How to check requirements consistency with RQS and IBM DOORS

October 17, 2017

The REUSE Company Worldwide

- Local partners: France, Germany, Italy, Spain and Japan
- Customers in different countries along United States, Europe and Asia
- TRC Headquarters is based on Madrid (Spain)
- United Kingdom TRC office
- Scandinavian TRC office (Sweden)

How to check requirements consistency with RQS and IBM DOORS

Checks the Quality of your requirements specifications
Correctness, Completeness and Consistency analysis
Is set up according to your own quality policies
Connected to most Requirements Management Tools

Requirements Quality Analyzer (RQA)

Manages terminology and knowledge of your system
Helps you in the creation of patterns
Provides methods for automatic generation of Ontologies
Manages knowledge evolution over time

Knowledge Manager (KM)

Assists you in the activity of writing requirements
Performs Correctness and Consistency analysis on the fly
Suggests terminology changes based on an ontology
Fully integrated in your Requirements Management Tool

Requirements Authoring Tool (RAT)

Content

- Introduction
- The consistency problem in systems engineering
- Consistency metrics in the Requirements Quality Suite
- Demo
  - Tailoring consistency metrics in Requirements Quality Analyzer (RQA)
  - Checking consistency metrics with RQA
  - Real-time consistency checking in Requirements Authoring Tool (RAT)

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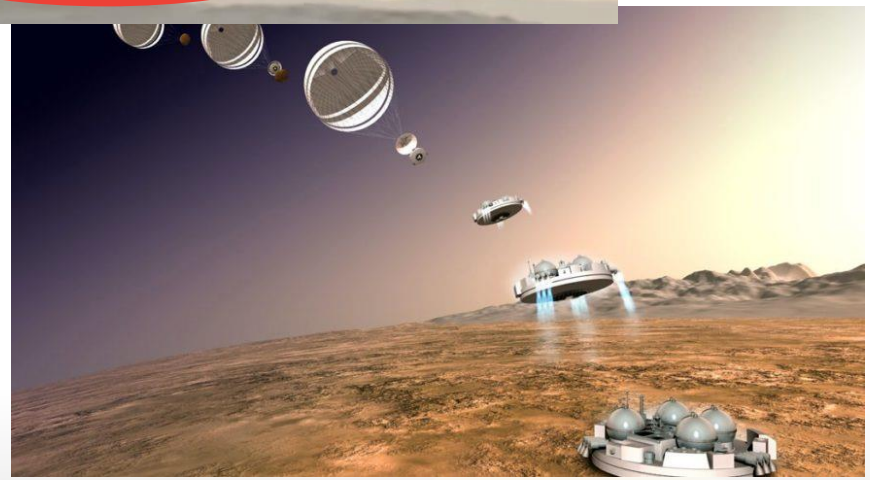
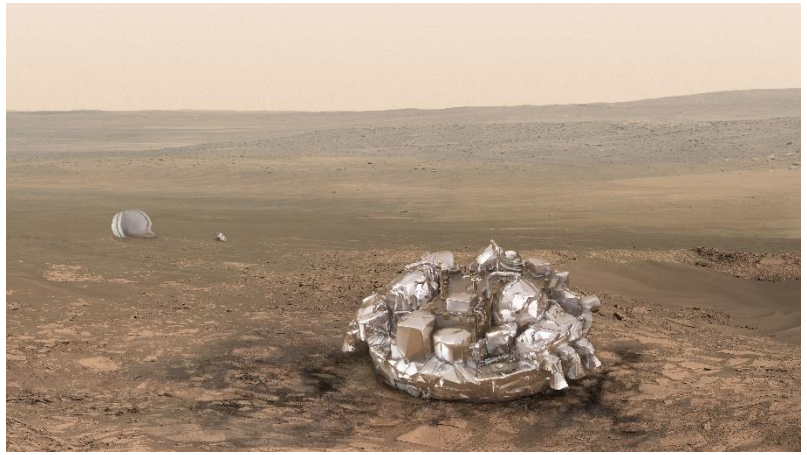
Introduction

What is consistency?



http://spacenews.com/esa-mars-lander-crash-caused-by-1-second-inertial-measurement-error/

Vs.



400.000.000 € missing

Schiaparelli lander's crash landing on Mars on Oct. 19 2016 - ESA

http://spaceflight101.com/exomars/exomars-tgo-enters-orbit-lander-falls-silent/

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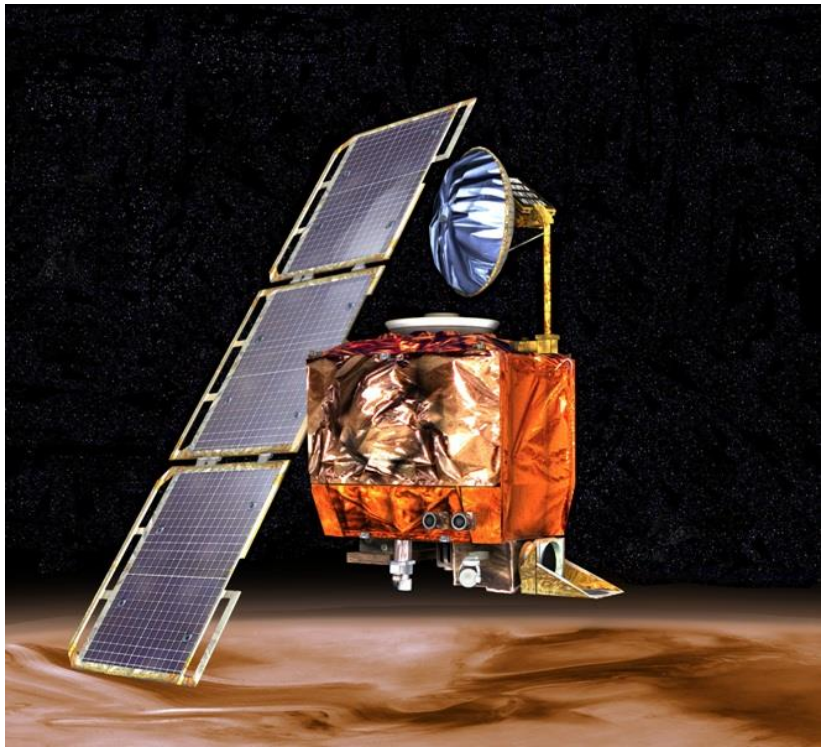
The consistency problem in systems engineering: NASA 1999

A disaster investigation board reports that NASA's Mars Climate Orbiter burned up in the Martian atmosphere because **engineers failed to convert units from English to metric**.

The $125 million satellite was supposed to be the first weather observer on another world.

A NASA review board found that the problem was in the software controlling the orbiter's thrusters. The **software** calculated the force the thrusters needed to exert in ***pounds*** of force. A separate piece of software took in the data assuming it was in the metric unit: ***newtons***.



"*People make errors,*" Gavin said. "*The problem here was not the error. It was* ***the failure of us to look at it end-to-end and find it.*** *It's unfair to rely on any one person.*"

https://www.wired.com/2010/11/1110mars-climate-observer-report/
http://edition.cnn.com/TECH/space/9909/30/mars.metric.02/

The consistency problem in systems engineering: Railway 2014

"SNCF's failure to verify measurements results in cost of **€50m to modify 1,300 platforms** in one in six regional stations"

"The train due on platform one will not be arriving for the foreseeable future – because **it is too big**."

"RFF sent SNCF the dimensions of stations built less than 30 years ago. It was then discovered – after it was too late – that the trains, due to go into service from now until 2016, were too big by several centimeters for stations built more than 50 years ago."

SNCF said **only 341 trains** – 182 from Alstom and 159 from Bombardier – were affected.

Mind le gap! France spends $15 billion on trains that are too fat for 1,300 station platforms – *Independent*

https://www.theguardian.com/world/2014/may/21/french-railway-operator-sncf-orders-trains-too-big

http://www.independent.co.uk/news/world/europe/french-rail-operator-orders-hundreds-of-new-trains-too-big-for-platforms-9412274.html

The consistency problem in systems engineering: Defense 2017

The Toulouse-based group has called for help on the **20 billion-euro** ($21.4 billion) program as it continues to encounter technical problems, **seven years after winning a 3.5 billion-euro** bailout from seven NATO nations.

Airbus has hinted at a broad shopping list of demands including a better share of liabilities on the A400M's engines, whose development has faced a series of problems.

Technical problems have put the A400M years behind schedule, with Germany's share of the costs having risen to 9.6 billion euros from an initial estimate of 8.1 billion.

https://www.reuters.com/article/us-airbus-a400m/airbus-faces-cash-headache-lengthy-talks-over-a400m-delays-idUSKBN1721UH

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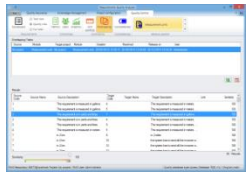
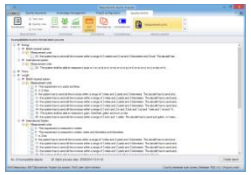
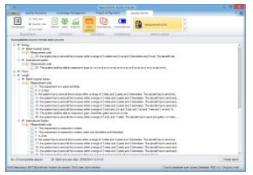
Consistency Metrics



Inconsistency By Arithmetic Operations with SKB



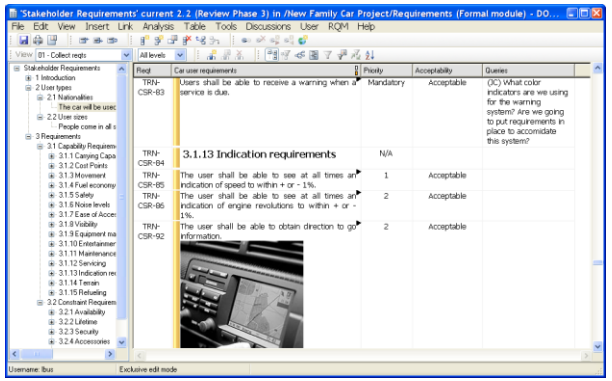
Inconsistency by comparison with other specifications



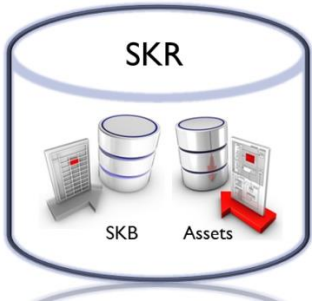
Inconsistency by NLP operations

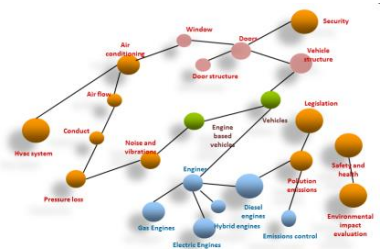
Requirements Quality Characteristics: Consistency

- How to… Perform Consistency
- Requirements Sets quality
  - Checks Consistency by performing arithmetic operations using information from the SKR



Arithmetic Ops

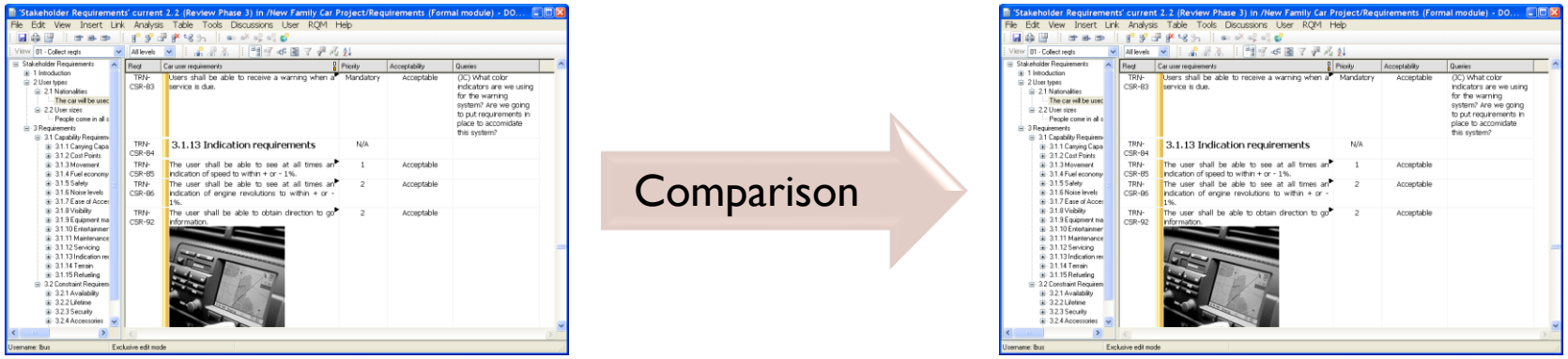




E.g. MTBF calculations

Requirements Quality Characteristics: Consistency

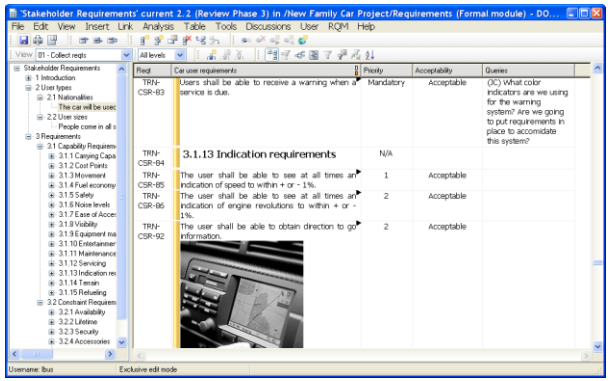
- How to… Perform Consistency
- Requirements Sets quality
  - Checks Consistency by comparison with other Requirements Set



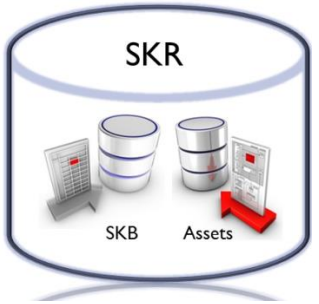
E.g.. Overlapping Requirements

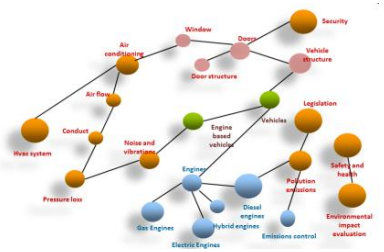
Requirements Quality Characteristics: Consistency

- How to… Perform Consistency
- Requirements Sets quality
  - Consistency



NLP Operation





E.g. Measurement Units Consistency

(In)-Consistency by Arithmetic Operation with SKB

- 1-Property Values Inconsistency
  - Property Values In-Specification vs. Property Values In-SCM (Conceptual Model)

- 2-Arithmetic Operation Compliance with SCM
  - Perform Arithmetic Operations within values of properties assigned to the elements of breakdown structures In-Specification comparing the result with the value of a property assigned to the composite of the breakdown. The breakdown Structure is selected in the SCM (Conceptual Model)

Notice that these (In)-Consistency Metrics need the existence of Ontologies (SCM + Patterns + Formalizations)

(In)-Consistency by Comparison with same/others specifications

- 3- Overlapping Requirements
  - Several requirements expressing the same need at the same level of abstraction

(In)-Consistency by NLP Operations

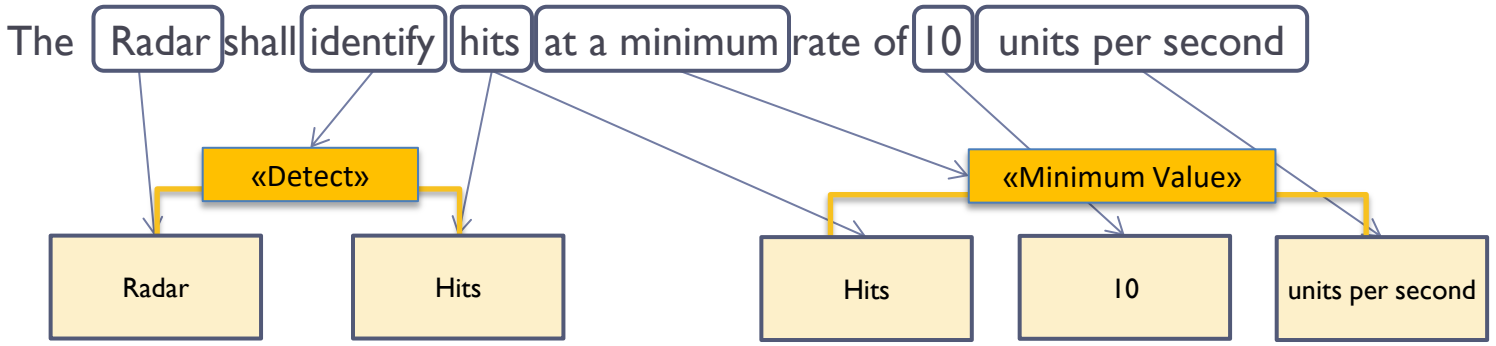
- 4-Measurement Units Consistency
  - Different requirements in the same specification uses different metric units

- 5-Measurement Units Inconsistency for specific property
  - Different units measuring the same property of an system component

Basics: Formalization of Requirements Statements

- The REUSE Company has developed IT solutions that attempt to understand, formalize, represent, reason-about and search-for all kinds of knowledge assets

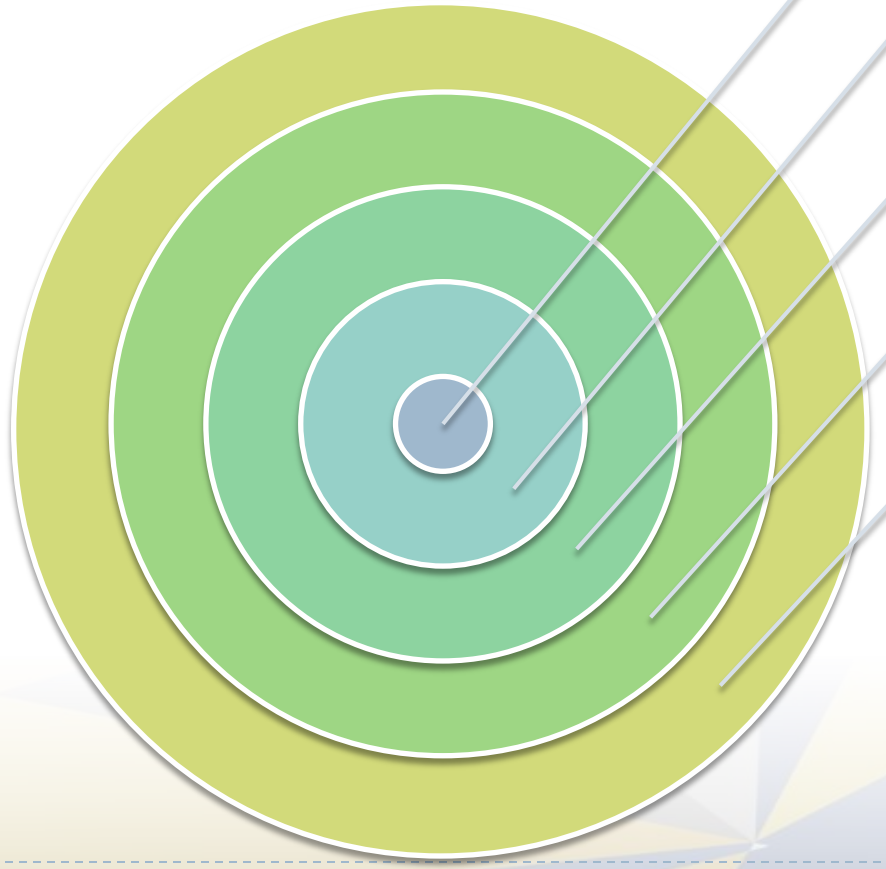
- Using graphs



  - And …

…And Ontologies

- What is an ontology for TRC



Terminology layer: valid terms, forbidden terms, other NL terms, Syntactic clustering types, everything as concepts

Thesaurus layer: relationships among concepts (hierarchies, associations, synonyms…) as well as semantic clusters and relationship types

Patterns layer: Matching Patterns

Formalization layer: Semantic formalization

Inference layer: for decision making (e.g. consistency, completeness)

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the REUSE company

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