



IBM Rational Software Conference 2009
As Real as It Gets!



Product Lifecycle Management

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Rational. software

Agenda

- Tendencias, retos y estado actual de la industria
- Plataforma Rational para PLM



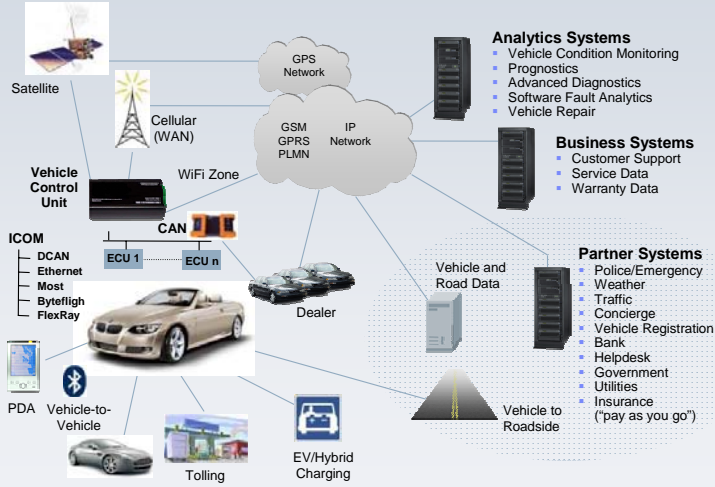
Agenda

- Tendencias, retos y estado actual de la industria
- Plataforma Rational para PLM



Tendencias en la industria

Sistemas cada vez más complejos: sistemas de sistemas



Desarrollo y construcción distribuida

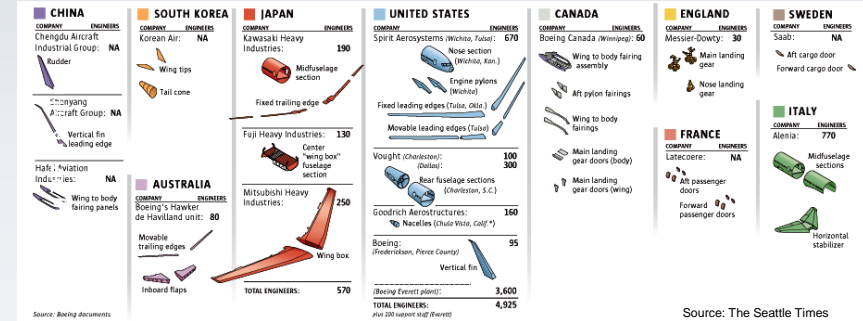
Boeing Commercial Aircraft: 787 Development Program



Number of parts: 6 million
Peak number of suppliers: 2,600

Who makes the parts and where the engineering jobs are:

Boeing 787: # of engineers are 2005 projections and may not include all engineering specialties. Production workers are not included.



Cada vez más software, y cada vez más importante...

1968

e.g. VW Squareback



- Fuel injection
- Manifold pressure control
- Digital clock

1983

e.g. Chrysler Imperial



- Ignition
- Engine controls
- Instrumentation

1995

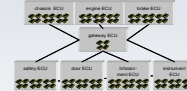
e.g. Honda CRX SI



- Engine management
- ABS
- Digital dashboard
- Electronic seats / doors
- Automated climate control
- Safety sensors

2008

e.g. BMW 7 Series Sedan



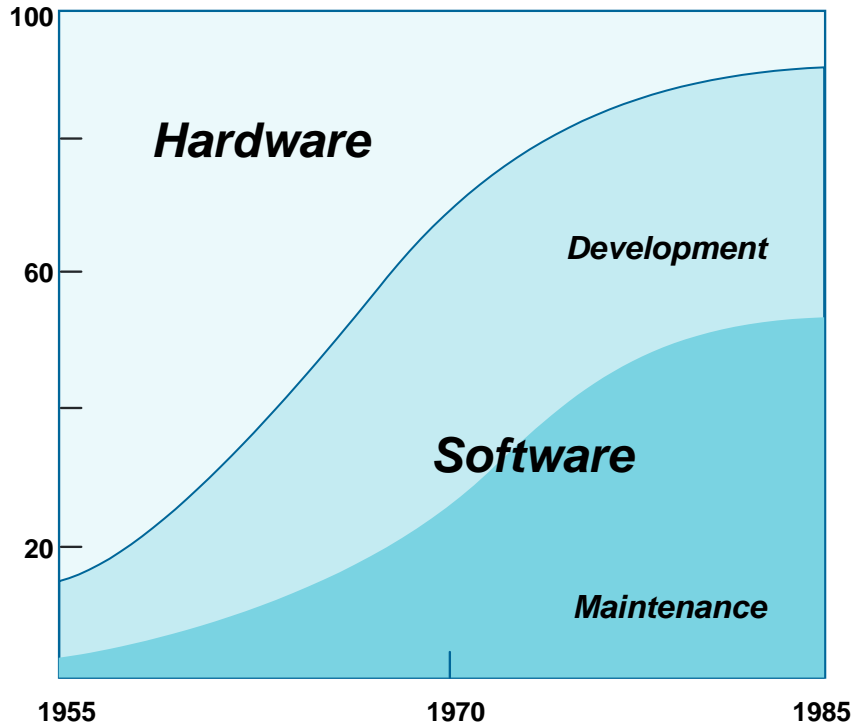
- Dynamic Damping Control
- Brake Energy Regeneration
- Integral Active Steering
- Electrically controlled air vents
- Night Vision
- Lane Departure Warning
- Lane Change Warning
- Adaptive Headlights
- Head-Up Display
- Active Cruise Control
- Camera systems
- Driver assistant systems

Platform	Year	% of Specification Requirements requiring SW Control
F-4	1960	8%
A-7	1964	10%
F-111	1970	20%
F-15	1975	35%
F-16	1982	45%
B-2	1990	65%
F-22	2000	80%



El software ha incrementado su presencia e importancia hasta diez veces en los últimos años...

Relative Distribution of Software/Hardware Costs
(Percent of total cost)



Platform	Year	Percent of Specification Requirements Requiring Software Control
F-4	1960	8%
A-7	1964	10%
F-111	1970	20%
F-15	1975	35%
F-16	1982	45%
B-2	1990	65%
F-22	2000	80%

Source: Software Engineering, IEEE Transactions on Computers December 1976

Source: The Australian Software Acquisition Management Course, Defense Systems Management College, March 2000



Fallos en el software pueden ser dramáticos en sistemas complejos

Agencia Aeroespacial

Prototipo de cohete de \$1B se autodestruyó 40 segundos después de despegar por un error en el software del sistema de teledirección



F-22, línea de cambio de fecha

Todos los sistemas de software dejaron de funcionar cuando el F22 pasó sobre la línea del cambio de fecha en un vuelo de prueba



Constructor de automóviles

Sensores de lluvia no funcionales por incompatibilidad entre el sensor y el grosor del limpiaparabrisas



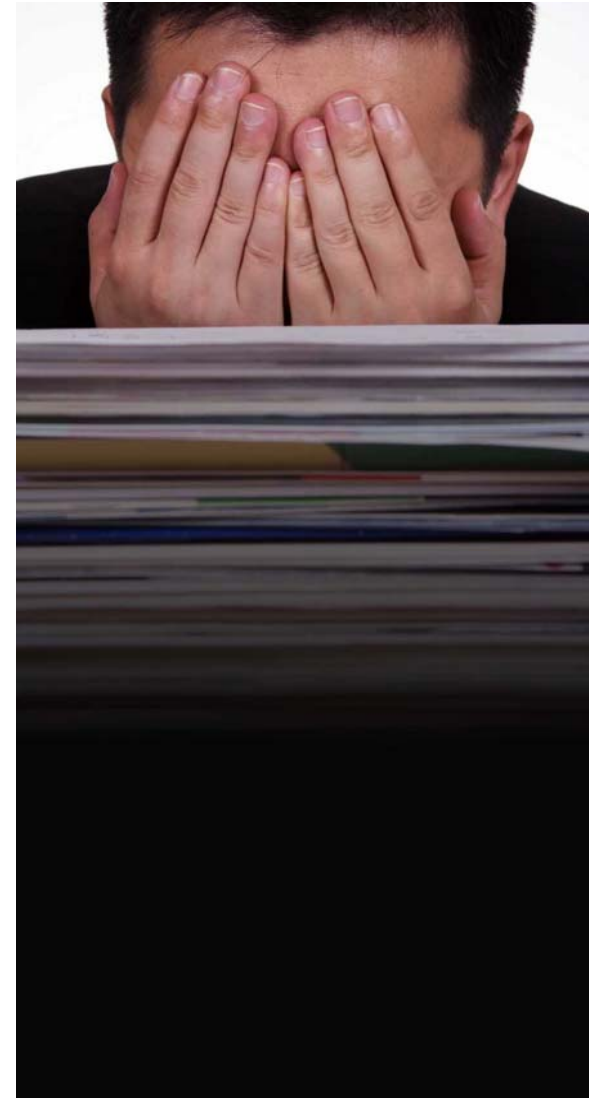
Microsoft Zune

1 millón de usuarios se levantaron una mañana y su dispositivo mp3 no funcionaba. El software no era capaz de manejar el día extra del nuevo año bisiesto



Retos en el desarrollo de sistemas en la actualidad

- La **complejidad** de los productos es cada vez mayor: sistemas de sistemas
- La **construcción** de los productos cada vez se encuentra más **distribuida**
- Cada vez **más software** y desempeñando un papel **más importante**
- Tradicionalmente **falta de comunicación entre disciplinas**: ingenieros de sistemas, ingenieros mecánicos, ingenieros eléctricos, ingenieros de software, ...
- Gestión de **cambios** globales
- Se requieren productos cada vez de **mayor calidad** y **libres de fallos** (integridad de las personas)
- El desarrollo de productos está cada vez **más regulado**. Cumplimiento de normativas y estándares, demostración de evidencias



Agenda

- Tendencias, retos y estado actual de la industria
- Plataforma Rational para PLM



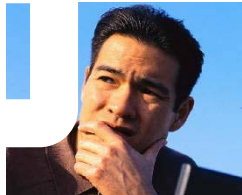
El equipo piensa como mejorar ...

"Si tuviera una única vista de los requisitos del producto, su evolución en desarrollo sw y construcción del hw correspondiente y como se validan, tendría un control total sobre el desarrollo del producto "



Jefe de proyecto/programa

Ingeniero de sistemas



"El producto es cada vez más complejo, necesitaría diseñar su arquitectura de una manera entendible por todos los ingenieros de forma que se represente claramente todos los componentes sw y hw del sistema, su interconexión y cómo satisfacen los requisitos del sistema"

"Si detectase errores en el diseño de la arquitectura del sistema durante su elaboración, evitaría el alto coste de arreglarlo si se detecta cuando el sistema esté construido"

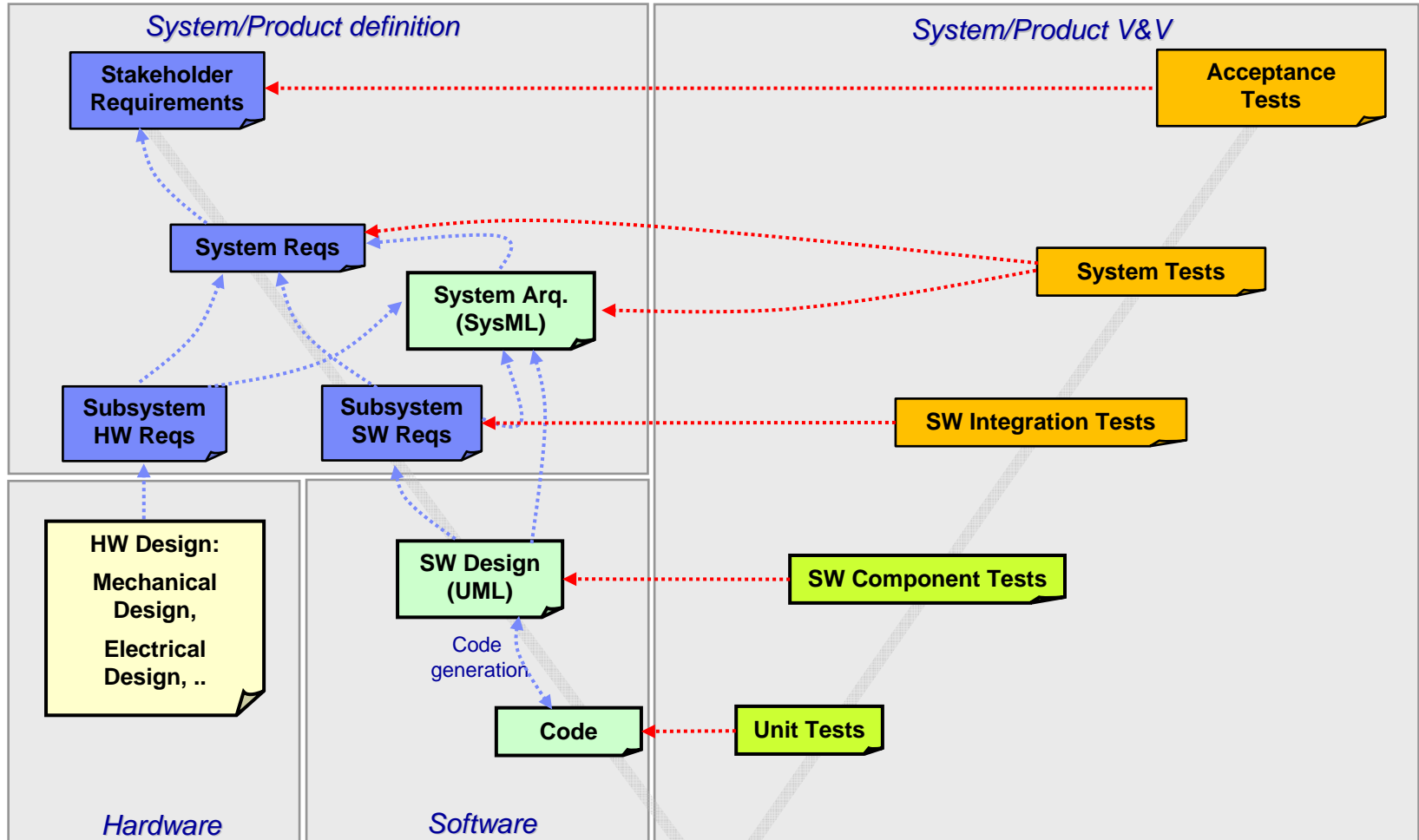
"Los cambios en un componente eléctrico puede requerir cambios en el software o en un componente mecánico. Necesito coordinar los cambios a nivel de producto, no sólo a nivel aislado por disciplina"



Responsable del control de cambios,
miembro del CCB

Plataforma para desarrollo de sistemas (I)

Definición, Desarrollo, Construcción y Verificación & Validación

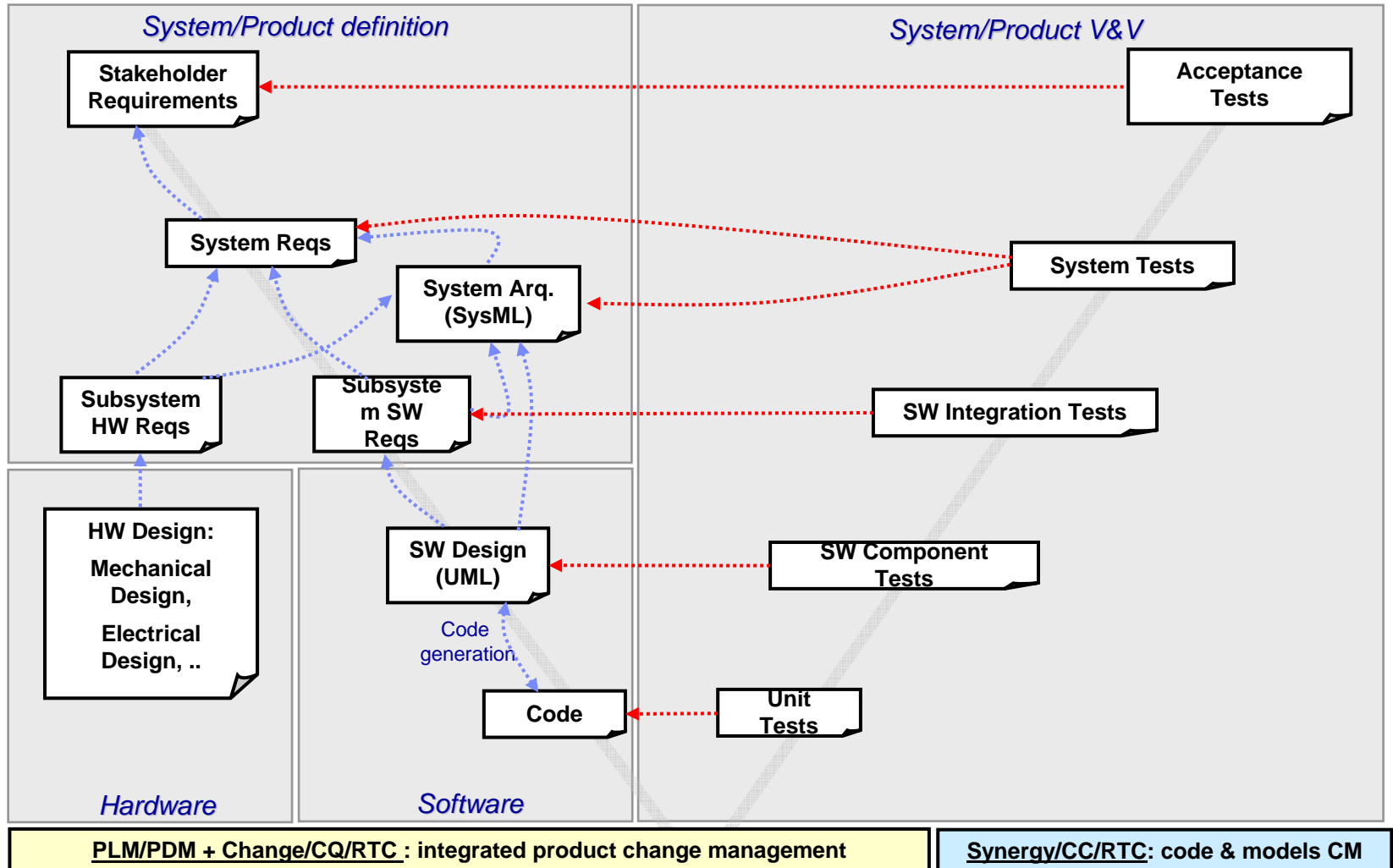


Rational DOORS	Rational Rhapsody	Catia, ProEngineer, xCAD	DOORS/RQM	Rhapsody TC, TRT
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Plataforma para desarrollo de sistemas (II)

Gestión de Cambios y de la Configuración

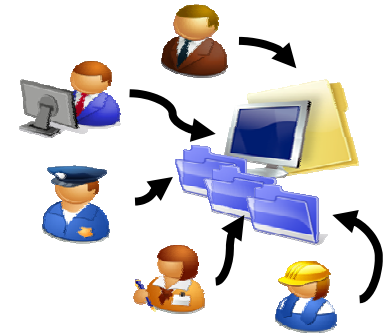




IBM Rational DOORS

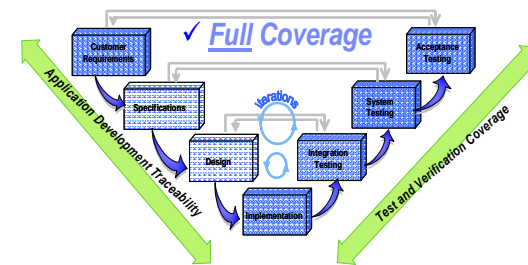
■ Plataforma de colaboración

- ▶ **Centralizar, organizar, estructurar, trazar** y **gestionar** los requisitos del producto
- ▶ Información actualizada **accesible** para todos los miembros del equipo. Facilita la **colaboración** y **comunicación** entre ellos.
- ▶ **Acceso controlado**, permisos de acceso



■ Trazabilidad

- ▶ **Establecer relaciones** entre requisitos, entre requisitos y pruebas, entre requisitos y diseño software, entre requisitos y diseño hardware (diseño mecánico, eléctrico, etc)
- ▶ Demostrar que el sistema final **cumple los requisitos** de cliente
- ▶ Demostrar que el sistema final está **probado**
- ▶ **Control** de los procesos de desarrollo/construcción y verificación&validación desde los requisitos

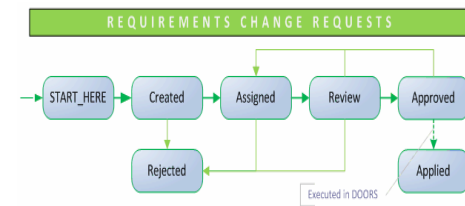


■ Gestión del cambio

- ▶ Análisis de **impacto de cambios**, **seguimiento** del estado de los cambios

■ Flexibilidad

- ▶ Fácil implementación de cualquier **proceso de desarrollo**



IBM Rational DOORS

Acceso controlado y organización de la información

The screenshot displays the IBM Rational DOORS software interface. It consists of several overlapping windows:

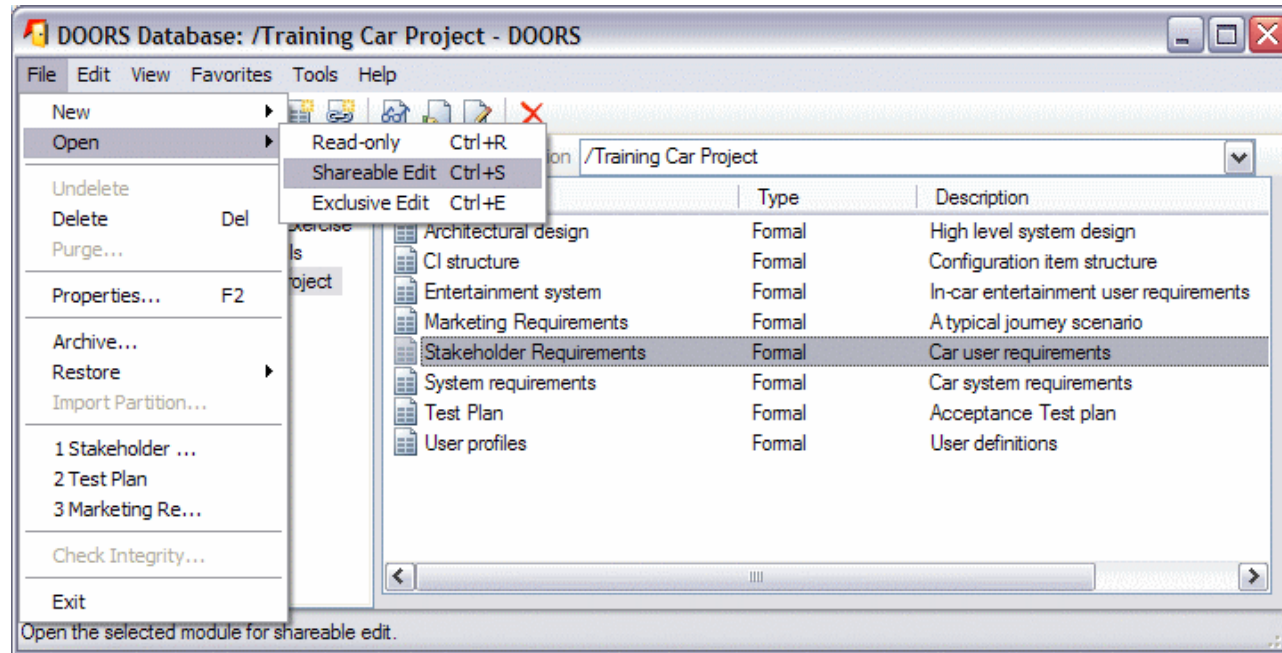
- Login - DOORS:** A small window for authentication with fields for Database, Username, and Password.
- DOORS Database: /Example Data/Company Programs/Vehicle projects/Light Trucks - DOORS:** A tree view showing the project structure, including folders like 'EasyStart Tutorial', 'Example Data', 'Company Programs', 'Vehicle projects', 'Cars', 'Light Trucks', 'Common compo', 'Flat bed trucks', 'Over sized truck', 'Prototypes', 'Sports utility veh', 'Company Standards', and 'General information'.
- 'Stakeholder Requirements' current 1.0 (2004 Model) in /Training Car Project (Formal module) - DOORS:** The main editor window showing a hierarchical tree of requirements on the left and a list of requirements on the right.

ID	Car user requirements
CSR1	1 Introduction
CSR133	This module contains the user requirements for a new car to be commercially av August 2004.
CSR2	2 User types
CSR3	2.1 Nationalities
CSR118	The car will be used in the following countries: UK, USA, Northern Europe, Easter Japan.
CSR5	2.2 User sizes
CSR6	People come in all shapes and sizes. The car must be suitable for people maximum minimum sizes 1.3 m to 2 m weighing 35 kilograms to 120 kilograms.
CSR7	3 Requirements
CSR8	3.1 Capability Requirements

At the bottom of the editor window, it shows 'Username: Administrator' and 'Exclusive edit mode'.

IBM Rational DOORS

Colaboración



Modo de apertura:

Sólo lectura



acceso sólo lectura, permite editar a otros usuarios

Edición compartida



permite editar a varios usuarios simultáneamente

Edición exclusiva



edición exclusiva del documento

IBM Rational DOORS

Establecimiento de relaciones

The screenshot shows two overlapping windows in the IBM Rational DOORS application. The top window, titled "Stakeholder Requirements Specification", displays a table of requirements for a Coyote UAV. The bottom window, titled "System Requirements Specification", displays a table of system requirements for the UAV system. A context menu is open over a requirement in the top window, and a mouse cursor is pointing at a requirement in the bottom window. A red box highlights the text "Nuevo Link" next to a requirement in the bottom window.

ID	Object Type	Stakeholder Requirements Specification for the Coyote UAV
UAV-5	*	2 Requirements
UAV-6	Requirement	The UAV is shall be a multipurpose and reusable U... multimission capability.
UAV-74	Requirement	The UAV shall...
UAV-75	Requirement	This is a new stakeholder requirement
UAV-7	Requirement	It shall operate at altitudes of up to 30,000 feet.
UAV-8	Requirement	It shall operate at altitudes of up to 30,000 feet.
UAV-9	Requirement	It shall operate at altitudes of up to 30,000 feet.
UAV-10	Requirement	It shall operate at altitudes of up to 30,000 feet.
UAV-11	Requirement	The UAV shall be capable of flying complex flight...
UAV-12	Requirement	The UAV shall be capable of flying complex flight...
UAV-13	Requirement	The UAV shall be capable of flying complex flight...
UAV-14	Requirement	The UAV shall be capable of flying complex flight...
UAV-15	Requirement	The UAV shall be capable of flying complex flight...
UAV-16	Requirement	The UAV and manned control capability from the g...

ID	Object Type	System Requirements Specification	Priority
SRSUAV-1	*	1 Overview	
SRSUAV-2	*	The Unmanned Air Vehicle System is a system solution to a medium-range reconnaissance in hostile environments with limited attack capability.	
SRSUAV-3	*	It is a medium-range long endurance UAV system that can carry a variety of payloads to assist in ground, air and sea operations.	
SRSUAV-4	*	A full UAVS consist of four UAVs and a ground Mission Planning and Control System.	
SRSUAV-5	*	2 System Requirements	
SRSUAV-74	*	2.1 UAV Vehicle	
SRSUAV-6	Requirement	The CUAV is shall be a multipurpose and reusable UAV with multimission capability.	High
SRSUAV-78	Requirement	This is a new system requirement.	Medium
SRSUAV-7	Requirement	It shall operate at altitudes of up to 30,000 feet.	High
SRSUAV-8	Requirement	It shall operate at altitudes of up to 30,000 feet.	High
SRSUAV-9	Requirement	It shall operate at altitudes of up to 30,000 feet.	Medium
SRSUAV-10	Requirement	It shall operate at altitudes of up to 30,000 feet.	High
SRSUAV-11	Requirement	The UAV shall be capable of flying complex flight plans with the operational goal of systematic area search.	Medium
SRSUAV-12	Requirement	The UAV shall be controllable from the ground station CMPCS.	High
SRSUAV-13	Requirement	The UAV shall be capable of flying complex flight plans with the operational goal of systematic area search.	High
SRSUAV-14	Requirement	The UAV shall be capable of flying complex flight plans with the operational goal of ground route or road based (synonym) search.	High

Creación con drag & drop



IBM Rational DOORS

Trazabilidad a varios niveles

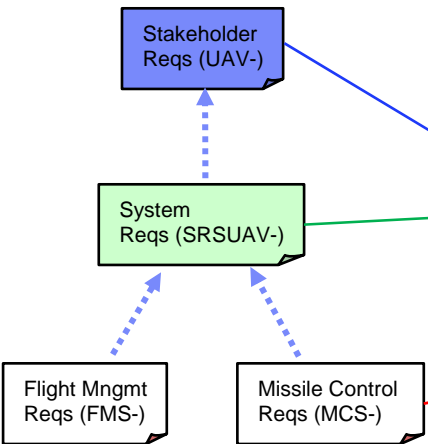
'Stakeholder Requirements Specification' current 0.1 in /1. Stakeholder Requirements Specification (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Publish WEXP Rhapsody 7.4 RG Analyst Change Management Harmony/ESW Harmony/ITSW Harmony/SE TAU Help

View U2 - Impact Analysis SS | All levels

ID	Object Type	Stakeholder Requirements Specification for the Coyote UAV	System <- Missile Control Subsystem	System <- Flight Management Subsystem
UAV-5	*	2 Requirements		
UAV-6	Requirement	The UAV is shall be a multipurpose and reusable UAV with multimission capability.	SRSUAV-6	SRSUAV-6
UAV-74	Requirement	The UAV shall...	SRSUAV-78	SRSUAV-78
UAV-75	Requirement	This is a new stakeholder requirement	SRSUAV-78	SRSUAV-78
UAV-7	Requirement	It shall operate at altitudes of up to 30,000 feet.	SRSUAV-7 MCS-11 MCS-13 MCS-20 SRSUAV-14 MCS-13 MCS-14	SRSUAV-7 FMS-11 SRSUAV-14 FMS-14
UAV-8	Requirement	It shall reach ground speeds of up to 100 knots in cruise mode.	SRSUAV-8	SRSUAV-8
UAV-9	Requirement	It shall reach ground speeds of 150 knots in dash mode.	SRSUAV-9	SRSUAV-9
UAV-10	Requirement	It shall carry payloads up to 450 lbs for durations exceeding 24 hours.	SRSUAV-10	SRSUAV-10
UAV-11	Requirement	The UAV shall fly unimpeded in low visibility environments while carrying reconnaissance or attack payloads.		
UAV-12	Requirement	The UAV shall be controllable from the ground station CMPCS.	SRSUAV-12	SRSUAV-12
UAV-13	Requirement	The UAV shall be capable of of flying complex flight plans with the operational goal of systematic area search.	SRSUAV-13 MCS-13	SRSUAV-13 FMS-13
UAV-14	Requirement	The UAV shall be capable of of flying complex flight plans with the operational goal of ground route or road based (synonym) search.	SRSUAV-14 MCS-13 MCS-14	SRSUAV-14 FMS-14
UAV-15	Requirement	The UAV shall be capable of of flying complex flight plans	SRSUAV-15	SRSUAV-15

Username: Administrator | Exclusive edit mode



IBM Rational DOORS

Trazabilidad a diseño software

'System Requirements Specification' current 0.0 in /2. System Requirements Specifications (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Publish WEXP Rhapsody 7.4 RG Analyst Change Management Harmony/ESW
Harmony/ITSW Harmony/SE TAU Help

View E1 - Allocated to All levels

ID	Object Type	System Requirements Specification	Allocated to (System Architecture)
SRSUAV-3	*	It is a medium-range long endurance UAV system that can carry a variety of payloads to assist in ground, air and sea operations.	
SRSUAV-4	*	A full UAVS consist of four UAVs and a ground Mission Planning and Control System.	
SRSUAV-5	*	2 System Requirements	
SRSUAV-74	*	2.1 UAV Vehicle	
SRSUAV-6	Requirement	The CUAV is shall be a multipurpose and reusable UAV with multimission capability.	Package: UAV_Vehicle
SRSUAV-78	Requirement	This is a new system requirement.	Package: UAV_Vehicle
SRSUAV-7	Requirement	It shall operate at altitudes of up to 30,000 feet.	Package: UAV_Vehicle
SRSUAV-8	Requirement	It shall reach ground speeds of up to 100 knots in cruise mode.	Package: UAV_Vehicle
SRSUAV-9	Requirement	It shall reach ground speeds of 150 knots in dash mode.	Package: UAV_Vehicle
SRSUAV-10	Requirement	It shall carry payloads up to 450 lbs for durations exceeding 24 hours.	Package: UAV_Vehicle
SRSUAV-11	Requirement	The UAV shall fly unimpeded in low visibility environments while carrying reconnaissance or attack payloads.	Package: UAV_Vehicle block: Flight_Management
SRSUAV-12	Requirement	The UAV shall be controllable from the ground station CMPCS.	Package: UAV_Vehicle
SRSUAV-13	Requirement	The UAV shall be capable of of flying complex flight plans with the operational goal of systematic area search.	Package: UAV_Vehicle
SRSUAV-14	Requirement	The UAV shall be capable of of flying complex flight plans with the operational goal of ground route or road based (synonym)	Package: UAV_Vehicle

Username: Administrator Exclusive edit mode

IBM Rational DOORS

Trazabilidad a diseño hardware

Technical Office Documentation' current 0.0 in /3. ASSURANCE/Technical Documentation (Formal module) - DOORS

'PSS 000' current 0.0 in /2. PSS (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools User NAVANTIA WEXP Analyst Help

View VACRM Assurance All levels

DOORS UID	Platform System Specifications	CAT0	Technical Documentation Associated	Remarks
PS000 - 4	This Specification defines details of Contractual technical aspects, i.e., ship's features, components, equipment, structure and materials, to be fulfilled during the ship's.	Inspection	0736350020R NOISE REPORT INF.LR 20080527 1111000010S SHELL EXPANSION APR.LR 20080508	
PS000 - 10	A margin provided in the ship design so that future systems can be added after the Ship is commissioned to the Commonwealth. FOR INFORMATION: XXX	Analysis		
PS000 - 12	This margin covers potential modifications in relation to GFE throughout design and construction with regard to GFE identified in the Contract.			
PS000 - 14	With the purpose of defining a later installation / integration of systems not installed in the ship			

Username: flopez Exclusive edit mode

Username: flopez Exclusive edit mode

Diseños mecánicos, eléctricos, informes técnicos asociados con el requisito



IBM Rational DOORS

Análisis de impacto de cambios

'User Requirements' current 1.0 (Issue 1) in /Sub-compact (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools User Help

View Full Trace View All levels

ID	User Requirements	Functional Requirements	Design	Test Plan
TRN-CSR-55	3.1.6.1.3 Clutch			
TRN-CSR-56	Users shall be able to operate the clutch, if fitted, in standard footwear.	FR-167 There shall be a standard lightweight clutch.	TRN-AD-45 Clutch	TRN-TP-36 Lightweight footwear control test
TRN-CSR-57	3.1.6.1.4 Gears			
TRN-CSR-58	Users shall be able to operate gears, if fitted, with minimal effort.	FR-169 The car shall be fitted with a lightweight 5 speed manually operated gearbox.	TRN-AD-44 Gearbox	TRN-TP-36 Lightweight footwear control test
TRN-CSR-59	3.1.7 Visibility			
TRN-CSR-60	3.1.7.1 Day light			
TRN-CSR-61	Users shall have maximum daylight visibility from within the vehicle.			
TRN-CSR-62	3.1.7.2 Night time			

Username: Dave Mason Exclusive edit mode

Evaluación del impacto de cambios de forma rápida y fiable a través de links

Un cambio en

impacta en

y en

IBM Rational DOORS

Progreso del proyecto

ID	User Requirements	Functional Requirements	Design	Test Plan
TRN-CSR-55	3.1.6.1.3 Clutch			
TRN-CSR-56	Users shall be able to operate the clutch, if fitted, in standard footwear.	FR-167 There shall be a standard lightweight clutch.	TRN-AD-45 Clutch	TRN-TP-36 Lightweight footwear control test
TRN-CSR-57	3.1.6.1.4 Gears			
TRN-CSR-58	Users shall be able to operate gears, if fitted, with minimal effort.	FR-169 The car shall be fitted with a lightweight 5 speed manually operated gearbox.	TRN-AD-44 Gearbox	TRN-TP-36 Lightweight footwear control test
TRN-CSR-59	3.1.7 Visibility			
TRN-CSR-60	3.1.7.1 Daylight			
TRN-CSR-61	Users shall have maximum daylight visibility from within the vehicle.			
TRN-	3.1.7.2 Night time			

Username: Dave Mason Exclusive edit mode

Fácil detección de requisitos no satisfechos, sin prueba asociada, etc...

Los huecos muestran los requisitos no satisfechos, trabajo que falta por hacer

IBM Rational DOORS

Progreso del proyecto con respecto a las pruebas

'System requirements' current 0.2 (a) in /Training Car Project (Formal module) - DOORS

File Edit View Insert Link Analysis Table Tools Discussions User Help

View Associated Tests

All levels

ID	Car system requirements	Requirement Status	Associated Tests & Status
SR1635	1.1.2.1 Without Winds	✓	
SR1009	The car shall be able to accelerate from 0 to 100 Kilometers per hour in 10 seconds on standard flat roads with winds of 0 kilometers per hour.	✓	TP-26.1 Action: In a flat road without winds, accelerate the car from 0 to 100 Km/h and observe the time taken Expected Result: The time taken must be less or equal than 10 seconds. Test Status: Pass
SR1010	The car shall be able to accelerate from 100 to 150 kilometers per hour at a rate of 5 kilometers per second on standard flat roads with winds of 0 kilometers per hour.	✓	TP-26.1 Action: In a flat road without winds, accelerate the car from 0 to 100 Km/h and observe the time taken Expected Result: The time taken must be less or equal than 10 seconds. Test Status: Pass
SR1011	The car shall be able to accelerate from 150 to 200 kilometers per hour at a rate of 3 kilometers per second on standard flat roads with winds of 0 kilometers per hour.	✓	TP-26.2 Action: Continue accelerating from 100 to 150 Km/h and observe the total time taken (from 0 km/h) Expected Result: The time taken from the beginning must be less or equal than 20 seconds. Test Status: Pass
SR1636	1.1.2.2 With winds from 10 to 20 km/h	✗	
SR1632	The car shall be able to accelerate from 0 to 100 Kilometers per hour in 12 seconds on standard flat roads with winds from 10 to 20 kilometers per hour.	✗	TP-36.1 Action: In a flat road without winds, accelerate the car from 0 to 100 Km/h and observe the time taken Expected Result: The time taken must be less or equal than 12 seconds. Test Status: Undetermined

System requirements

- 1 Functional Requirements
 - 1.1 Power car
 - 1.1.1 Move car
 - 1.1.2 Accelerate car
 - 1.1.2.1 Without Win
 - The car shall be
 - The car shall be
 - The car shall be
 - 1.1.2.2 With winds f
 - The car shall be
 - The car shall be
 - The car shall be
 - 1.2 Control car
 - 1.3 Illuminate car
 - 1.4 Control windows
 - 1.5 Control sun roof
 - 1.6 Maintain visibility
 - 1.7 Stabilize occupants
 - 1.8 Protect passengers
 - 1.9 Protect environmental
 - 1.10 Modularity
 - 1.11 Control entertainment
 - 1.12 Communicate
 - 1.13 Calculate
 - 1.14 Accommodate
- 2 System constraints

Username: Administrator Exclusive edit mode



Beneficios Gestión de trazabilidad con DOORS

- **Control de los procesos de desarrollo, construcción y validación y verificación del producto** a partir de los requisitos
- **Cumplimiento** con estándares y normativas
 - ▶ CMMI: trazabilidad bi-direccional
 - ▶ FDA, IEC 61508, DO-178B: trazabilidad hasta código
 - ▶ ...
- La gestión de la trazabilidad con DOORS facilita actividades de **análisis** como:
 - ▶ Análisis de **impacto de cambios**
 - ▶ Control y seguimiento del **progreso** del proyecto
 - ▶ **Cobertura de pruebas**





IBM Rational Rhapsody

Model Driven Development

■ Diseño Arquitectura del Sistema (SysML)



- ▶ Mejora la comunicación y el entendimiento entre disciplinas
- ▶ Trazabilidad a requisitos
- ▶ Simulación del modelo. Verificación temprana.
 - Detección de errores en fases iniciales, reducción de costes.
 - Validación de los requisitos en fase de diseño

Modelado y simulación proporciona un ROI del 30% según Gartner y una reducción del 25% del time-to-market según Nokia

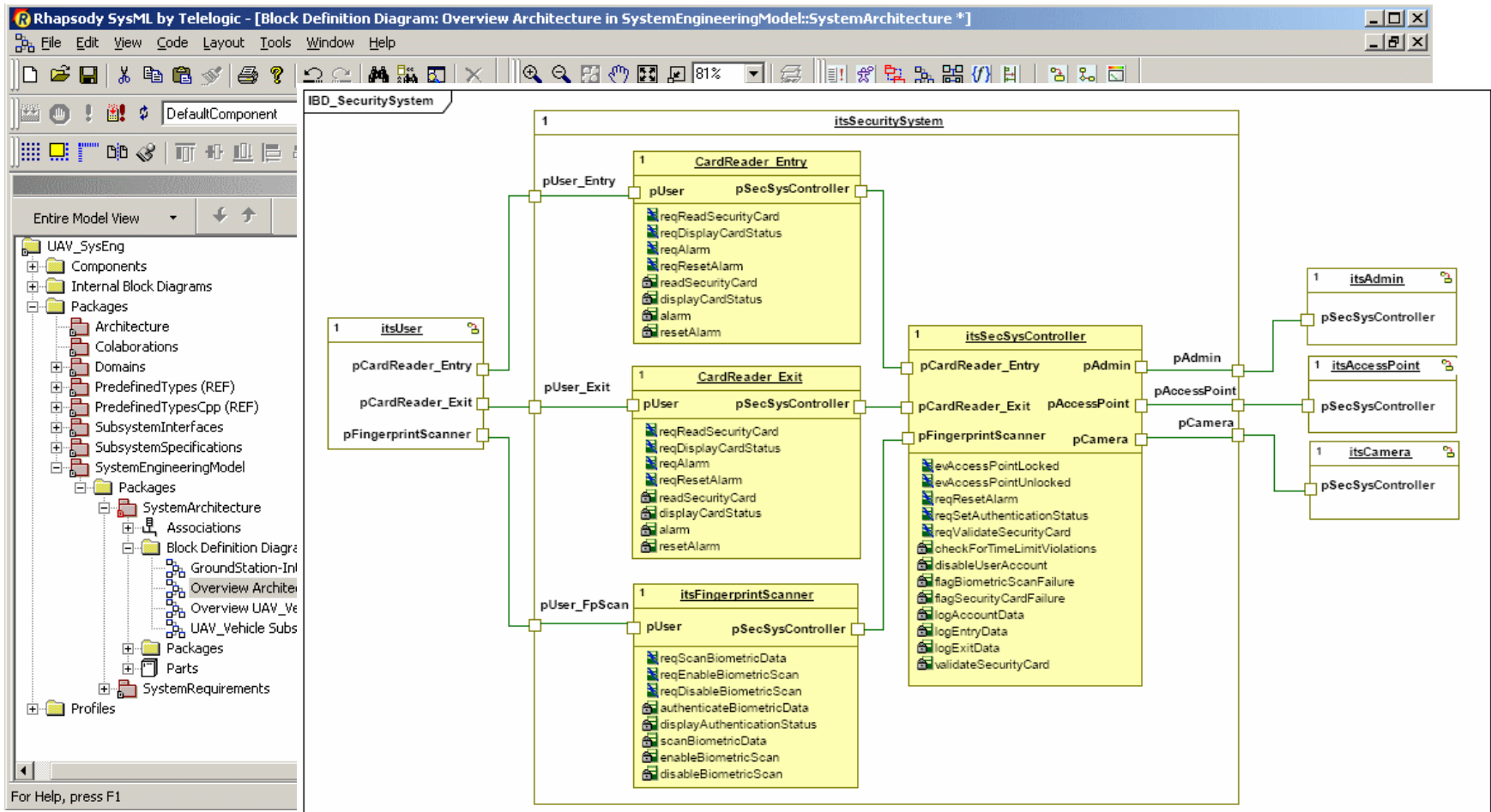
■ Diseño y desarrollo de Software (UML)



- ▶ Generación automática de código a partir del modelo
 - ▶ Simulación del modelo. Depuración en tiempo de diseño. Detección de errores en fase de diseño.
 - ▶ Despliegue en cualquier plataforma de destino: VxWorks, Linux, etc
- ### ■ Pruebas dirigidas por modelos (MDT – Model Driven Testing)
- ▶ Pruebas generadas automáticamente desde el diseño, sincronización constante.
 - ▶ Mayor productividad en los procesos de prueba
- ### ■ Colaboración equipos distribuidos.

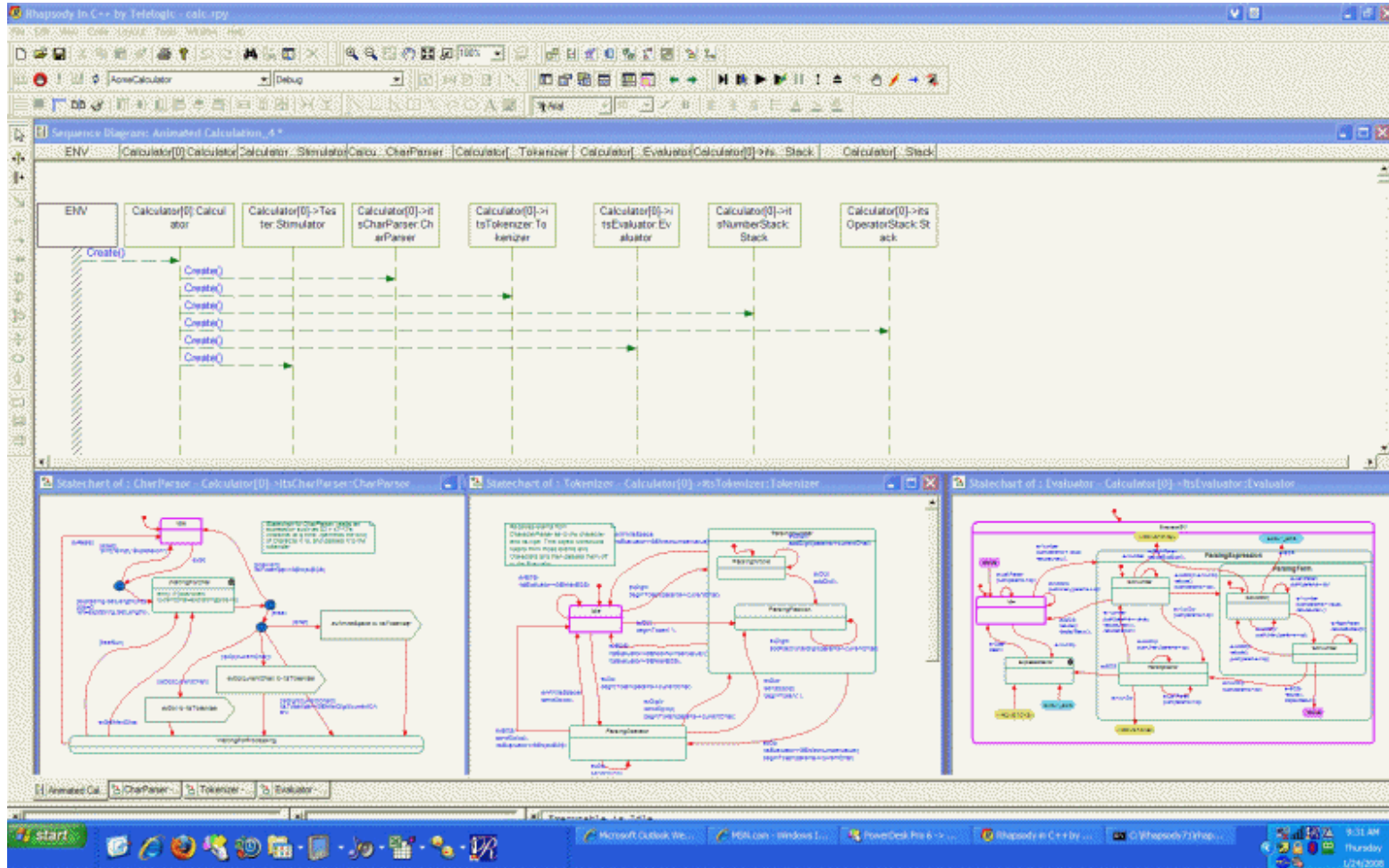
IBM Rational Rhapsody

Diseño de la arquitectura del sistema



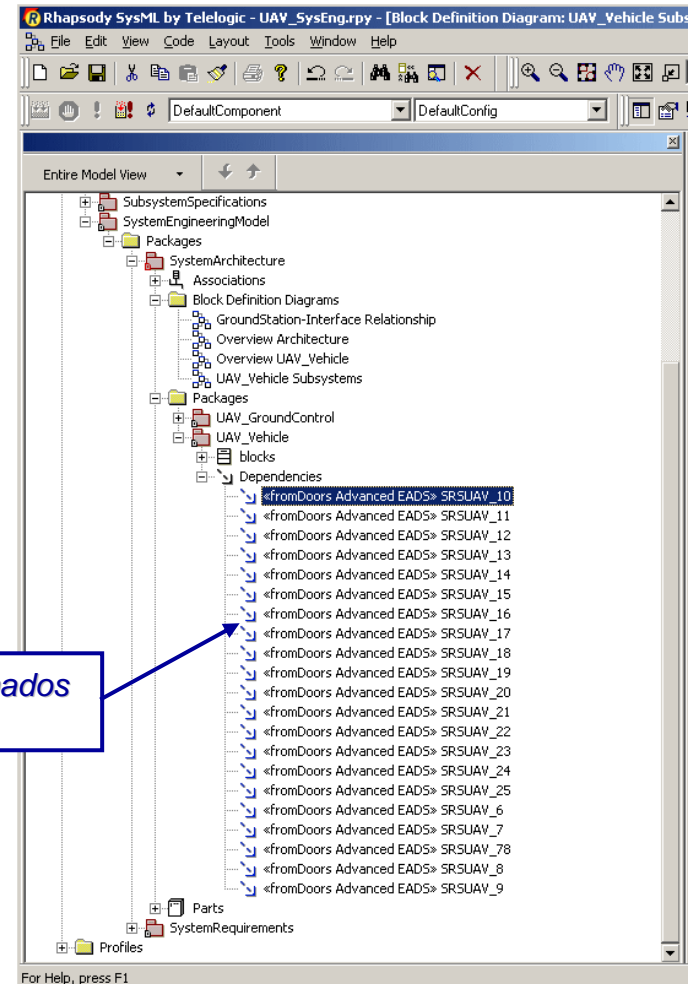
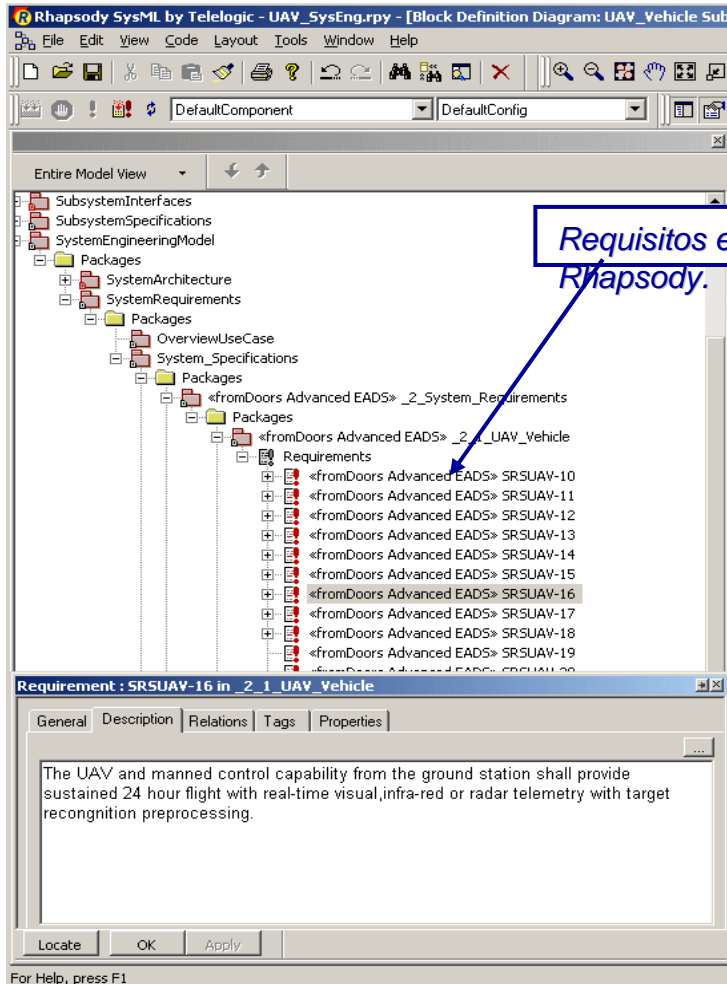
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Simulación, verificación temprana



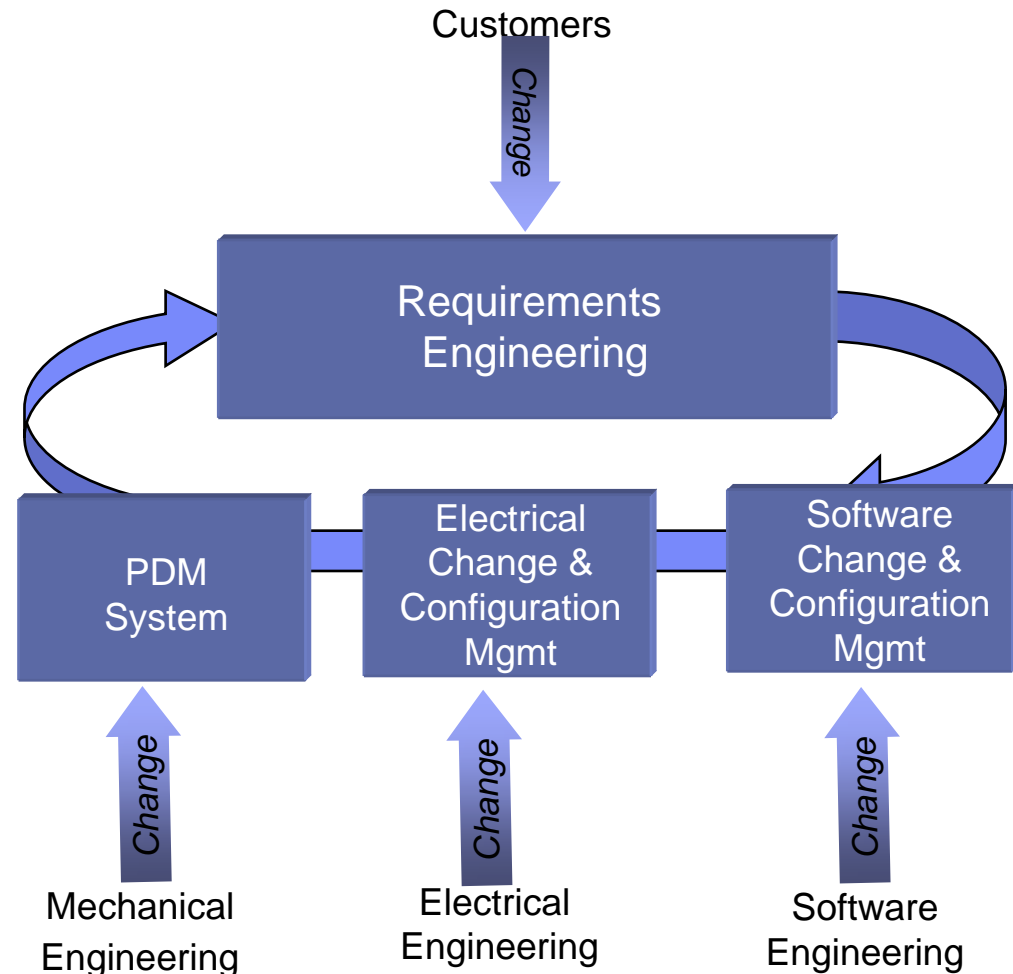
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Gateway - Trazabilidad a Requisitos



Gestión Integrada del Cambio

- Procesos integrados para la gestión de cambios en el sistema
 - ▶ Petición de cambio sobre el sistema (mejora, defecto, cambio sw, hw,...), iniciada en cualquier punto, se comunica automáticamente al resto de miembros del equipo
- Eliminación de barreras de comunicación
 - ▶ Permite que SW, HW y electrónica trabajan como departamentos integrados
 - ▶ Facilita la integración de sistemas y reduce los errores producidos por una incorrecta integración
- Gestión de Configuración del Producto
 - ▶ Permite sincronizar la entregas de SW y las versiones de HW para tener una versión coherente del producto final
- Integración entre herramientas:
 - ▶ IBM Rational para la gestión del cambio y la configuración: ClearCase, ClearQuest, Synergy, Change, RTC
 - ▶ Sistemas PLM/PDM: Dassault, Siemens, PTC



Beneficios plataforma Rational

- **Control de los procesos de construcción** del producto: trazabilidad desde requisitos de producto hasta el diseño hardware y software (trazabilidad hasta el código en sw)
- **Control de los procesos de verificación y validación**: gestión de las pruebas y trazabilidad a requisitos
- Proceso de **control de cambios** integrado: Reducción del riesgo de fallo por integración.
- **Cumplimiento con estándares y regulaciones**. Demostración del cumplimiento de los requisitos del cliente.
- **Mejora la comunicación** entre las diferentes disciplinas: ingenieros mecánicos, eléctricos, ingenieros de sistemas, etc.



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