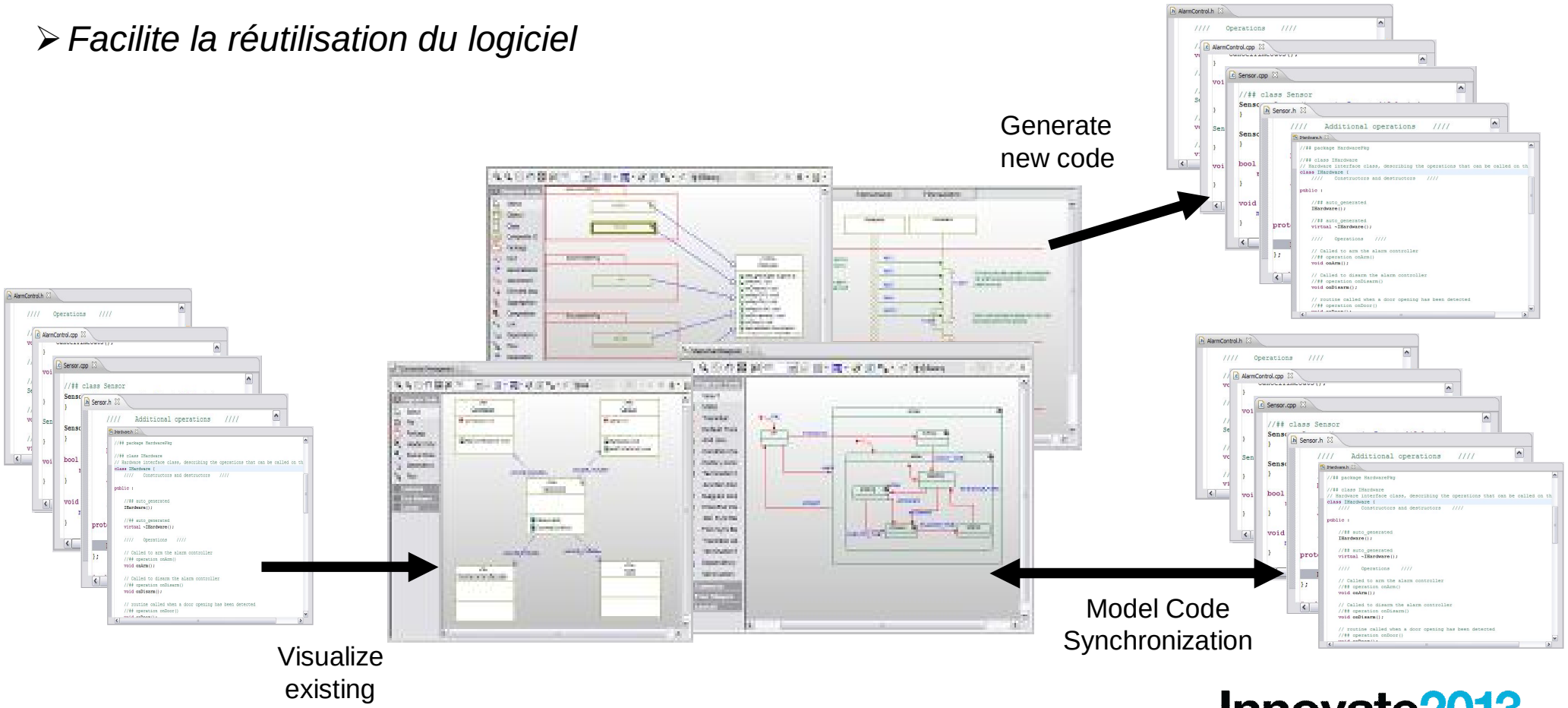
Model-Driven Development (MDD) : Utilisation de Rhapsody pour la génération de code

- Rhapsody inclut des générateurs de code pour les langages C, C++, Ada et Java
- Le simulateur de Rhapsody est utilisé ici pour faire la mise au point du modèle
- Les tests de non-régression peuvent être automatisés avec le module Test Conductor

➢ *Augmente la productivité et la qualité du logiciel*

➢ *Facilite la réutilisation du logiciel*

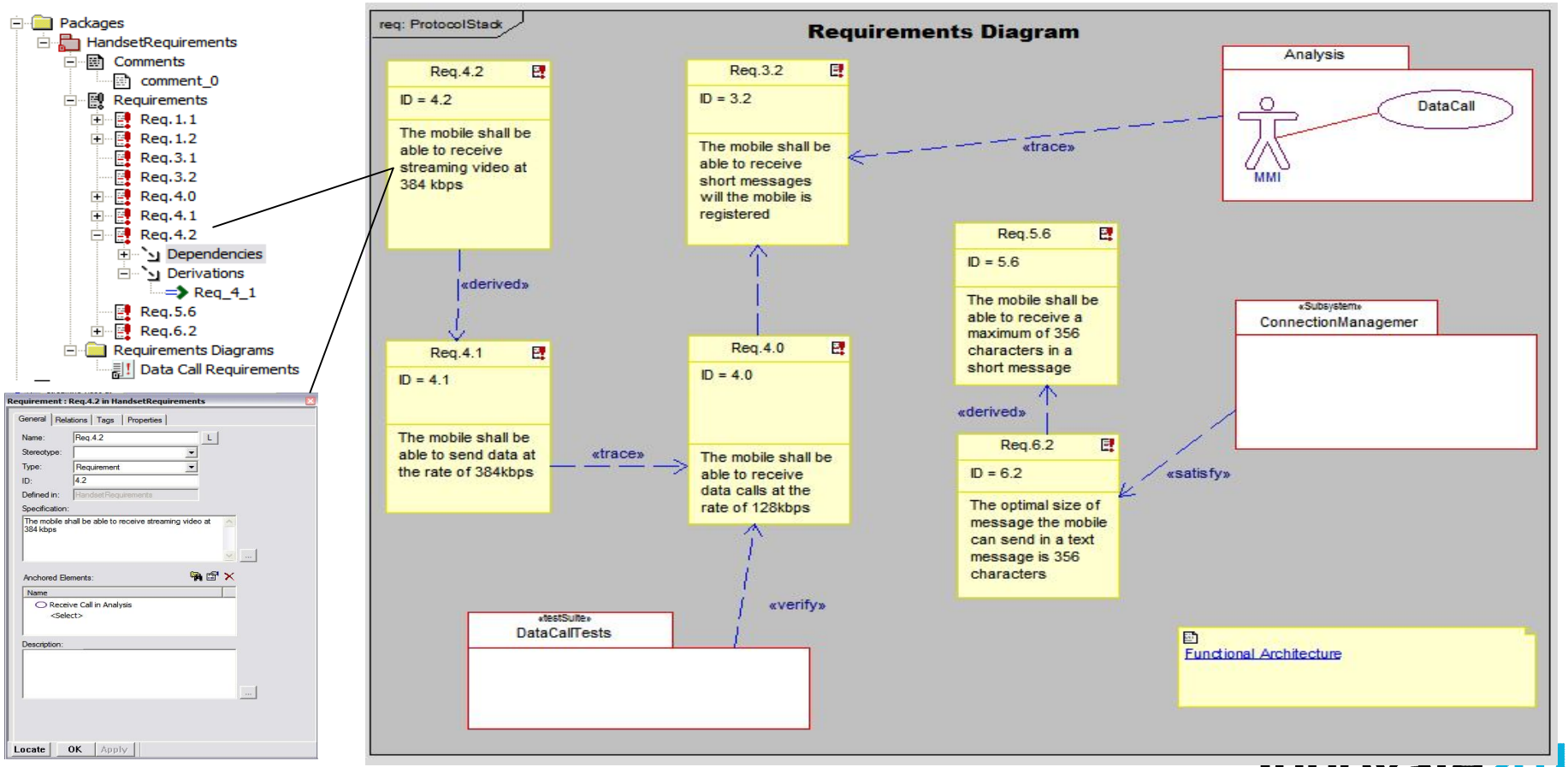


Approches MBSE et MDD :
Traçabilité avec l'analyse et la conception du système

- Les exigences peuvent être tracées sur les modèles d'analyse (use cases) et de conception (blocks, classes, interfaces…)

➢ *Permet de justifier l'architecture conçue*

➢ *Permet de vérifier que les exigences sont prises en compte*



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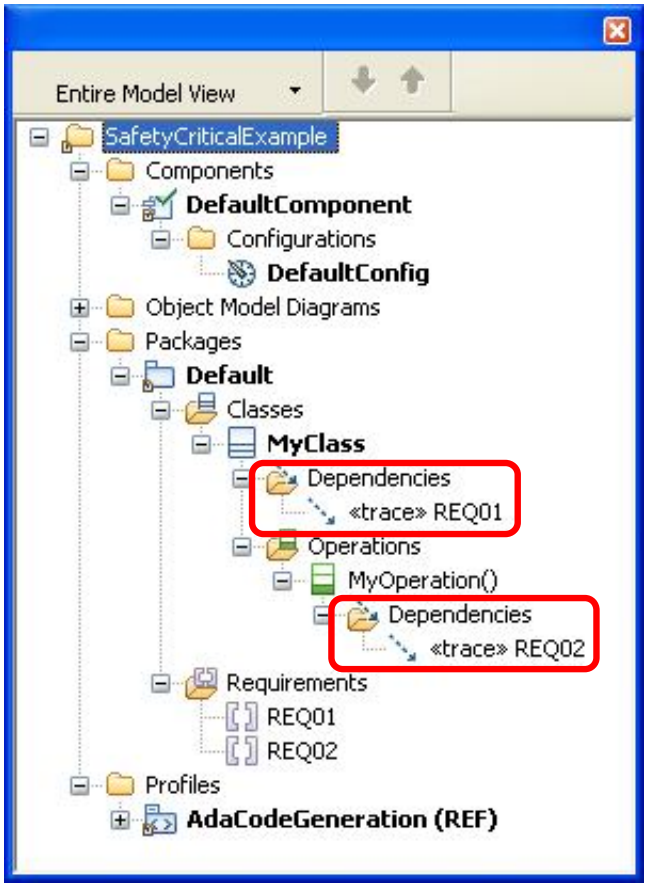
Approche MDD :
Traçabilité avec le code

- Dans une approche DOORS-Rhapsody pour le MDD, le code généré à partir du modèle UML peut être enrichi avec un retour aux exigences Systèmes
  - Code généré pour les classes, opérations et automates

➢ *Facilite la certification du logiciel*




```
--++ class MyClass
-- Realizes requirement REQ01 :
--    This is requirement 01
package MyClass is

  type MyClass_t;
  type MyClass_acc_t is access all MyClass_t;

  type MyClass_t is tagged null record;

  --Public Functions/Procedures section --------
  -- Realizes requirement REQ02
  --++ operation MyOperation()
  procedure MyOperation (this : in out MyClass_t);

private

end MyClass;
```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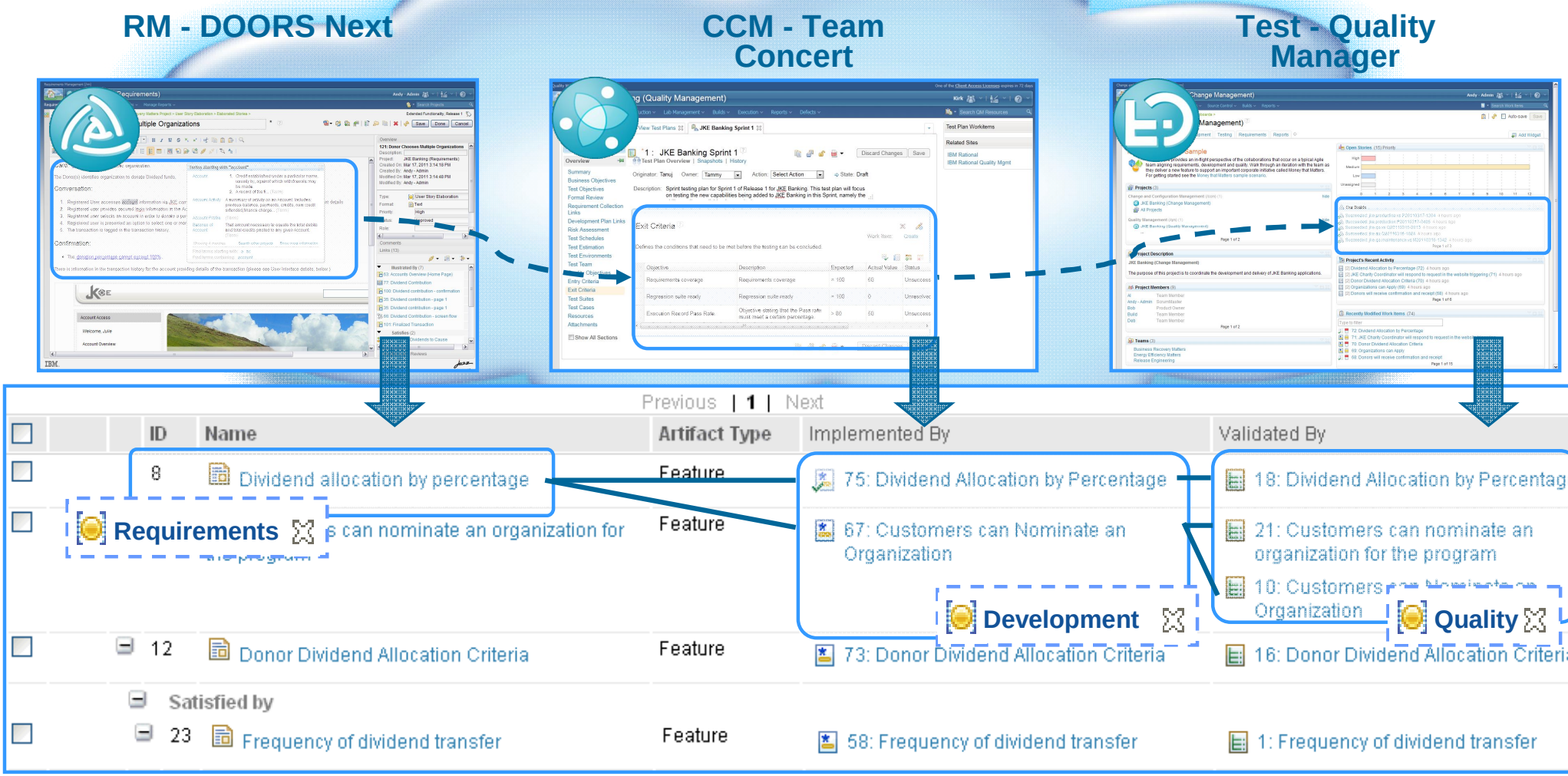
Traçabilité OSLC de bout-en-bout



Exemples d'utilisation des outils d'IS témoignés à Innovate US 2013

- Aeronautique-Espace-Défense
  - Raytheon :
    - RTC-RMC-DOORS-Rhapsody, SE-1567
    - DOORS-Rhapsody, SE-2327
  - Indian Navy : Harmony, SE-2285
  - Cassidian : Rhapsody et VAPS, AS-1298
  - Lockheed-Martin :
    - DOORS-Rhapsody, SE-1539
    - UML Action Language, AS-1625
  - Airbus Innovation Works : RELM, SE-1487
  - SAAB : MBSE, AS-1815
- Gouvernement
  - Atelier IS, SE-1751
- Automobile
  - GM : MBSE avec DOORS-Rhapsody, AS-1871
  - Jaguar Land Rover : DOORS-RTC-RQM (et Rhapsody) avec DS Enovia, SE-2576
- Transport
  - Alstom Transport: DOORS, SE-1383
- R&D Projects
  - DANSE : Europe, Rhapsody, SoS, UPDM, simulation multiphysique, SE-1535
- Initiative OSLC
  - SE-1976

A Process Makeover to Enhance Usability and Compliance

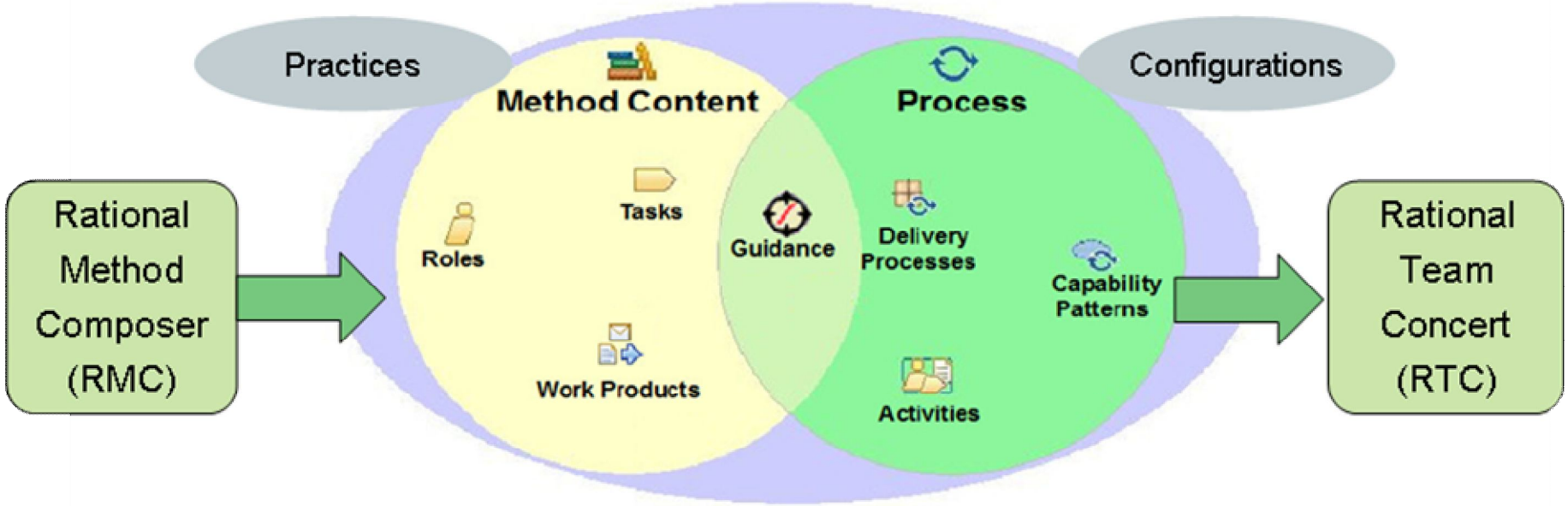
A Process Makeover
to Enhance Usability and Compliance

Lee Kappel
Engineering Fellow, Raytheon Company
Lee_J_Kappel@Raytheon.com
Stream: Team Directions
Track: Systems Engineering

Basic Concepts – Method Content, Process
Basis for Reuse

Stay ahead.

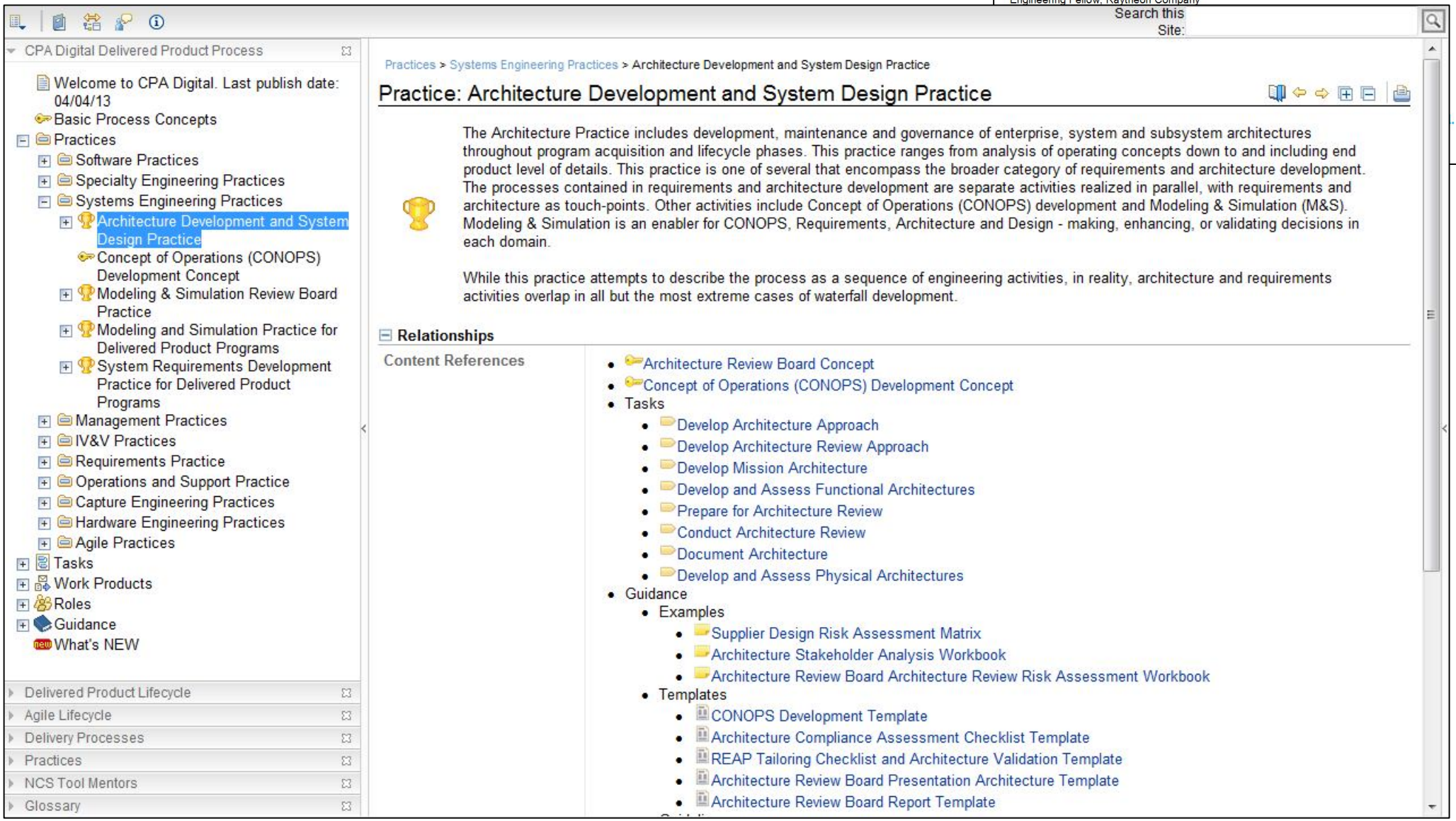
- Method Content **(Who, What, Why, How)**
  - Highly re-useable information
  - Definition of Roles, Tasks, Work Products and associated relationships
  - Includes Guidance and Categories
  - No timing information
- Process **(When)**
  - End-End sequence of Phases, Iterations, Activities and Milestones that define the development lifecycle.
  - Defines When tasks are performed via Activity Diagrams and/or Work Breakdown Structures



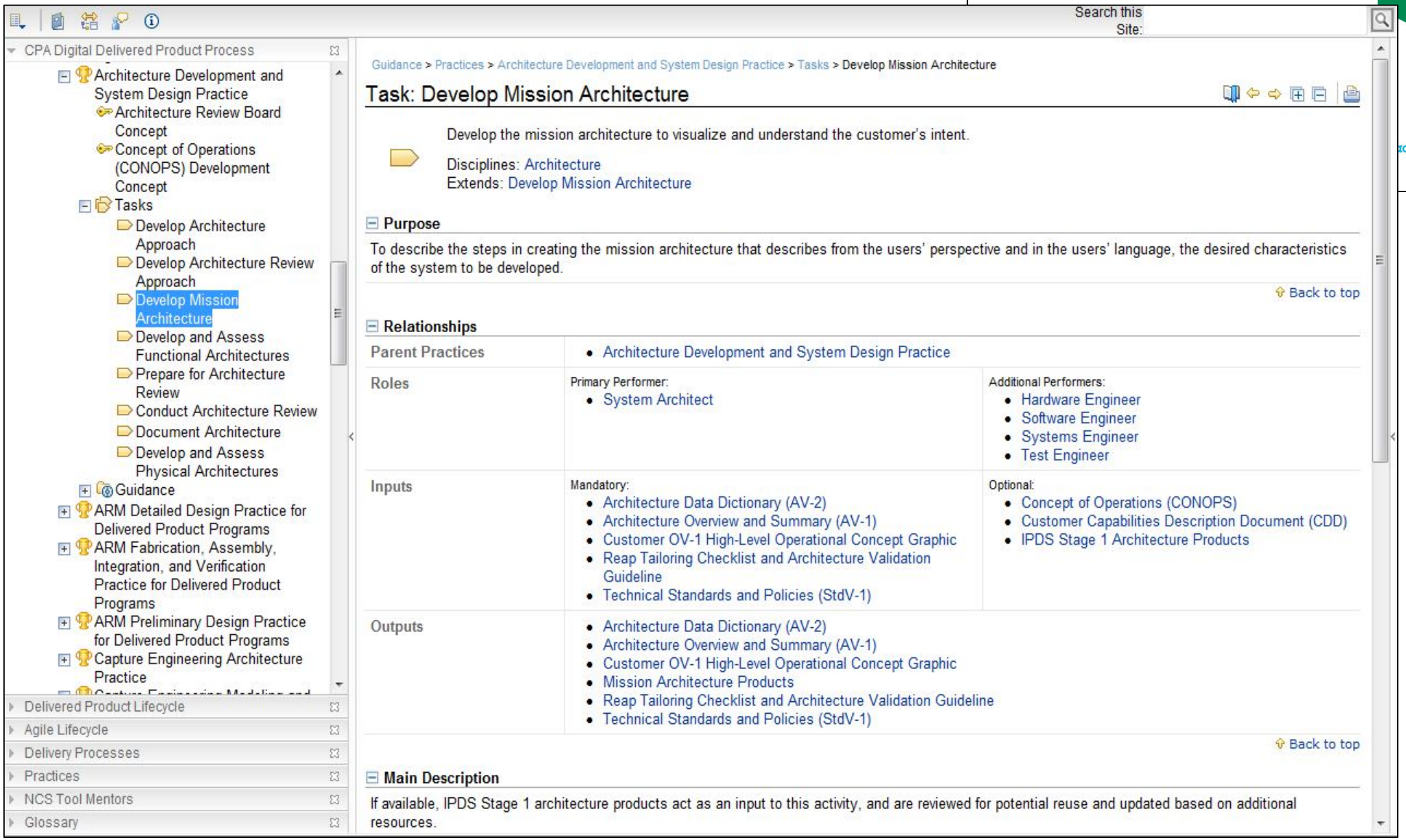
OMG Software & Systems Process Engineering Meta-Model Specification (SPEM) V2.0
http://www.omg.org/spec/SPEM/2.0/PDF

A Process Makeover to Enhance Usability and Compliance
Example of a Practice

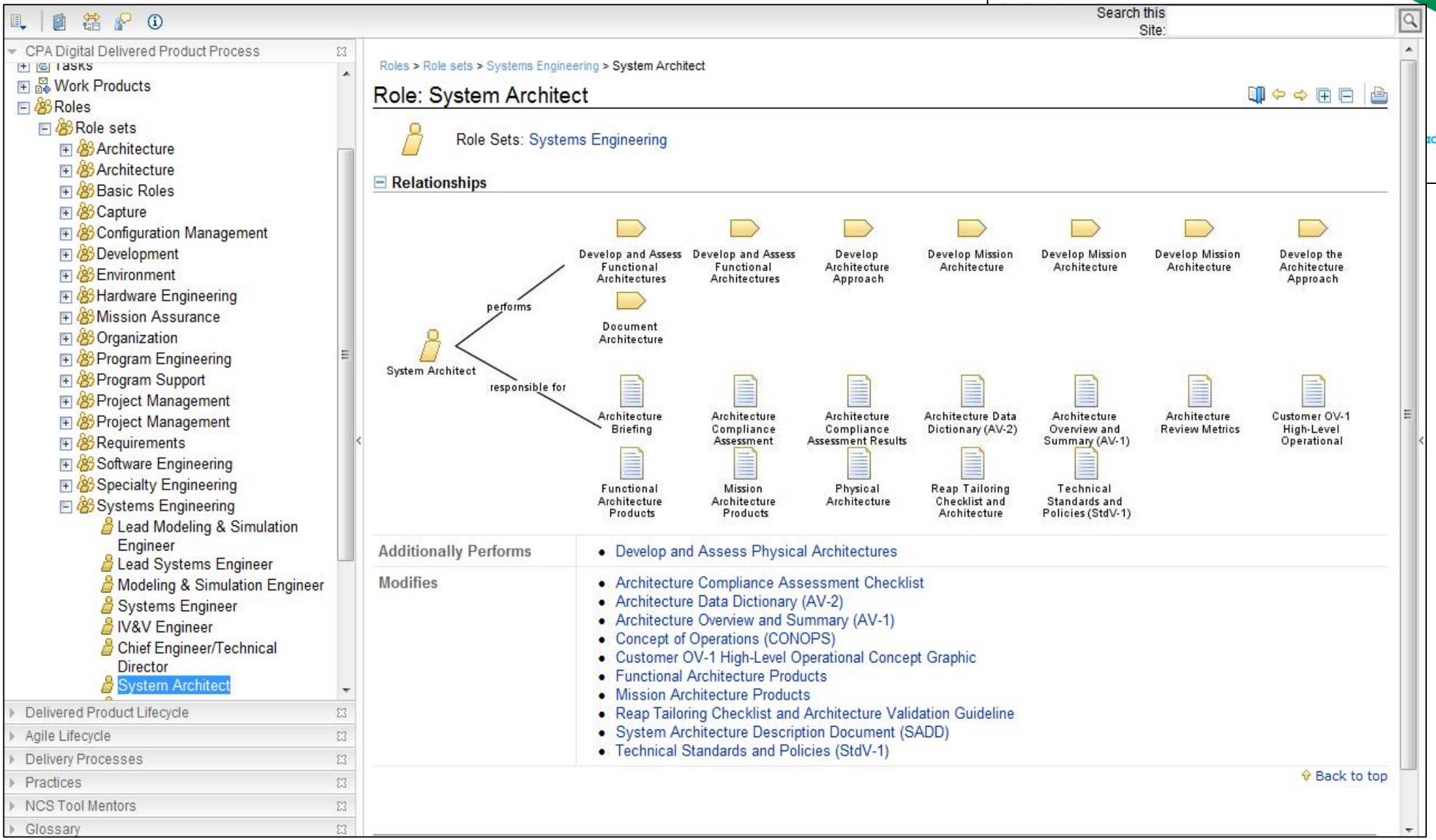
Lee Kappel
Engineering Fellow, Raytheon Company



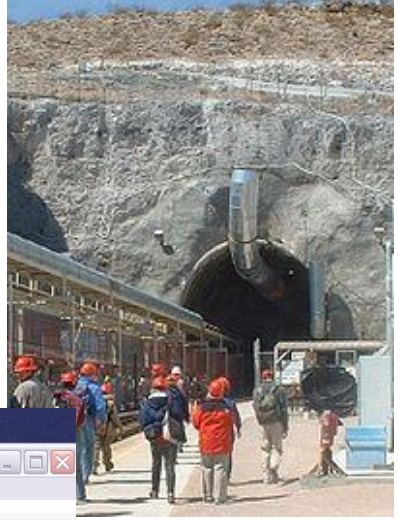
A Process Makeover to Enhance Usability and Compliance
Example of a Task



A Process Makeover to Enhance Usability and Compliance
Example of a Role



US Department of Energy (DOE) - Yucca Mountain Repository



Develop a national site for spent nuclear fuel & high-level radioactive waste storage.
Project lead by a consortium of government contractors, URS Corporation, Shaw Corporation and Areva Federal Services LLC.

The program used ***Rational's DOORS*** product to develop an extensive requirements database to track and manage an extremely broad range of program and regulatory requirements ranging from US CFRs to Contract Requirements.

Requirements in ~20 areas managed with DOORS

Emergency Mgt.

Safety and Heath

Safeguards & Security

Integrated SW Systems Engineering
Based on Rational Harmony for Systems Engineering

Faster Indigenous Navy Systems fueled by MBSE

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Session Code 2285

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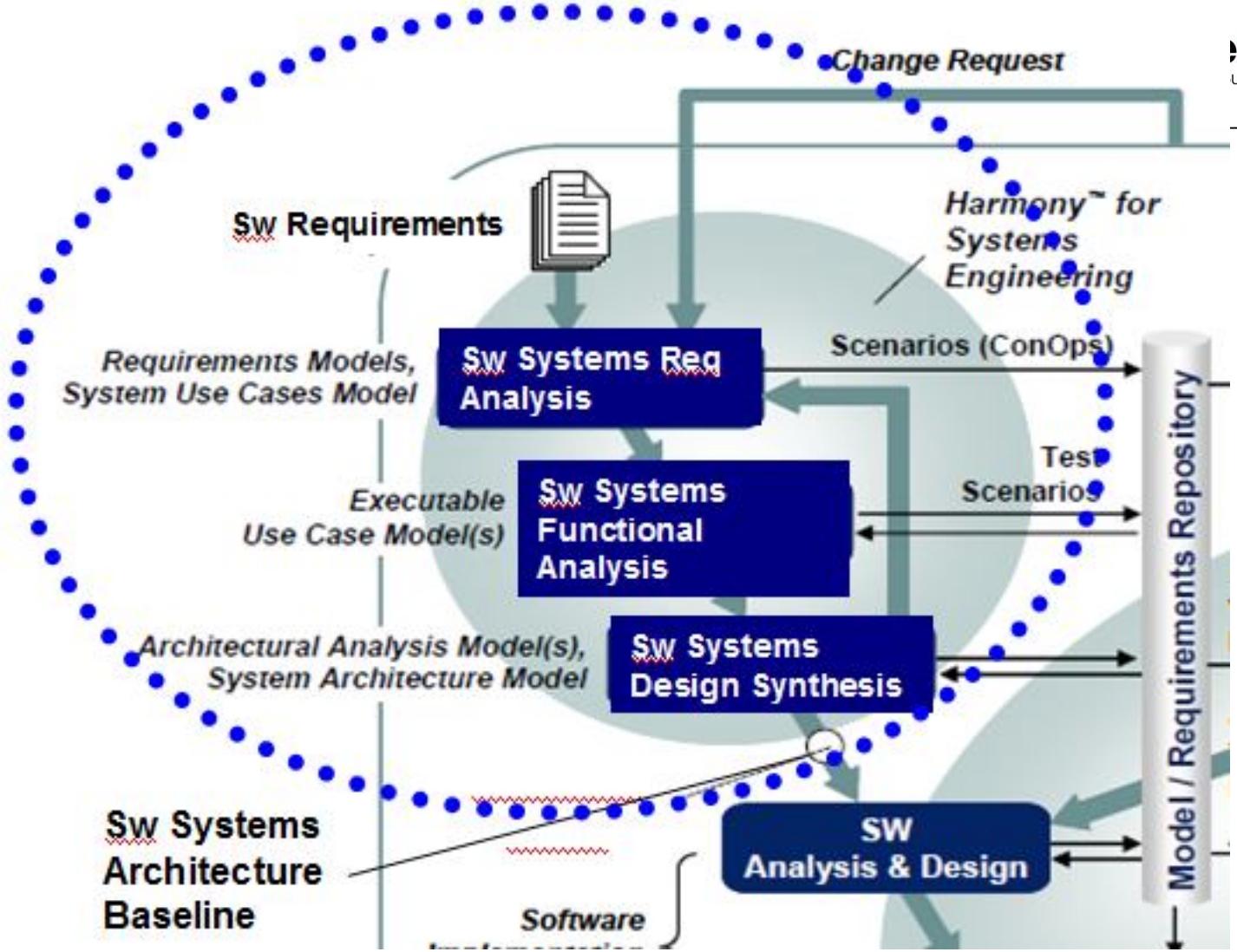

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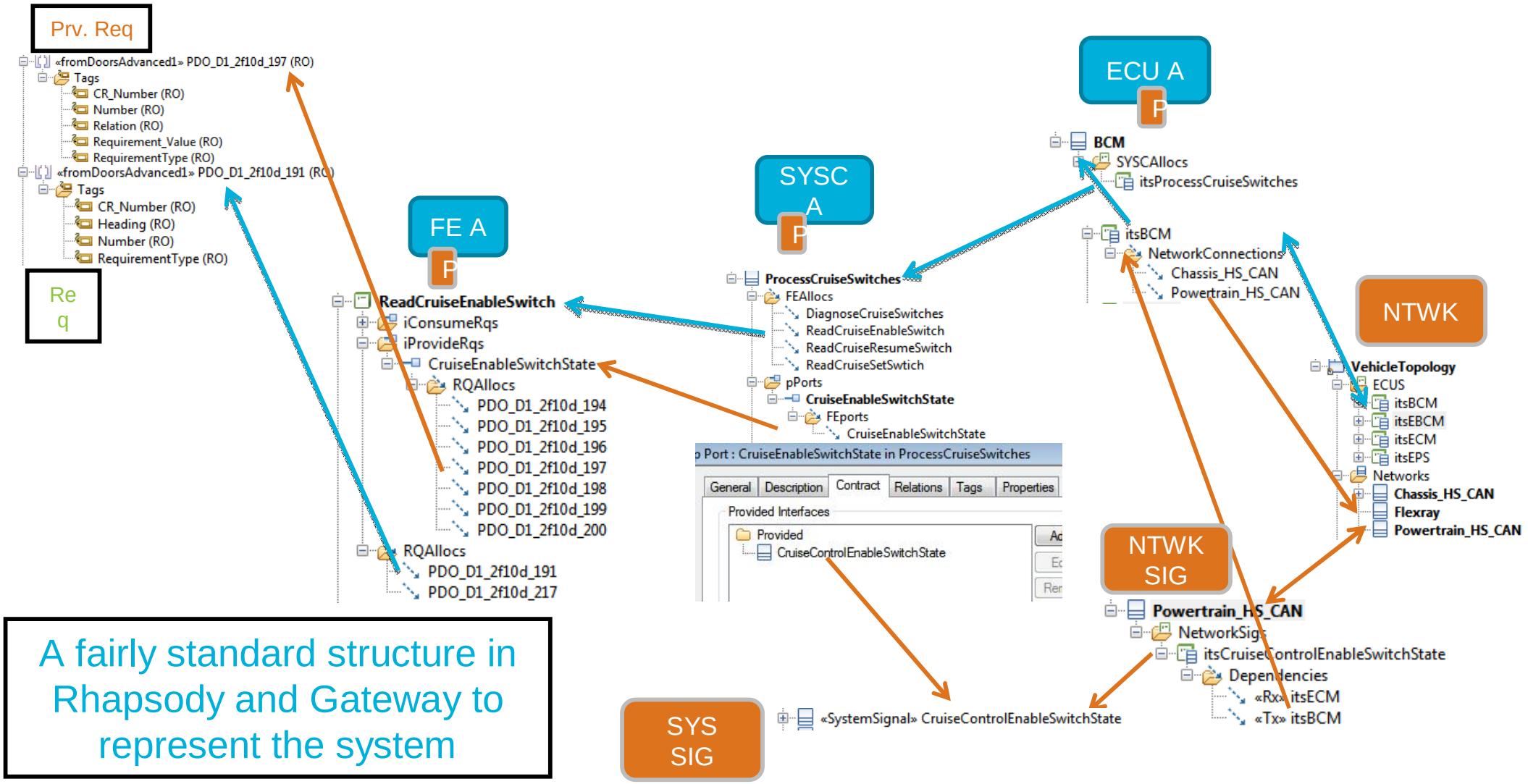
SW Systems Engineering Correlated to Systems Engineering

Systems Engineering (SE) Phase	Sw Systems Engineering (SSE) Phase	Description (Key Aspect)
Requirement Analysis	Sw Req Analysis	The inputs to this phase in SSE are requirements allocated to Software compared to Stakeholder Requirements of SE. The output of this phase in SSE are Sw System Requirements and Sw System Use Case Model.
System Functional Analysis	Sw System Functional Analysis	The inputs to this phase in SSE are Sw System Use Cases compared to System Use Cases of SE. The output of this phase in SSE are Sw System Operations, Executable Sw Use Case Models and Sw Use Case black-box scenarios.
Architectural Analysis	Sw System Architectural Analysis	The output of this phase in SSE are Sw System Architecture compared to System Architecture of SE. The Block Definition Diagram of SSE consists of S/w Subsystems, compared to hardware, electrical, software, .. Block in SE.
Architectural Design	Sw System Architectural Design	The focus of this phase in SSE is on allocation of Sw System Operations to identified Sw Subsystems compared to allocation of System Operations to Subsystems based on engineering disciplines in SE.
Architectural Detailed Design	Sw Architectural Detailed Design	The focus of this phase in SSE is on is on the definition of the ports and interfaces and on creation and validation of state-based behavior of the system blocks at the lowest level of the architectural decomposition.
Handoff	Sw Subsystems Handoff	The suitable handoff to s/w subsystems development in SSE consists of key artifacts namely baselined executable models of s/w subsystems, subsystem level ports & logical interfaces, test scenarios and allocated functional, non-functional and performance requirements.

Benefits Realized

- Quantitative
  - 60% reduction in overall Development Schedule and Cost
    - attributed to upfront validation of system behavior
  - 80% Reduction in Integration issues/defects
    - attributed to precise definition of logical interfaces of sw subsystems.
  - 80% reduction in ramp-up time of new officers and scientists
    - attributed to scientifically written system requirements, visual representation of system architecture and dynamic/runnable system behavior models
- Qualitative
  - Set a benchmark and precedence in Indian Defense systems development entities
  - Easy and unambiguous to view and audit Sw Systems Architecture and Behavior
  - Teleological questioning led to Systemic Thinking
  - The Navy Officers involved confident to repeat the workflow in other projects.

Requirements-Functions-Components

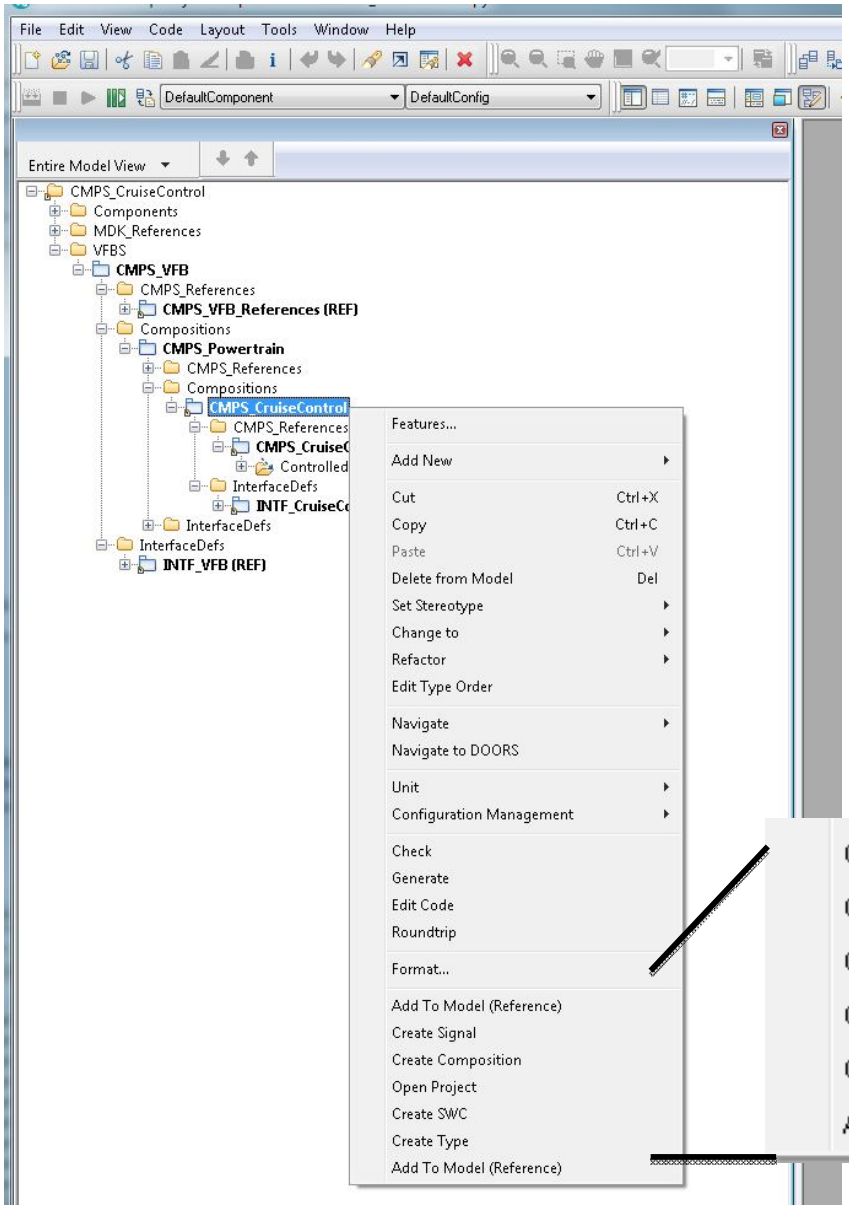


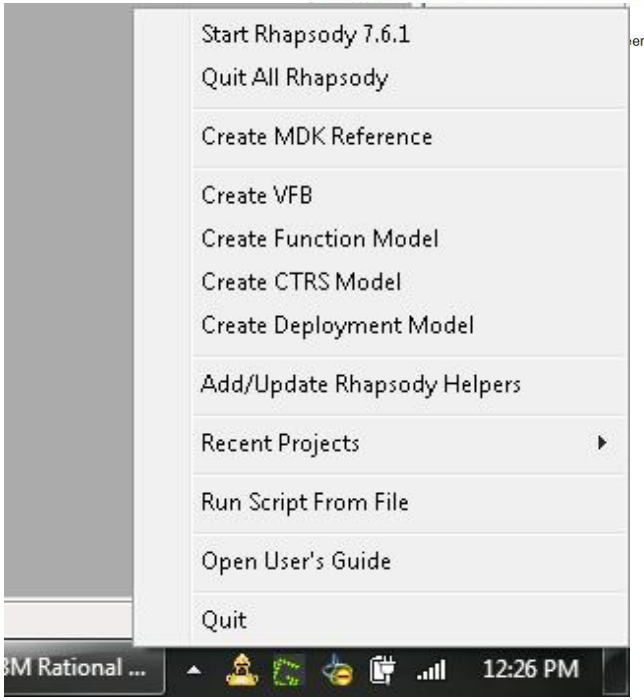
A fairly standard structure in Rhapsody and Gateway to represent the system

GM Model Development Kit (MDK)

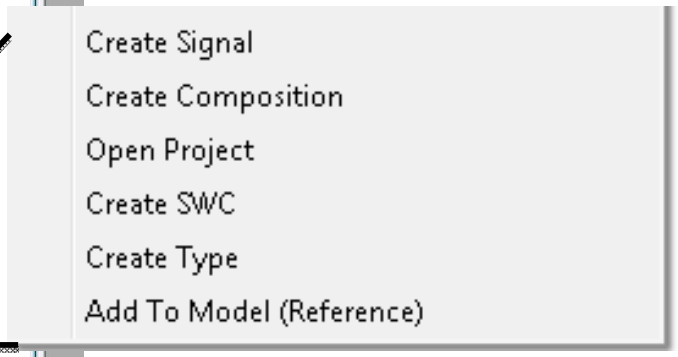
- The GM MDK is a toolkit composed of modeling 'Profiles' and a set of 'Scripts' that abstracts the engineers from the complexity of model element creation and maintenance based on GM's defined architecture.
- Profiles
  - Contain terms used in our architecture that are applied to the model elements for quick identification, grouping or filtering.
  - GM makes extensive use of the Rhapsody "Term" capability to allow engineers to work in our terminology instead of native UML
- Scripts
  - These are model element context-based applications written in Java that use the Rhapsody API to manipulate model elements. The scripts have a User Interface for information entry and a corresponding logic that runs the script.
  - An example of a script is 'Create Signal'. A signal is composed of several model elements that have interconnected relationships. The script ensures that these elements and relationships are created properly and the proper term (Profile) applied.
- The GM MDK is installed using a Windows installer and runs as a stand alone application.
- Total of ~2.5 man years development effort (requirements → test → deployment)

GM Rhapsody MDK





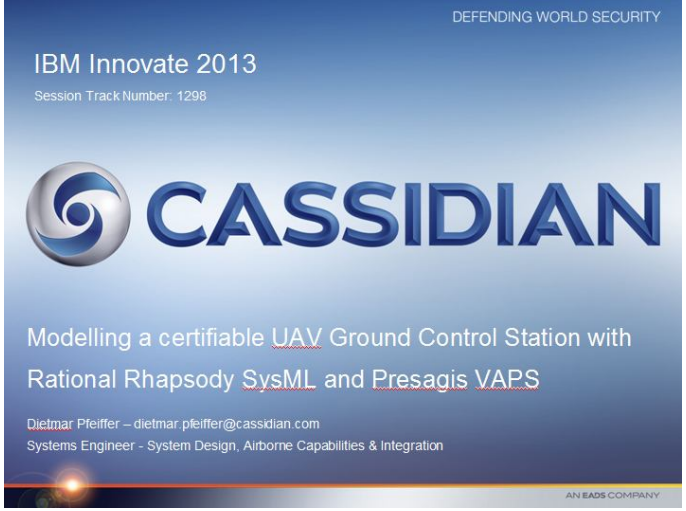
Notification Area Menu



Context Menu Extensions

Methods and Toolset

GCS : Ground Control Station



GCS Concept - document based

General Principles, Trade Offs,
Hardware Issues, Operational Concepts

GCS Definition - model based

HMI Model

Presagis VAPS XT

(options: Qt, Rhapsody, Altia, ...)

- Reuse of available libraries
- Experienced users
- Verification through execution
- Certifiable code possible
- Reuse of model during later implementation

Interface (optional)

Functional Systems Model

IBM Rational Rhapsody

- SysML with Harmony SE toolkit
- Reuse of model elements from earlier UAV use cases
- Experienced users
- Verification through execution
- In-house guidelines available
- System requirements in Word

DEFENDING WORLD SECURITY

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Session Track Number: 1298

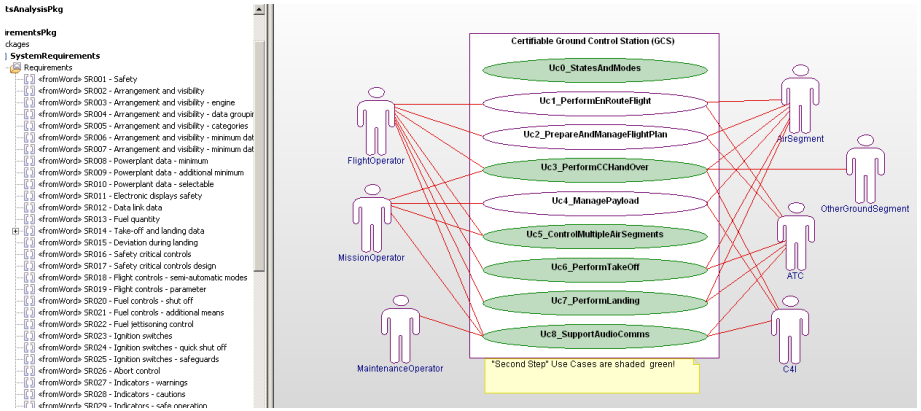
CASSIDIAN

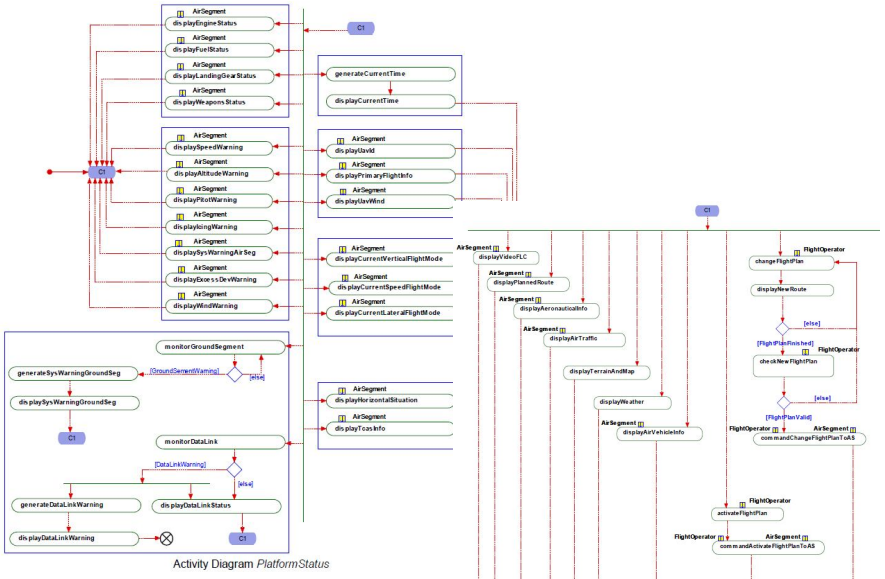
Modelling a certifiable UAV Ground Control Station with Rational Rhapsody SysML and Presagis VAPS

Dietmar Pfeiffer – dietmar.pfeiffer@cassidian.com
Systems Engineer - System Design, Airborne Capabilities & Integration

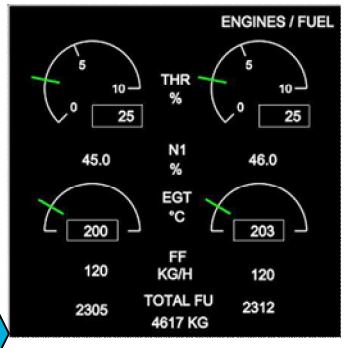
AN EADS COMPANY

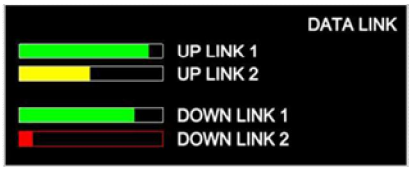
SysML Model in Rhapsody

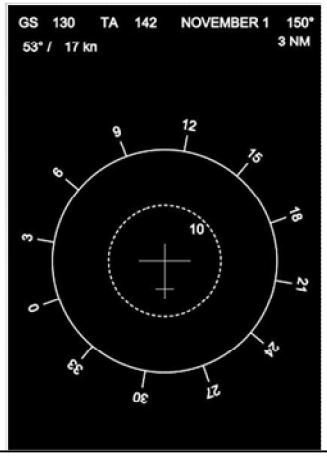




HMI Model in VAPS







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Conclusion, tendances

- Les valeurs sures
  - Gestion formelle des exigences (en général avec DOORS)
  - UML pour la modélisation, mais complété avec d'autres techniques comme Simulink, Modelica et le maquettage 3D (CATIA)
  - UPDM et DoDAF pour les systèmes de systèmes et la Défense
- Pratiques en cours de généralisation
  - Formalisation des processus
  - MBSE avec allocation Exigences-Architecture
  - Multi-disciplinarité, communication entre outils, ouverture, OSLC
  - Simulation avec IHM graphiques
- Besoins émergents
  - Connexion avec le PLM
  - Simulation multi-physique
- N'apparaissent pas comme des besoins immédiats
  - Génération de code assistée ou automatisée

Questions

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