CRitical S**YST**em Engineering **A**cce**L**eration

A summary of the feedback from assessment of IBM Solution for Systems and Software Engineering towards the Industry Use-cases

Analysed by support for Engineering Methods

D611.051

DOCUMENT INFORMATION

Project	CRYSTAL
Grant Agreement No.	ARTEMIS-2012-1-332830
Deliverable Title	Analysis of the application of the IBM Solution for Systems & Software Engineering to the use cases, by way of support for Engineering Methods
Deliverable No.	D611.051
Dissemination Level	PU
Confidentiality	R
Document Version	V1.0
Date	2014-01-31
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Acknowledging the use case description in Section 3 from the relevant use-case owners.

CHANGE HISTORY

CHANGE HISTORY Version	Date	Reason for Change	Pages Affected
0.1	12/12/13	First draft	Many
0.2	27/12/13	Cap1 specify Change Impact Analysis CAP4 identify the need for List Enabler	Many
0.3	31/12/13	Update artefact alignments Add extended system context to meet artefact need Distill Requirements, add glossary, update the approach Include first Healthcare use case analysis Format to meet Crystal deliverable standard	Many
0.4	3/1/14	Include feedback from IBM team. Update diagrams	Many
0.5	14/1/14	Include feedback from review	Marked
0.6	21/4/14	Include feedback from review. Update selected diagrams.	Marked
0.7	22/1/14	Include feedback from partners. Include 4.2 summary from Philips and initial analysis.	Marked
Pre-rel	30/1/14	Include 4.6 summary. Include further feedback from review	Marked
1.0	30/1/14	M9 Release	Clean

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2 INTRODUCTION

2.1 ROLE OF DELIVERABLE

Deliverable 6.11.51 for the first iteration of Crystal Task 6.11.4

This deliverable provides certain selected documentation, analysis and consolidation of process support and IOS related requirements as they may impact IBM products from the IBM Rational Solution for Systems and Software Engineering: to contribute to and assist achievement of the lifecycle integration use-cases identified within the domains with an emphasis on Healthcare WP4.1, 4.2, 4.3, 4.45 and 4.6 and the Public Aerospace use-case.

2.2 APPROACH

Due to the diversity of industry use-cases, needs are identified from the Engineering Methods, this method predates the Technical Management Process, but can be readily aligned. They are characterised here for the System and Software Development Lifecycle (SDLC) area:

1. Engineering Method purpose
2. Engineering Method activities analysis and identification of requirements
3. Engineering Method goal based analysis
4. Engineering Method capabilities
    a. These will be used to define the Innovations and Stakeholder Requirements
5. Engineering Method enablers and IOS enabling components
    a. These will be used to define System Requirements and Technical Items
6. Major artefacts used within the Engineering Method
    a. These will inform the System Requirements and Technical Items
7. IBM solution alignment
    a. The Technical Items will be aligned here
8. Identification of common vocabulary

In considering enablers we aim to focus, where possible, on the tool interoperability needs rather than the intrinsic SDLC needs, hence focusing on the IOS based enablers.

During the analysis we identified certain common terms that we highlight which could contribute to a common Crystal vocabulary.

SDLC, as a short form for System and Software Development Lifecycle is ill-defined and potentially wide topic so the approach taken initially is to investigate the needs from the domain use cases and converge to a workable scope.

3 Overview of Industry Use Cases

The aim here is to identify the main scope and commonalities of the industry use-cases.

3.1 UC2-8 - Aerospace Industry public use case

3.1.1 Objective

Definition of De-icing System for Regional Turboprop Aircraft, with:

- Minimal Cost, Weight, Power Consumption
- Fulfilling safety constraints
- Fulfilling functional needs (i.e. keep Aircraft components free-of ice)

  Multiple potential solutions for de-icing exist – for example pneumatic boots, de-icing fluid, aero thermic engine cooling air, electro-impulsive, electric, aero thermic using bleed air.

3.1.2 Use Case Description in terms of Engineering Methods used

The use case applies all of the Crystal Engineering Methods. For the M9 deliverable a selection of methods has been chosen to trial the approach and to seek to validate the value towards intended improved processes within the domains, see Figure 1.

3.1.3 Additional Use Case Commentary

In considering the selected Engineering Methods for the M9 iteration, for simplicity the Change Impact Analysis Engineering Method is characterised as having domain specific aspects and common aspects.

Domain specific aspects:

Measures of Effectiveness for the De-icing System

Certain specific models like the Physical environment models of aircraft journeys and Physical models of aircraft weight

Names and descriptors on artefacts and their elements

Detailed steps of certain assessments and analyses within the method[1]

Domain neutral aspects:

Main types of artefacts under consideration

Main flow of activities through the Engineering Method

3.2 UC4.2 - Selected Healthcare use case

Use case 4.2 was analysed as a sample Healthcare case in lieu of other industry use cases from Healthcare being available. There is not yet a defined need for the IBM solution from this use-case. The aim was to look for alignment of Engineering Methods and validation of the method adopted here.

For the purposes of the M9 deliverable we consider the impact analysis aspects of this use case, as it is close in business intent to the Change Impact Analysis, which is to identify affected artefacts and relationships. The criteria here relate to the same considerations as Change Impact Analysis with the additional concerns of the hazard, harm and risk analysis. These are additional criteria, artefacts, queries and views.

3.2.1 Objective

Improvement of the cost, time and errors associated with the system safety risk management process, which runs in conjunction with the development process. The safety risk management process takes into account the system requirements and the system design and analyses whether additional risk control measures need to be implemented to fulfil safety requirements.

3.2.2 Use Case Description in terms of Engineering Methods used

The use case applies certain specialized Engineering Methods for Risk Management which extend the basic topic of “Generate Fault Trees” in the current list of Engineering Methods. In addition certain more general Engineering Methods are specialised according to this use case.

Key steps in the Healthcare 4.2 use case are:

1. Marshalling information from the field installation (if a field issue)
2. Perform Safety Analysis (Causes, Hazards, Harms, probability)
3. Allocate safety risk to component (subsystem)
4. Analyse impact and/or problem < Aligned to Change Impact Analysis

[1] It can be argued that recalculation or redesign arising from a “proposed” change is outside of the Change Impact Analysis method, and that the analysis here is at the artefact level, although certain MoEs are exposed for evaluation, typically from assessment or calculation.

5. Update FMEA as relevant
6. Check completeness
7. Create and update the risk management plan and measures including Change Requests
8. Update operational plan to include risk management Change Request effectivity
9. Validate the compliance records

The requirements for the safety risk management process are defined in ISO 14971: “Medical devices – Application of risk management to medical devices

ISO 14971: clause 3.1 Risk management process

The manufacturer shall establish, document and maintain throughout the life-cycle an ongoing process for identifying hazards associated with a medical device, estimating and evaluating the associated risks, controlling these risks, and monitoring the effectiveness of the controls. This process shall include the following elements:

- risk analysis
- risk evaluation
- risk control
- production and post-production information.”

Cited from The Healthcare use-case 4.2. CRYSTAL_D_402_010_v1_A.doc

In general it achieved through identification of causes of risk, investigation of hazards and assessment of harm through an on-going risk management cycle. These cycles operate through all aspects of the lifecycle, especially during new design, design update and investigation of operational aspects from field installations. Results of risk analysis are expressed in ppm, occurrence per million usages.

The actions and measures arising from risk management relate to and are applied to project or process activities and system elements. They also operate in the context of other prevailing change requests, such as for new product functions, system performance improvement or cost reduction.

The industry regulations demand that adequate and certain specific records are kept to document the actual process followed, evidence and approvals.

3.3 UC4.3 - Selected Healthcare use case

3.3.1 Objective

Use Case 4.3 will target improvement of the following two items and will focus on Software Verification and System Verification (as the part of the V-model).

1. The development effort and lack of early feedback on extra-functional requirements.
2. High release effort due to late integration and manual testing.

Its aim is to reduce development and test effort through the use of In-the-loop simulation and applying a Continuous Integration strategy.

3.3.2 Use Case Description in terms of Engineering Methods used

The use case focuses on two developments processes

A. The “implement and test” cycle,
B. System verification

For each process, improvements actions have been defined in different key steps mentioned below.

Key steps of the “implement and test” cycle are:

A1. Build software update
A2. Manual testing on full system
A3. Manual testing on simulated system
A4. Regression tests on simulated subsystem
A5. Automatic build of new baseline
A6. Run all modules tests
A7. Run all regression tests on simulated subsystem
A8. Publish test results
A9. Install binaries on full test system and do smoke test

The key step of the “implement and test” cycle is:

B1. Execute test plan

The identified engineering methods in the Healthcare use-case U4.3 at M9 are:

- Test with In-the-loop simulation,
- Report verification results.

Cited from the Healthcare use case
CRYSTAL_D_403_010_v1_1_Jan13_proposal.doc

3.4 UC4.45 - Selected Healthcare use case

This is formed from the original Barco UC4.4 and UC4.5.

UC4.4 Medical Certification and Requirements Management Framework

UC4.5 SW Centric Scalable Safety Critical Medical Display Platform

3.4.1 Objective

The goal of the use case is the complete engineering lifecycle needed to change their medical display platform from a hardware centric, custom platform towards a flexible software centric, Commercial-off-the-Shelf (COTS) platform.

3.4.2 Use Case Description in terms of Engineering Methods used

The use case has 11 steps or aspects

1. Requirements
2. Release Planning
3. Sprint Planning
4. System Engineering
5. Components Engineering
6. System Integration
7. System Integration Test
8. System Acceptance Test
9. Product Delta (Not detailed at 31/12/13)
10. Impact Analysis (on going)
11. Risk Management (on going)

Furthermore an analysis for Engineering Methods in this use case has revealed this additional list, work will be needed to cross-reference and consolidate them.

The identified engineering methods in the Healthcare use-case U4.45 at M9 are:

1. Requirements engineering
2. Functional modelling
3. Performance modelling
4. Architectural design
5. Architectural trade-off analysis
6. Formal Verification
7. Risk Analysis
8. Fault Tree Analysis (FTA)
9. Fault Mode and Effects Analysis (FMEA)
10. Certification Reporting
11. < Aligned to Change Impact Analysis
12. Corrective Actions Preventive Actions (CAPA)
13. Software Development
14. Electronics Development
15. Mechanical Development
16. Review
17. Cross Domain Configuration Management
18. Product Variant Management

3.4.3 Additional Use Case Commentary

At M9 there are candidates here to extend or tailor the core set of Crystal Engineering Methods shown in Fig 1, therefore for M9 certain assumptions and selections have been made for inclusion here. The initial aim will be to address Coverage and Impact Analysis.

It is worth noting here that the initial scope of Impact Analysis in UC4.45 includes impact analysis at the system and component level and then across development plans (sprints) and an impact on the installed base of products.

3.5 UC4.6 - Selected Healthcare use case

This is based on the original RGB UC4.6.

UC4.6 An intelligent infusion controller for Blood Pressure regulation in Operating Room

3.5.1 Objective

The system under development is a drug infusion device that operates delivering vasoactive drugs to maintain the patient blood pressure under some limits in Operating Rooms (OR) or Intensive Care Unit (ICU). The system operates as a closed control loop reading the blood pressure and applying the required drug quantity to reduce it, if required. A special algorithm based on fuzzy logic is used for performing such monitoring and controlling.

The main challenge in the development process consists on obtaining a product that provides the functionality and meets the certifications and norms required for its use in real medical environment. The fact of fulfilling these norms forces the development process to accomplish some required steps and tasks for providing evidences about the correct behavior of the system and that the development process has been performed as expected.

3.5.2 Use Case Description in terms of Engineering Methods used

This use case is mainly centered on the tasks at the top of the V, namely, the Requirement Specification (1), Rapid Prototyping of Architecture and Design (2) and the System Validation (7). This is due to the fact that those tasks provide most of the information required as evidences for certification process and, therefore, the automation and the interconnection of such a data will produce a high benefit in the development cycle.

The objective is to have a connection between Requirements Specification and the Architectural Design, to allow a more efficient design cycle and a connection between Requirement Specification and System Validation. The main issue is to trace requirements to design elements and to validation test cases. This is a very important task and a must for the certification process.

The Table below shows a summary of the process activities identified that could be useful for our purposes. The table includes the name, a description and a column indicating whether a tool can be used or not.

Id	Activity	Description	Use tool
1	Define initial requirements	Based on customer and market requirements a basic product requirements must be produced	Yes
2	Analyze requirements	The requirements must be analyzed to check that are feasible, not contradictory and really fulfill the customer/product expectations	Yes
3	Define validation plan	Based on the requirements the validation plan can be defined. It must include all test cases that will test all the functionalities. Scenarios and required equipment must also be detailed	Yes
4	Architectural design	Define the architecture of the system (hardware/software decomposition, etc.) to fulfill the requirements. Traceability is created from the architectural components to the Stakeholder Requirements for certification, coverage analysis and impact analysis.	Yes
5	Performance and interoperability analysis	Performance and interoperability is dependent on architecture, therefore different possible architectures can be evaluated to select the best one for the requirements fulfillment.	Yes
6	Comparison and selection	The most suitable architecture, among the possible, is chosen.	Yes
7	Fault-tree generation	A safety critical system must define a fault-tree to help in the definition of the safety requirements.	Yes
8	Software modular design	Detailed design of the software based on the decomposition into modules.	
9	Hardware modular design	Detailed design of the hardware based on the decomposition into modules.	
10	Software implementation	Implementation of the software source code. Different approaches, techniques and tools can be used.	Yes
11	Hardware implementation	Implementation of the hardware. Different approaches, techniques and tools can be used.	Yes
12	Software module verification	After the implementation each software module must be verified to check that it	Yes

		behaves as specified.	
13	Hardware module verification	After the implementation each hardware module must be verified to check that it behaves as specified.	Yes
14	Hardware/Software integration	It must be checked that the software runs with the hardware.	No
15	System Validation	System validation based on the specifications. The validation tests defined at the beginning of the project are executed. The plan defines all the tests, the pass/fail conditions and so on.	Yes
16	Device/Environment simulation	In the system validation some devices or the environment can be simulated if the real ones are not easily available or there are some risks. Some simulators can be developed to emulate those devices or environments.	Yes
17	Norms compliance checking	If the final product is going to be certified under a norm, the compliance with the norm could be checked.	

Table X Process Activities identified

3.5.3 Additional Use Case Commentary

The Table 3-1 shows a summary of the detected engineering methods and a short description summarizing their function in the V model of the use case.

Engineering method	Description
Analyze Requirements	Consists on all the activities to analyze all the requirements collected to check the completeness and that they really provide all the required functionality for all stakeholders.
Validation Plan Definition	Based on the requirements, it consists on the preparation of the validation process by the definition of the test cases, the environment, equipment required and so on. It is very important the traceability of the tests cases with the requirements.
Architecture Design	All processes and tasks required for defining the architecture for the system that fulfills all the requirements. The process includes the possibility of creating multiple possible architectures and selecting the most suited for the problem.
Heterogeneous Simulation	In the architecture design there are several possible simulations that can help to decide among different architectures. This engineering methods covers the process of creating and using simulators of different parameters (timing, throughput, interoperability, etc)
Trade-off Analysis	Process of electing among alternatives based on criteria

	previously defined.
Fault-tree generation	Creation of a fault-tree for the system. This is a critical task for safety-critical applications and depends completely on the product domain.
Detailed Software Design	Activities to decompose the software into modules that have very little coupling among them (and a clear interface) that can be developed independently.
Detailed Hardware Design	Activities to decompose the hardware into modules that have very little coupling among them (and a clear interface) that can be developed independently.
Software Development	Development of the source code. There are many possible techniques, processes and tools.
Hardware Development	Development of hardware. There are many possible techniques, processes and tools.
Unit Testing	Unit testing consists on the test of the small pieces of code, as they are being developed to assure that we build over solid basements. There are several possible tools and strategies that mainly depend on the programming language.
Testbench	Similar to unit testing but used in hardware development. Consists on the execution of the different hardware blocks simulating the inputs to check the output.
Software Verification	Process of verification of the software. There are many different techniques and tools and the election of the ones to use depends on the safety level required for the final application.
Hardware Verification	Process of verification of the hardware. There are many different techniques and tools and the election of the ones to use depends on the safety level required for the final application.
Hardware/Software Integration Plan Execution	The integration of the hardware and software developed separately.
HiL Simulation	The process of defining and developing simulators to be used instead of some peripheral or the environment. Simulators are very important elements because in complex system not all the peripheral or a real environment can be used on testing.
Validation Plan Execution	Process of execution the validation as specified in a plan. The plan includes the definition of the test cases, the test environment and checking the result.
Requirement Traceability	The requirements fulfillment must be traceable through the architectural elements and the test cases. This is very important to help in impact analysis and to evaluate the implication in case of failure.
Search Data	Management of all the data generated in a projects
Document Management	Management of all documents generated in the process. It is important to control versions, document status and life cycle.
Impact Analysis	In case of changes it is necessary to be able to determine

	the scope of such a change.

Table 3-1: UC4-6 Engineering methods

Next step is the identification of the appropriate tools to help in each of the engineering methods. Because the special situation of this use case, some tools are not yet incorporated to the development cycle and some are under evaluation.

Within UC4-6 IBM Rational DOORS B2_10 has been identified as a candidate brick, and the activity to test OSLC interaction of tools for this use case for the specific interests within CRYSTAL framework has started at M9.

3.6 Selection of Engineering methods from Industry use-cases

For M9, the prioritisation and selection was undertaken by the industry domain leads in conjunction with the WP6.11 workgroup for this deliverable.

For Aerospace we identified Change Impact Analysis as the initial focus

For Healthcare four Engineering Methods were identified: Verify requirements was selected overall as a pilot for the 1st iteration but the analysis was not ready to include here for M9. This initial document aims to consolidate the Change Impact Analysis Engineering Method as currently identified, and start some of the analysis of Healthcare needs. Initial analysis of U-C4.2, 4.3 and 4.45 provides alignment to Change Impact Analysis as follows

Use-case	Healthcare Engineering Method	Core EM set based on Aero PU-C Alignment
4.2	Analyse impact and/or problem	Change Impact Analysis
4.3	Test with In-the-loop simulation,	Heterogeneous Simulation Change Impact Analysis
4.45	Coverage and Impact Analysis	Change Impact Analysis Traceability
4.6	Change Impact Analysis	Change Impact Analysis

4 ENGINEERING METHOD ANALYSIS

4.1 MATRIX OF ENGINEERING METHODS AGAINST USE CASES CONSIDERED

The initial set of Engineering Methods arose from the Aerospace Public Use case and adopted within 6.1. Other Engineering Methods are being identified from the use-cases. An initial selection from the Healthcare Use Cases has been made and a first alignment undertaken. It is expected this list will be refined.

This table is based upon the Aerospace Public Use-case and an initial set from Healthcare

	Aero	Healthcare			
	PU-C8 De-icing	UC4.45 SW System	UC4.2 Safety Risk Mngmnt	UC4.3 In the Loop	UC 4.6 Infusion Control
Analyse Requirements	>M9				X
Verify Design Against Requirement	>M9				X
Verify Requirements	TBD	Noted			
Maintain Consistency Between Multi-Viewpoint Models	>M9				
Trade-off Analysis	M9 Initial				X
Heterogeneous Simulation	>M9				X
Generate Fault Trees	>M9				X
Provide Specification Document	>M9				
Process Management	>M9				
Change Impact Analysis	M9	M9 Initial	M9 Initial		M9 initial
Traceability	M9 Initial				X
Search Data	M9 Initial				X
Configuration Control	>M9				
Test with In the loop simulation				M9 Initial	X
Report verification results			M9 initial		

Figure 1 Engineering Method alignment to selected use-cases

The M9 focus was in detail on Change Impact Analysis which has some overlap with the highlighted EMs. The Coverage and Impact Analysis of the Healthcare U-C4.45

is similar in scope to Change Impact Analysis. Similarly Test with In the Loop Simulation is very similar to Heterogeneous Simulation and has elements of Change Impact Analysis, so further alignment and structuring is necessary after M9.

4.2 Change Impact Analysis

At M9 the primary input for this Engineering Method has come from the Aerospace Public Use Case. Some initial assessment and alignment has been done from the input from Healthcare Use Cases 4.2 and 4.3.

4.2.1 Purpose

A Requirements Engineer or a Systems Engineer or any role undertaking change impact analysis wants to assess the impact of a requirement change to the current technical solution for the (e.g. de-icing) system.

The goal of this method is defined as an accurate view of artefacts affected by the proposed change: the so-called ‘affected items’. Accuracy is proposed here as confident selection or assessment against criteria, e.g. scope of change being assessed, reasonableness of completeness, accessibility, pedigree and currency.

Such criteria are themselves affected by factors such the cost and time to gather and check information, places to gather information from and ability to get access; which in turn could be considered criteria towards accuracy.

4.2.2 Overview of Engineering Method

4.2.2.1 Pre-conditions

Engineers have defined a first technical solution for the de-icing system based on a given set of requirements. The technical solution is described in many different models managed by various tools and databases. A key requirement is changed.

4.2.2.2 Post-conditions

A list of impacted artefacts and a traceability matrix or graph is created that illustrates the data impacted by the requirement change.

4.2.2.3 Analysis of the Activities including identification of requirements

The activities were identified within the referenced Aerospace use-case description[2]:

Activity:

A1. Upon receipt of a Change Request, Requirements Engineer selects the weight, or other NFR or MoE, to be changed and launches a Change Impact request or query to get list of related artefacts.

Identified requirements:

R1. Artefacts affected or impacted by a proposed or actual change shall be able to be identified by the application of criteria.

[2] Aerospace use case description D208.010

R2. A list of affected items identified by Change Impact Analysis shall be created and shared with consumers.

Derived requirements:

DR1. It should be possible to selectively apply criteria to adjust the extent of impact analysis (Examples from the domain use cases are: product or system identity, purpose or structure, context, effectivity, type, weight, MoE)

Activity:

A2. Change Impact Request is forwarded to other tools (don't show the request as an objective today – e.g. to carry the impacted item)

Identified requirements:

R3. Criteria for change impact assessment queries or requests should be able to be associated with a Change Request

R4. Change Impact requests can be directed to multiple contributors (users or service providers (tools)

R5. A list of affected artefacts should be able to be associated with a Change Request

R6. Affected artefacts should be able to be identified from additional external processing or evaluation. (Examples from the domain use-cases include analysis or simulation of models to produce updated MoE values).

Activity:

A3. Tools send back list(s) of related data

Identified requirements:

R7. Information about affected items shall be provided as a list according to criteria

A4. A "traceability" table or matrix or view is created to illustrate the related potential impacted items and their relationships to each other and the source requirement

Identified requirements:

R8. Information about affected artefacts should be able to be viewed in tables and matrices and forms and list

Derived requirement:

DR2. Information about affected artefacts should be able to be viewed in graphs as structured trees or networks

DR3. Information about affected artefacts should be composable by system viewpoint

Activity:

A5. Requirements engineer *reviews the traceability matrix and* requests a preview of a system architecture model that is relevant to the understand the change in weight against the underlying requirement

Identified requirements:

R9. Artefacts shall be accessible for viewing from the list of impacted items

Derived requirement:

DR4. Views should be composed or tailored by criteria e.g. to locate or highlight a stakeholder concern

Activity:

A6. *The selected System Architecture Model preview* request is forwarded to the respective modelling tool

Identified requirements:

R10. Requests for artefact views should be communicated to owning resources

Derived requirements:

DR5. Change Impact Analysis requests and their criteria shall be provided to contributors (users, services providers (tools)

Activity:

A7. Modelling tool generates a preview of the architecture and sends it back *to the originating requestor.*

Identified requirements:

R11. Artefact previews should be provided to external or remote requesters

Derived requirements:

DR6. Views of artefacts shall be configured or tailored, e.g. highlighting, by criteria

DR7. Change Impact Results can be compared across sets of criteria and their different value, to determine scope and extent of impact

This workflow can be represented as an activity diagram, thus:

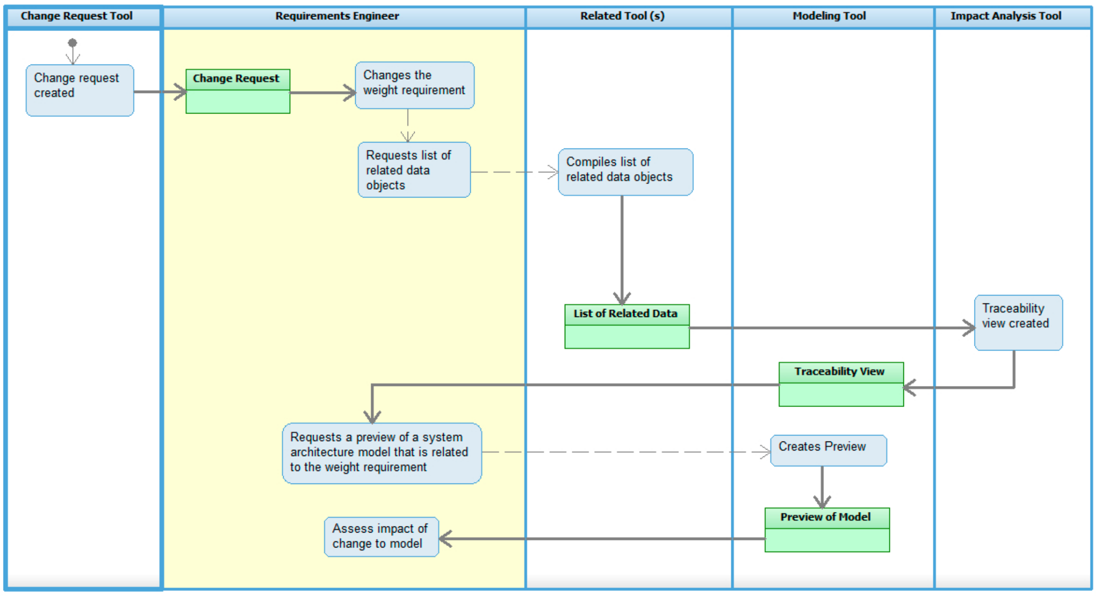


Figure 2 Change Impact Analysis Activity Diagram

4.2.2.4 Analysis of the identified artefacts

Within the Aerospace public use-case the artefacts identified by the analysis of the Engineering Method were:

Artefact in the use case	Generalised type (proposed)	Example given in the use case
Change Request	Change Request	Rational ClearQuest Rational Team Concert
Requirement	Requirement (Natural language or models)	Rational DOORS
De-icing System model	System model (Logical model with state based behaviour)	
	Measure of Effectiveness	Weight, cost, failure rate, ice-formation
	Safety Model (to support failure analysis and dysfunctional behaviour)	
	Physical behaviour model	Simulink Dymola
	Physical weight model	
	System Product configuration	

Artefact in the use case	Generalised type (proposed)	Example given in the use case
	Model elements	Diagrams
	Change Impact results	Date of creation, System behaviour, cost difference, weight difference, ice formation or reduction
Healthcare Risk Analysis	Customer feedback	Trackwise Rational ClearQuest
	Causal analysis	Trackwise Rational ClearQuest
	Hazard analysis and trend	Excel, Word Qlikview
	Failure mode analysis	Excel
	Risk probability analysis	
	Risk management plan	
	Design Structure Matrix	
	System Component Model	
Sprint plan	Project and activity plan	
	System Use Case	
	Executable system function model	
	State diagram	
In the Loop Simulation HW model	System model (Logical model with state based behaviour) Physical behaviour model	Dymola
In the Loop Simulation SW model	System model (Logical model with state based behaviour) SW Simulation model	Matlab
In the Loop Simulation Simulation results		POOSL
In the Loop Simulation	System Product configuration	

Artefact in the use case	Generalised type (proposed)	Example given in the use case
System configuration		
In the Loop Simulation Environment		

4.2.3 Comments from initial analysis Change Impact Analysis Engineering Method

1. The Role is identified as Requirements Engineer but could be any role authorised to carry out such an analysis
2. The "outer loop" of creation and tracked closure of the Change Request itself is not currently in the scope of the activities identified in the Public Aerospace use case
3. The topic of recording confidence in, or accuracy of, the Change Impact result is not addressed, such as recommendation or approval or recording of checks or specific tests on the results
4. The System measure of effectiveness is identified as Weight but it could be any combination of evaluated (typically) Non-Functional Requirements like Weight, Cost, lead time, reliability (MTBF) etc.
5. The method creates a traceability matrix (table), alternative presentations are also useful. In fact this is an area of innovation due to the typical complexity of such results
6. The user views a system architecture model; however any affected artefact could be viewed. It is envisaged that such views may themselves be modified such as to highlight affected items or to show some tailored view arising from the impact analysis (query)

4.2.4 Strategic Capability Model for Crystal Engineering method: Change Impact Analysis

To consider the tool interoperability needs more generally we propose the use of a technique from Enterprise Architecture methods, TOGAF and DODAF, by way of considering the capability needed to achieve the intended outcome of an Engineering Method. In summary we seek to identify key capabilities and their dependencies that can achieve a measurable business outcome.

Using this technique we propose the term of enabler as the lower level, or finer grained, capability that represents modular IT tool based functions; then to specifically identify certain lower level tool interoperability enablers as IOS components, i.e. capabilities that could be included in an IOS. Recognising at M9 in Crystal these are candidate enablers for inclusion in the IOS.

The approach taken in this technique is to start with a coarse grained approach to expose the major functions and interoperability rather than a fine grained or even attempt an exhaustive approach. This approach is calibrated using certain subject areas or key business entities, aka artefacts. The aim is to look for major, and hence likely common, interdependencies in the Engineering Method, again at a coarse grained level.

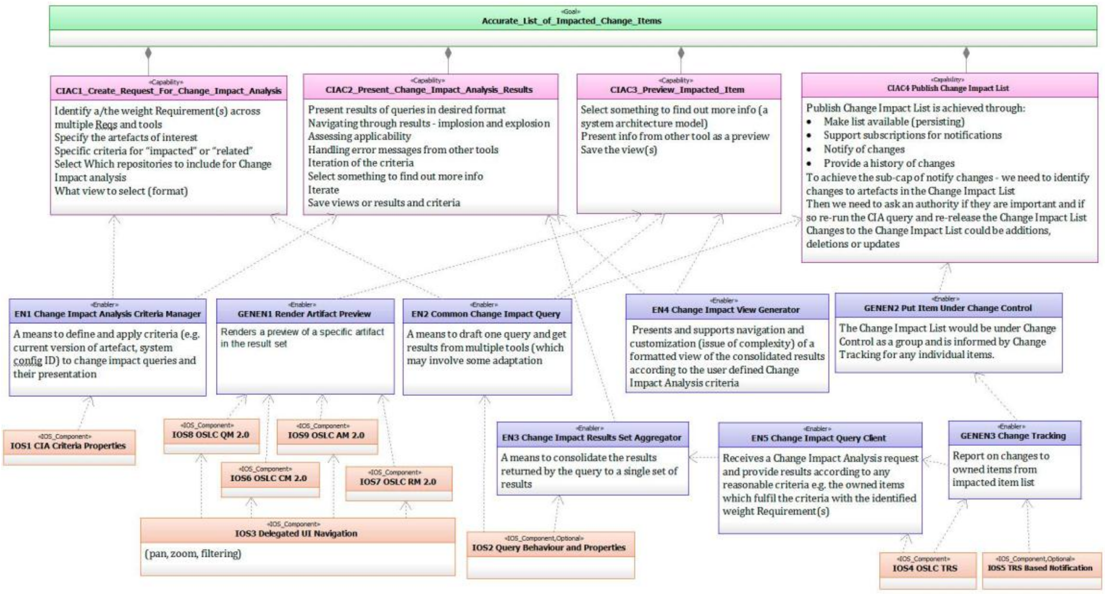


Figure 3 Capability Model for Change Impact Analysis

4.2.5 Business goal: Accurate list of impacted change items

Accuracy is proposed here as the ability to locate linked (affected) artefacts (as noted above this within a reasonable time limit or resource allocation) and evaluate them successfully according to criteria such that reasonable tests show as adequate or trusted .as opposed to exhaustive searches.

It is assumed that the purpose of this method is to support decision-making during the planning of changes to the products, plans, requirements, specification, design or tests. It is likely that multiple iterations of change impact analysis are needed as the work progresses, for instance where legacy design components have hidden or missing relationships.

4.2.6 Change Impact Analysis (CIA) Capabilities:

CIA CAP1 Create Request for (Specify) Change Impact Analysis

Identify a/the relevant system measure(s) of effectiveness from requirement(s) across multiple Requirement and tools

Specify the artefacts of interest

Specify criteria for “impacted” or “related”

Select which repositories to include for Change Impact analysis

What view to select (format)

CIA CAP2 Present Change Impact Analysis results

Present results of queries in desired format

Navigating through results – implosion and explosion

Assessing applicability

Handling error messages from other tools

Iteration of the criteria

Select something to find out more info about

Iterate

Save views or results and criteria

CIA CAP 3 Preview Impacted item (artefact)

Select something to find out more info (a system architecture model)

Present info from other tool as a preview

Save the view(s)

CIA CAP 4 Publish Change Impact List

Make list available (persisting

Support subscriptions for notifications

Notify of changes

Maintain change history

Support collaboration e.g. discussion thread

4.2.7 Enablers for Change Impact Analysis (CIA)

4.2.7.1 Specific Enablers

Enablers for specific Change Impact Analysis capability.

CIA EN1: Change Impact Analysis criteria manager: A means to define and apply criteria (e.g. evaluated property, current version of artefact, system configuration ID) to change impact queries, artefact identification and their presentation

CIA EN2: Common Change Impact query: A means to draft one query and get results from multiple tools (which may involve some adaptation)

CIA EN3: Change Impact Results set aggregator: A means to consolidate the results returned by the query to a single set of results

CIA EN4: Change Impact View generator: Presents and supports navigation and customisation (issue of complexity) of a formatted view of the consolidated results according to the user defined Change Impact Analysis criteria

CIA EN5: Change Impact query client: Receives a Change Impact Analysis request and provide results according to any reasonable criteria e.g. the owned items which fulfil the criteria with the identified weight Requirement(s) > this may be just an IOS component

CIA EN6 Change tracking. Report on changes to owned items (Optional)

4.2.7.2 Generic Enablers

Generic enablers are used by many resources

GENEN1: Render Artefact preview by provide a preview of a specific artefact.

GENEN2: Put item under Change control.

GENEN3: Change tracking by reporting on changes to individual or groups of items

4.2.7.3 Enabling IOS components

The Enabling IOS components, identified here, are candidate elements of a future IOS i.e. service provider and consumer behaviour or resource type or properties

CIA Enabler IOS component 1: Support for specific CIA criteria properties (optional)
CIA Enabler IOS component 2: Support for specific CIA query behaviour and properties (optional)

CIA Enabler IOS component 3: Delegated UI navigation (pan, zoom, filtering, tailoring) (optional)

CIA Enabler IOS component 4: OSLC TRS (optional)

CIA Enabler IOS component 5: TRS based notification (optional) CIA Enabler IOS Component 6: OSLC CM 2.0 (where used by the owning resource)

CIA Enabler IOS Component 7: OSLC RM 2.0 (where used by the owning resource)

CIA Enabler IOS Component 8: OSLC QM 2.0 (where used by the owning resource)

CIA Enabler IOS Component 9: OSLC AM 2.0 (where used by the owning resource)

4.2.8 Information model for the method

A sample information model for the method used in the Aerospace use-case is shown:

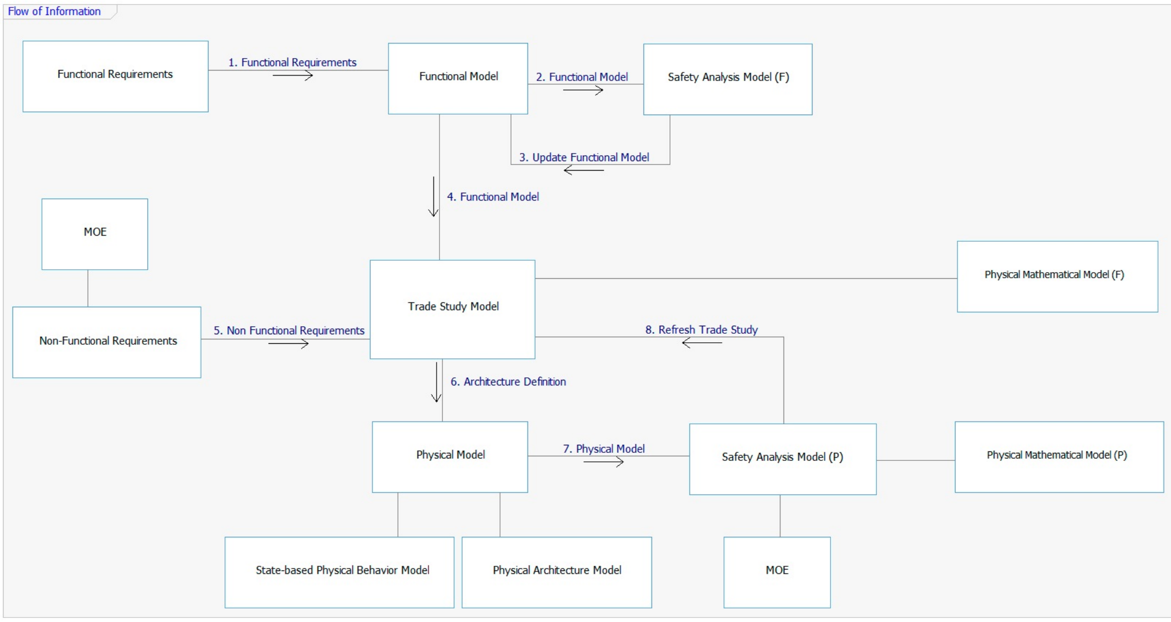


Figure 4 Fundamental information items and flow

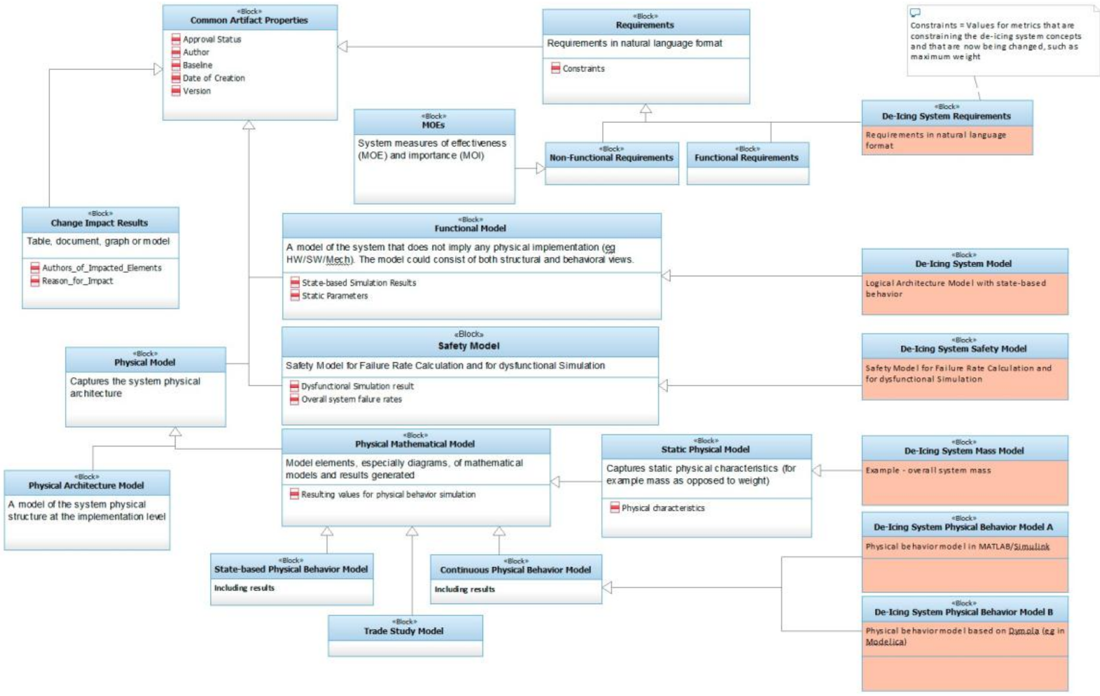


Figure 5 Change Impact Analysis - key instanced artefact relationships

Figure 5 is currently based upon analysis of the Aerospace Public Use Case and aims to show generic models of a method and the domain instance.

4.2.9 Overview of the current IBM Solution

The IBM Solution for Systems and Software Engineering provides a wide range of capabilities to support Change Impact Analysis. The support for Change Requests is not described here. The main focus is on the Change Impact Analysis activities identified, including engaging with the artefacts through IBM Rational Engineering Lifecycle Manager, Crystal Brick TBD

A summary of the main application:

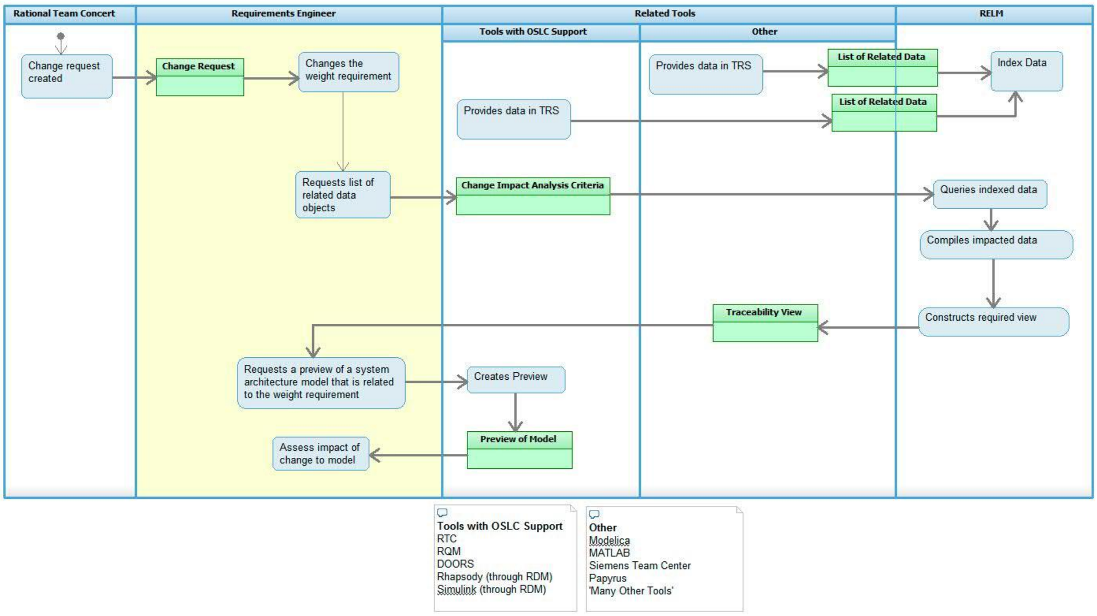


Figure 6 Change Impact Analysis - IBM solution support overview by activity

4.2.9.1 Solution packaging

IBM packages the Solution for Systems and Software Engineering by way of Industry Solutions for:

Aerospace

IBM Rational Solution for Aerospace and Defence - DO-178B/C

IBM Rational Solution for Aerospace and Defence - DoDAF

Automotive

IBM Rational Solution for Automotive Engineering - ISO-26262

Healthcare

IBM Rational Solution for Medical Devices

And other industries.

E.g. IBM Rational Solution for Energy & Utilities

4.2.9.2 Practices

IBM provides a wide set of processes and practices within the Solution for Systems & Software Engineering (Brick TBD) and the Collaborative Lifecycle Management

Solution. The full set of practices is available at http://www-01.ibm.com/support/docview.wss?uid=swg24030663.

A detailed practice library for Change Impact Analysis can be assembled and managed with Rational Method Composer (Brick TBD).

An example of such practices is the Change Management practice. Currently this is an advisory, or descriptive, practice within the IBM Solution for Systems & Software Engineering, that is, it does not have a detailed definition of activities or specifically an enacted workflow in Rational Team Concert (Brick 2_19). This is not a limitation, such flows can be readily defined and enacted.

4.2.9.3 Supporting Tools within the IBM Solution for Systems and Software Engineering

Within Crystal this uses Bricks 2_9, 2_10, and 2_19

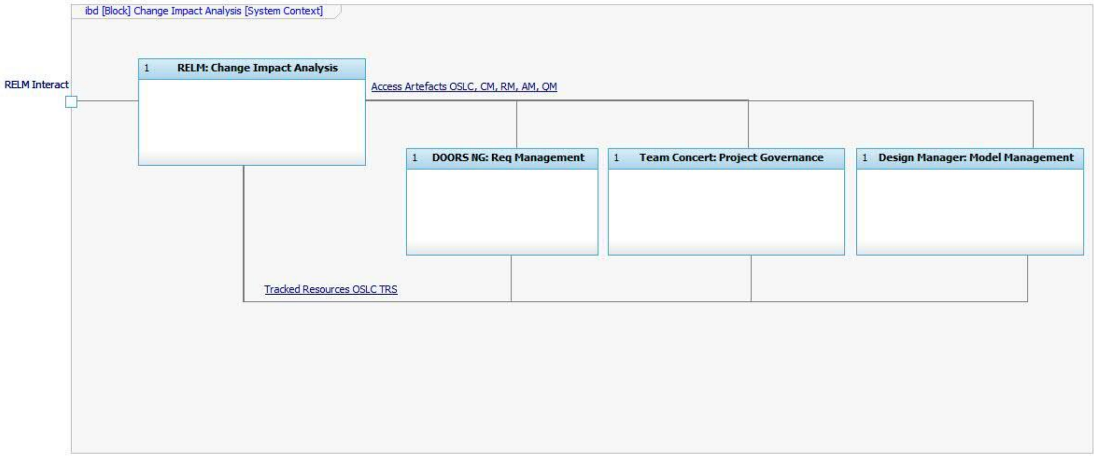


Figure 7 Sample system context for Change Impact Analysis

Brick BX_TBD Rational Engineering Lifecycle Manager provides the main environment for preparing and assessing the change impact. An index of artefacts and their change history is assembled from the owning resources (tools) by way of IOS OSLC TRS specification based services, the tracked resources in Fig 7. This index has a SPARQL based query interface that enables views to be generated that show the relationships between artefacts. The level criteria of the artefacts and their relationships can be evaluated and filtered, for example, to provide perspectives with and indicators. RELM has specific Change Impact Analysis functions to enable dependencies to be identified and navigated. Queries and views can be saved and shared with colleagues.

From the views within RELM the artefacts can be progressively engaged with, such as through the use of rich hover and launching of remote resources through linked data supported through the IOS OSLC AM, CM, RM and QM support in Fig 7.

Additional queries can be used to decorate views to show if items of interest have changed such as artefacts or MoE so an additional level of confidence about currency, goal fulfilment and scope can be gained.

In this way RELM provides a new level of capability to identify, navigate and assess the artefacts and their dependencies across many types of Change Impact Analysis.

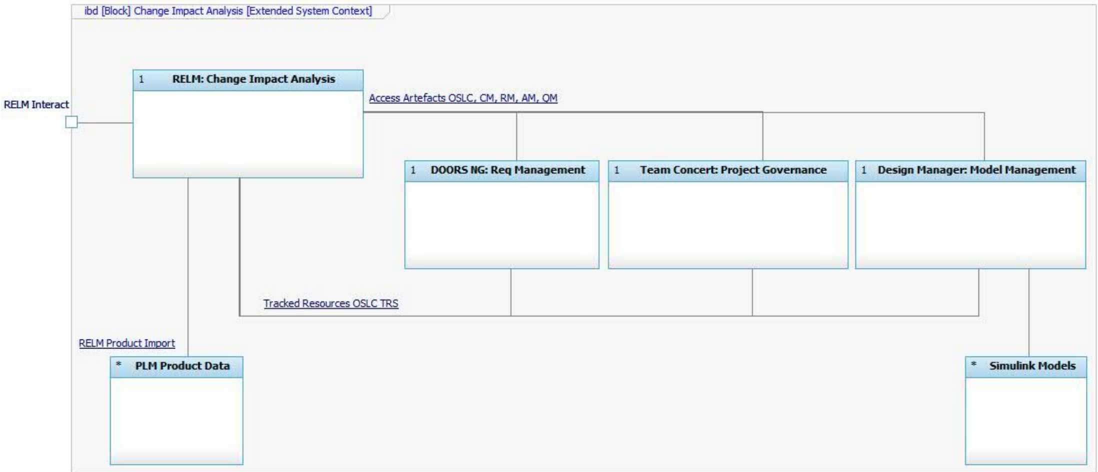


Figure 8 Extended system context for Change Impact Analysis

In such an extended Change Impact Analysis system context, information from 3rd party tools can be included in the analysis supported by Rational Engineering Lifecycle Manager.

4.2.9.4 IBM Solution Scenario storyboard

Sample Change Impact Analysis user stories:

4.2.9.4.1 An engineer creates a Change Impact Analysis view

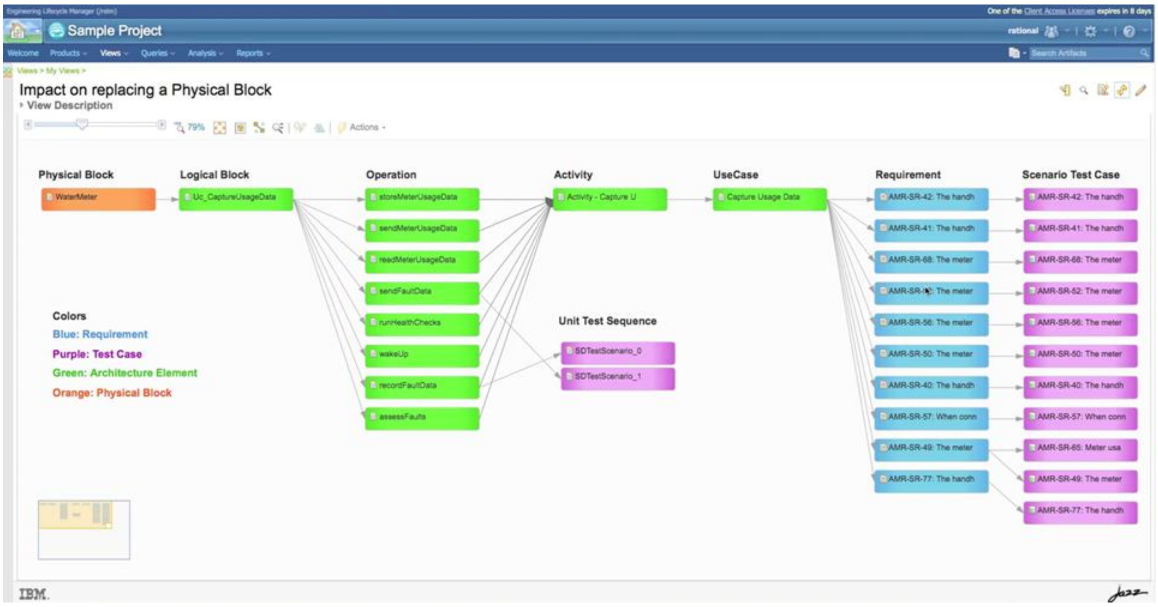
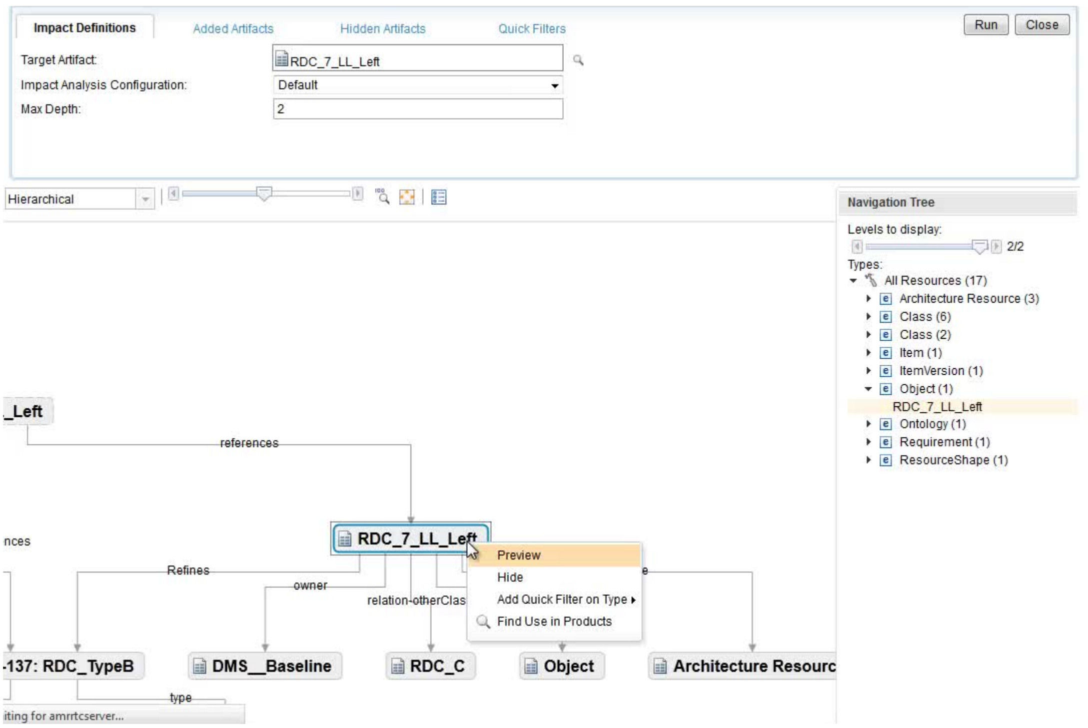


Figure 9 RELM view of related artefacts

For instance the view can show the association between Requirements and Measures of Effectiveness and the different system concepts, solutions and models

4.2.9.4.2 An engineer views a Change Impact Analysis



4.2.9.4.3 An engineer views an impacted artefact

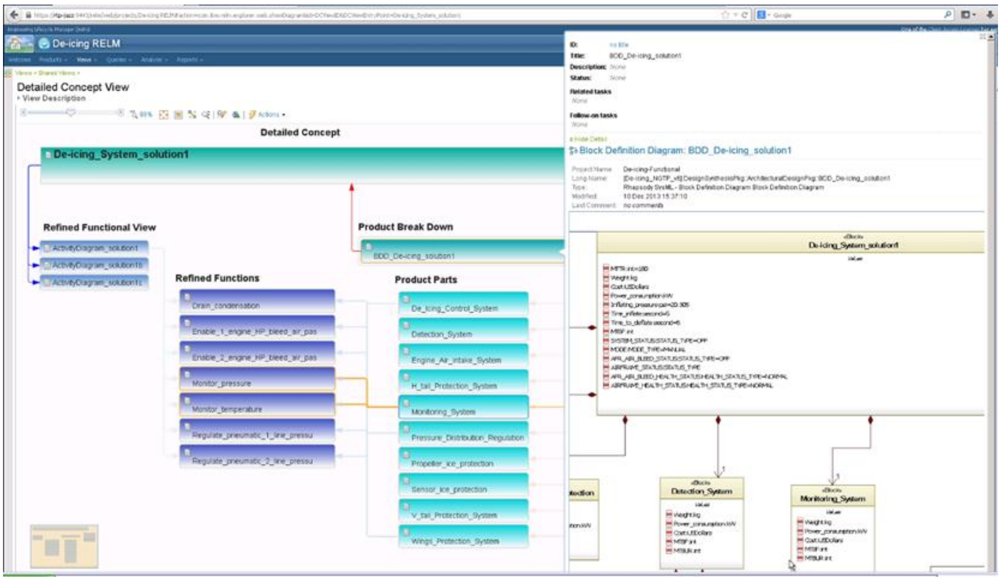
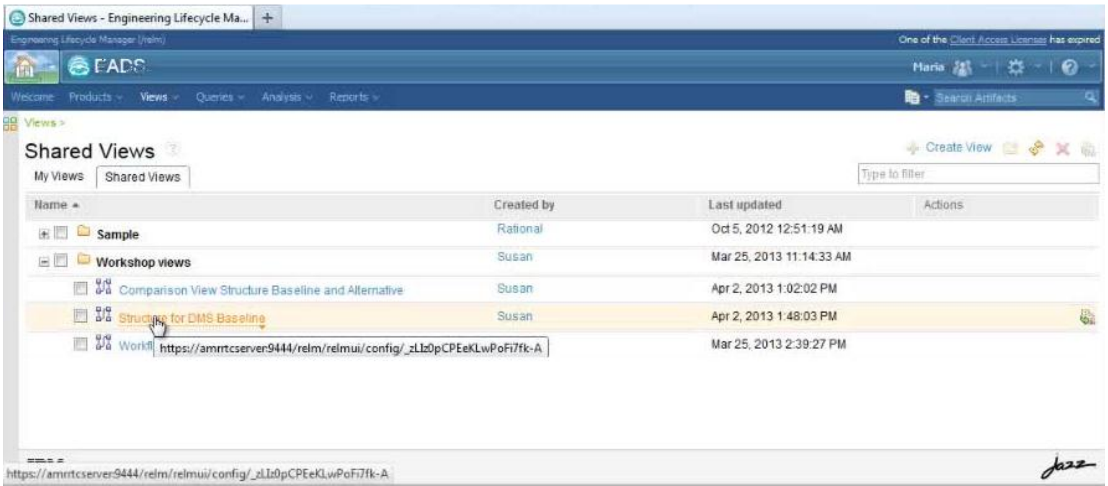


Figure 10 An Engineer previews an artefact found in the Change Impact Analysis

4.2.9.4.4 An engineer shares a Change Impact Analysis view with a colleague



Related user stories:

4.2.9.4.5 An engineer views, and can track, which artefacts have been updated during a change

Image missing

4.2.9.5 Summary of provision and areas of need

Item	Summary of Provision	Where Found?	NEEDS Identified	Notes
CIA CAP1 Create Request for (Specify) Change Impact Analysis	Queries can be created, evaluated and Shared	Rational Engineering Lifecycle Manager		
CIA CAP2 Present Change Impact Analysis results	Change Impact graphs, Tables and forms can be generated from Query results	Rational Engineering Lifecycle Manager Design Manager	Links to Dymola artefacts	**Access to Simulink artefacts via Design Manager**
CIA CAP 3 Preview Impacted item (artefact)	Identified artefacts can be previewed	Rational Engineering Lifecycle Manager and Associated tools	Simulink & Dymola Model preview & results view	**OSLC Delegated UI and Launch via a Link are used**
CIA CAP 4 Publish Change Impact List	Queries and Views are Saved and Made available	Rational Engineering Lifecycle Manager and Rational Team Concert	Change control not assessed or trialled	
CIA EN1: Change Impact Analysis criteria manager:	Queries and Views can be created and saved for re-use	Rational Engineering Lifecycle Manager	Handling of alternative scenarios not investigated	
CIA EN2: Common Change Impact query:	Queries are run across a common index from OSLC TRS Providers	Rational Engineering Lifecycle Manager	Handling of complex models not assessed	
CIA EN3: Change Impact Results set	An index is generated from multiple sources	Rational Engineering Lifecycle	Additional OSLC TRS providers	

Item	Summary of Provision	Where Found?	NEEDS Identified	Notes
aggregator	via OSLC TRS	Manager		
CIA EN4: Change Impact View generator	Generate Change Impact graphs and tables	Rational Engineering Lifecycle Manager	Handling of complex models not assessed	
CIA EN5: Change Impact query client	Locate and select artefacts according to criteria	Variously across the family		
CIA EN6 Change tracking. Report on changes to owned items	Provide information about changes to artefacts	Rational Engineering Lifecycle Manager using information from other members of the family	Not investigated yet	**Optional: Outside of current Engineering Method scope**
GENEN1	Preview of linked artefacts	Variously across the family	Dymola models	
GENEN2	Put items under change control	Variously across the family	Change Item list	
GENEN3	Track changes	**Variously across the family**	Change Item list	

Figure 11 Change Impact Analysis - Table of capabilities and enablers

IOS component	Rational Team Concert	Rational DESIGN MANAGER	RATIONAL DOORS	RATIONAL Engineering LIFECYCLE Manager	Rational Quality Manager	Needs Identified
1: CIA	Y[3]	Y[3]	Y[3]	N/A	Y[3]	

[3] Via existing OSLC properties, others require API extension

IOS component	Rational Team Concert	Rational DESIGN MANAGER	RATIONAL DOORS	RATIONAL Engineering LIFECYCLE Manager	Rational Quality Manager	Needs Identified
criteria properties						
2: CIA query behaviour and properties	Y[4]	Y[4]	Y[4]	Y[5]	Y[4]	
3: Delegated UI navigation (pan, zoom, filtering, tailoring)	Y[6]	Y[6]	Y[6]	N/A	Y[6]	
4: OSLC TRS	Y	Y	Y	Y[7]	Y	
6. OSLC CM 2.0	Y	Y	Y	Y[7]	Y	
7: OSLC RM 2.0	Y[7]	Y	Y	Y[7]	Y[7]	
8: OSLC QM 2.0	Y[7]	Y[7]	Y[7]	Y[7]	Y	
9: OSLC AM 2.0	Y[7]	Y	Y	Y[7]		

Figure 12 Change Impact Analysis - Table of IOS components

[4] Via OSLC standard query

[5] Via SPARQL based query

[6] Restrictions on filtering and tailoring

[7] Consumer

4.2.9.6 Hosting of information model within the IBM Solution

Artefact	Generalised type	Support	Primary Hosting in the IBM Solution
Change Request	Change Request	✓	Rational Team Concert Rational ClearQuest
Requirements	Requirement (Natural language or models)	✓	Rational DOORS Rational Rhapsody
De-icing System model	System model (Logical model with state based behaviour)	✓	Rational Rhapsody Rational Design Manager
	Measures of effectiveness	✓	Rational Rhapsody Rational Engineering Lifecycle Manager
	Safety Model (to support failure analysis and dysfunctional behaviour)	✓	Rational Rhapsody Rational Design Manager
	Physical behaviour model	✓	Rational Rhapsody with external analyser or simulator Rational Design Manager
	Physical weight model	✓	Rational Rhapsody with external analyser or simulator Rational Design Manager
	System Product data	✓	Rational Rhapsody Rational Engineering Lifecycle Manager
	Change Impact results	✓	Rational Engineering Lifecycle Manager
Healthcare Risk Analysis	Customer feedback	✓	Rational Team Concert Rational ClearQuest
	Causal analysis		Not assessed at M9
	Hazard analysis and trend		Not assessed at M9
	Failure mode analysis	✓	Rational Rhapsody
	Risk probability analysis		Not assessed at M9

Artefact	Generalised type	Support	Primary Hosting in the IBM Solution
	Risk management plan		Not assessed at M9
	Design Structure Matrix		Not assessed at M9
	System Component Model	✓	Rational Rhapsody Rational Engineering Lifecycle Manager
Sprint plans	Project and activity plans		Not assessed at M9
Healthcare Platform design	System Use cases	✓	Rational Rhapsody
	Executable system function models	✓	Rational Rhapsody
	State diagrams	✓	Rational Rhapsody

These sit in some kind of context of the product/system and the alternatives have some relationship – via the MoE?

4.2.10 Summary of needed capabilities, enablers and IOS components

The main needs identified at M9 are associated with access to the artefacts within Simulink and Dymola in CAP2 and 3.

4.2.11 Demonstrator of support for Change Impact Analysis

The first Crystal demonstrator shows aspects of Change Impact Analysis and the above user stories in 4.10.1.4.

This is currently available for use within the Crystal project, and is proposed for external dissemination. See the Crystal project reference material below.

4.3 Traceability

4.4 Search

4.5 Trade-off Analysis

4.6 Requirements Verification

4.7 Test with In-the-loop-simulation

4.7.1 Purpose

An Engineer wants to identify Software problems, especially where there is an issue with hardware or hardware interfacing, early in the lifecycle to avoid cost and rework.

The goal of this method is

4.7.2 Overview of Engineering Method

4.7.2.1 Pre-conditions

4.7.2.2 Engineers have access to alternative configurations and abstractions of HW and SW as models in multiple languages like Matlab, Dymola, POOSL). Engineers may have access to tool flows or model glue code or environments to handle multiple steps

4.7.2.3 Post-conditions

Results artefacts and collections for different analyses and combinations including comparisons and evaluations against criteria. Criteria include "correctness", fault impact,

4.7.2.4 Analysis of the Activities including identification of requirements

The activities were identified within the referenced Healthcare use-case description[8]:

Activity:

A1. The user installs the simulation environment(s) and software components on the appropriate resources.

Identified Requirements:

R1 User shall be able to select the simulation environment based upon SW artefact and vice versa

Derived Requirements:

[8] Aerospace use case description D208.010

DR1 Simulation environments shall have attributes to enable selection

DR2 Environments shall have repeatable installation steps through automation or manual guides if full automation is not available

A2. The user selects simulation purpose (e.g., functional, real-time) and mode (e.g., manual, automated testing).

Identified Requirements:

R2 Simulation environment shall have a purpose and mode (need to elaborate all purposes and modes)

A3. The user selects the machine configuration (e.g., component types, software version) to be simulated. The simulation environment presents a subset of the models that can be selected for the desired simulation (e.g., detailed models, fast high-level models).

Identified Requirements:

R3: Simulation models shall be selected according to system under test (machine) configuration

A4. The user selects the models to be used, the tool environment prepares appropriate glue / communication code that allows communication between hardware model and (model of) the software.

Identified Requirements:

R4: The user shall initiate environment installation

Derived Requirements:

DR3: The user shall be notified when the environment is ready for use

A5. In case of automated testing, test scripts (including input data for the models) are downloaded from a database, taking into account the machine configuration.

Identified Requirements:

R5: Simulation test programs are selected according to system under test configuration

Derived Requirements:

DR4: Test programs shall have attributes to enable select by way of system configurations

A6. The user starts the simulation; the simulation of the hardware model is synchronized with (the model of) the software.

Identified Requirements:

R6: Simulation of HW and SW shall be synchronised

Derived Requirements:

DR5: There shall be agreement on definition of common aspects of system behaviour between HW and SW models

A7. During manual simulation: a 3D visualisation of the system is shown giving the user feedback on movements; the user can provide input (to the software; and via the simulation environment to the models) and inject faults; Giving input to the models should be user-friendly (e.g.: for testing an object distance sensor the user should not have to input distances, but rather place a foreign object in the 3D environment, to which distances can be calculated).

Identified Requirements:

R7: Manual Simulation allows user interaction on 3D position and distance between system under test elements

R8: Faults can be selected and injected manually into fault simulation

Re-use CIA R4: Change Impact requests can be directed to multiple contributors (users or service providers (tools)

Re-use CIA R6: Affected artefacts should be able to be identified from additional external processing or evaluation. (Examples from the domain use-cases include analysis or simulation of models to produce updated MoE values).

Re-use CIA DR4: Views should be composed or tailored by criteria e.g. to locate or highlight a stakeholder concern

A8. The simulation results (e.g., pass/fail) are automatically stored in a database.

Identified Requirements:

R9: Simulation results artefacts shall be stored

Derived Requirements:

DR6: Simulation results artefacts shall be associated with test plans and system under test configuration

DR7: Simulation results artefacts shall be available to other Engineers

4.7.2.5 Analysis of the identified artefacts

Within the Healthcare use-case 4.3 the artefacts identified by the analysis of the Engineering Method were:

Artefact in the use case	Generalised type (proposed)	Example given in the use case
HW model	Physical behaviour model	Dymola
SW model	SW Simulation model	Matlab
Simulation results		
System configuration		
Environment		

5 Vocabulary, Terms and Trademarks

5.1 Engineering method common terms

Name	Sample Occurrence	Type	Quick description	Acceptance
Criterion	CIA EN1	General	A measure to decide something	
Artefact	CIA EN1	General	Unit of information e.g. Document, Model	
Repository	CIA CAP1	General	Store of information	
Tool	CIA CAP1	General	Information processor	
Query (Noun)	CIA EN2	General	Request for information	
View (Noun)	CIA EN4	General	A particular representation of information	
DUI view	IOS Component 3	General	Delegated view generated by another tool	
Item	CIA CAP3	General	Thing represented by information	

Figure 13 Common terms

5.2 Engineering Method Noun Vocabulary

Name	Sample Occurrence	Type	Acceptance
Change Impact Query	CIA EN1	Method specific	
Change Impact Query Results		Method specific	
Change Impact List	CIA CAP4	Method specific	

Figure 14 Table of artefact candidates (Nouns)

5.3 Engineering Method Verb Noun Vocabulary

Name	Sample Occurrence	Type	Acceptance
Define criteria	CIA EN1	General	
Apply criteria	CIA EN1	General	
Draft Change Impact Query	CIA EN2	Method Specific	
Present Results	CIA EN2 (implied)	General	
Discover query behaviour	IOS Component 2	General	
Aggregate query results	CIA EN3	General	
View Generator	CIA EN4	General	
Navigate DUI view	IOS Component 3	General	

Name	Sample Occurrence	Type	Acceptance
Tailor DUI view	IOS Component 4	General	
Specify Change Impact Analysis	CIA CAP1	Method specific	
Preview artefact	CIA CAP3	General	
Control Change Impact list changes	CIA EN6	Method Specific	
Notify changes to subscribers	IOS component 5	General	

Figure 15 Table of process elements (Verb / Noun pairs)

5.4 Trademark Acknowledgement

All trademarks and logos are acknowledged as belonging to their respective owners.

5.5 Additional Glossary

AM	Architecture Management (in the context of OSLC)
CAP	Indicator for a capability
CAPA	Corrective Actions Preventive Actions
CIA	Change Impact Analysis Engineering Method
CM	Change Management (in the context of OSLC)
DOORS	IBM Rational DOORS
Dymola	Dassault Systemes Dymola
EN	Indicator for an enabler (sub-level of capability)
FMEA	Failure Modes Effects Analysis
FTA	Fault Tree Analysis
IOS	Interoperability Specification
IOC Component	Component of the IOS
M9	refers to Artemis Crystal Month 9 iteration
MoE	measure of effectiveness (an example of criteria)
MTBF	Mean Time Between Failure
NFR	Non-functional requirement

OSLC	Open Services for Lifecycle Collaboration
PLM	Product Lifecycle Management
QM	Quality Management (in the context of OSLC)
RELM	IBM Rational Engineering Lifecycle Manager
RM	Requirements Management (in the context of OSLC)
RQM	IBM Rational Quality Manager
RTC	IBM Rational Team Concert
SDLC	System & Software Development Lifecycle
Simulink	Mathworks Simulink
SSE	IBM's Solution for the System and Software Lifecycle
TRS	(OSLC) Tracked Resource Set
WP	Crystal Work Package

6 Reference Material

6.1 Crystal Project Material

Item	Reference	Location	Version	Comments
Aerospace Public use case presentation				
Aerospace Public Engineering Method summary analysis	D208.010 CRYSTAL_D_208_010_v1.00.docm	AVL site SP2 Work Deliverable M09	V2	Updated at 30/1/14
Aerospace EngineeringMethods_UseCase_PublicAeroSpace_v3 (spreadsheet)		Engineering Method Description	V3	
Crystal Change Impact Analysis demonstrator Video_Raw_PAUC_Demo_Dec2013		AVL SP2 Work WP208		As shown at the Artemis conference Dec 4-5 2013 Munich
Healthcare UC4.2 description	CRYSTAL_D_402_010_v1_A.doc	AVL site SP4 Work WP4.2	v1_A	
Healthcare UC4.45 description	CRYSTAL_D_404+405_010_v0_9_7.doc	AVL site SP4 Work WP4.45	v0_9_7	
Healthcare UC4.45 Engineering Method analysis	Engineering Methods-Barco_Use-Case_4_4+5 v0_9_7.xls	AVL site SP4 Work WP4.45	v0_9_7	
Healthcare UC4.3	Crystal_611 5_V06_210114_mbonin2.do	WP4.3	V0.6	

	cx			
Healthcare UC4.6	Crystal_611 5_V06_210114_mbonin2.docx	WP4.6	V0.6	

6.2 Acknowledgements

The Aerospace public use case contributing partners like EADS and Alenia.

The Healthcare use case owners and contributing partners like Philips, Barco and RGB

6.3 IBM Solution information

6.3.1 Please read this disclaimer

Within this document any information on IBM products and or services is provided here as-is and without any warranty. No commitment or assurance must be taken for any statement of capability or product functionality or performance herein. Neither must any assumption be made about IBM's ability or willingness to meet any capability identified or implied as desirable, missing or a "gap".

All information provided is indicative only and no contract terms can be based upon any content herein.

6.3.2 Additional sources of information about IBM solutions

This document does not aim to reproduce the information that is freely available on ibm.com, jazz.net or developerworks. Sample links are

Item	Location	Notes
Solution Overview	http://pic.dhe.ibm.com/infocenter/rssehelp/v1r0m0/index.jsp?topic=%2Fcom.ibm.rational.sse.doc%2Fhelpindex_sse.html	Checked 30/121/3
Solution Overview	https://jazz.net/products/sse/	Checked 30/121/3

A summary only is provided here of the main IBM Solution for System and Software Engineering.

6.4 Other Reference Information