First steps to improve the quality of your requirements

- Webinar rules:
  - The Webinar will start in few minutes
  - You'll be muted throughout the Webinar
  - There's a chat box for you to ask questions at any time during the webinar
  - Please address comments and questions to the user "The REUSE Company" and not to the presenter directly
  - If you have any technical issues please use this chat box, or mail us at: support@reusecompany.com
  - The Webinar will be recorded. A link to the recording will be sent to you in few days time

TRC

WEBINARS 2018

First steps to improve the quality of your requirements

Wednesday, 25 September 2024

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TRC Webinar - First steps to improve the quality of your requirements

the REUSE company

About The REUSE Company (TRC)

01 The company was created in **1999**

As a spin-off of a local university in Madrid (Spain)

02 **System + Software Engineers**

Smart combination between Company staff and R&D from Academia

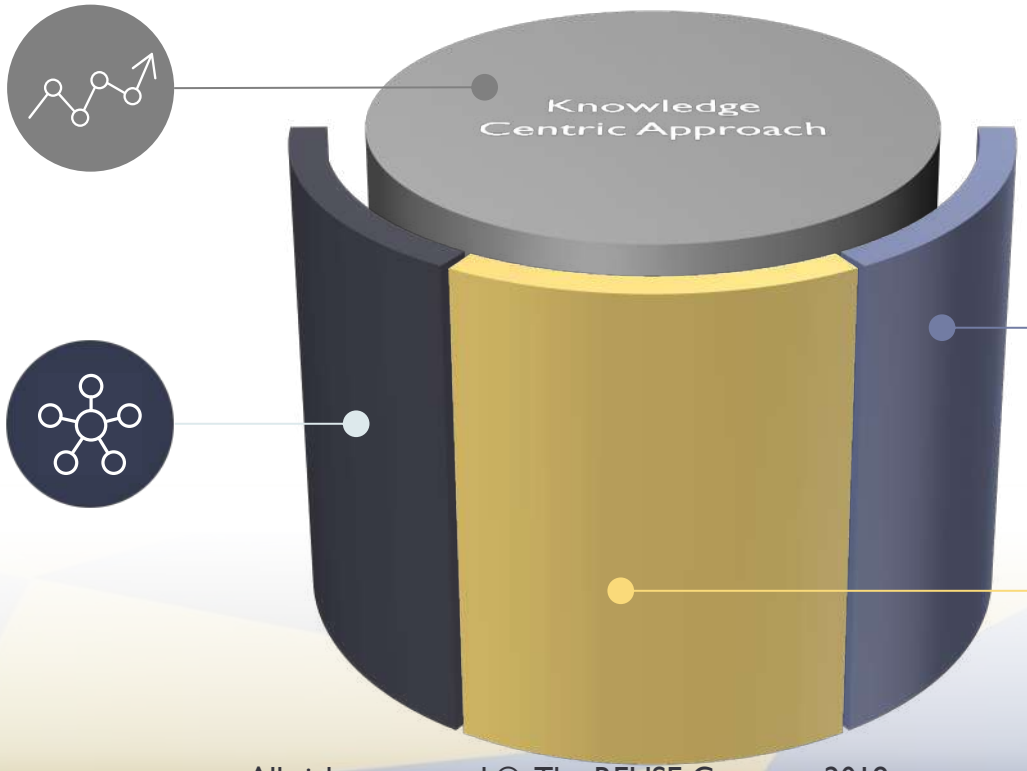
03 **Head Quarters:** Madrid

International offices: London (UK) Stockholm (Sweden)

04 Offering a **knowledge centric** approach to leverage system engineering activities in our customers

T (he) R (euse) Q (ompany)

To leverage Systems Engineering activities in our customers



TRACEABILITY

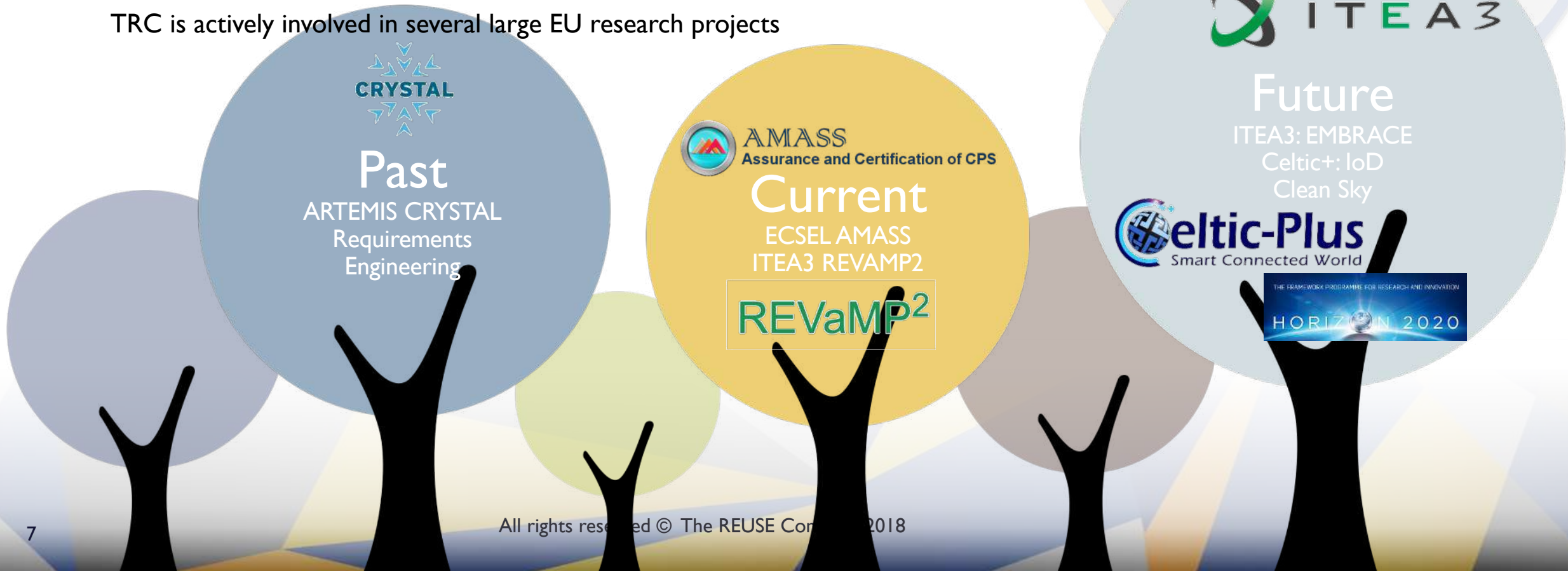
QUALITY

REUSABILITY

Research and innovation in our DNA. Public projects

Research and Innovation in our DNA

- Spin-off of Carlos III University of Madrid
- TRC's headquarter is in the Legatec Technology Park of the University
- ≈10% of revenues are devoted to R&D
- TRC is actively involved in several large EU research projects



Who is using our technology?

AIRBUS
AIRBUS DEFENCE & SPACE
AIRBUS GROUP INNOVATIONS
SAFRAN AIRCRAFT ENGINES
THALES
HENSOLDT
THALES Communications & Security S.A.S.
aes
arianeGROUP
FUSION FOR ENERGY
iter the way to new energy
EDF
REPSOL
Shell
RENAULT
THINK SURGICAL
HealthNet
SIEMENS
Santander
BCR Banco de Costa Rica
rtve
ELRA European Land Registry Association
tirant lo blanch

José Fuentes

- Current position: Chief Operating Officer of the REUSE Company
- For over 5 years, product manager of the Requirements Quality Analyzer tool
- INCOSE CSEP Certified, and member of the board of AEIS – the Spanish chapter of INCOSE
- Active contributor to the INCOSE Guide for Writing Requirements

José Fuentes

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The impact of poor-quality requirements

The consistency problem in systems engineering: Schiaparelli lander

Vs.

400.000.000 € loss

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

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

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

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

The consistency problem in systems engineering: S-80 submarine

Spanish new flet of submarines **S-80**, from 2,132 M€ to 3,907 M€, a rise of 83%.

Close to 10 years behind Schedule

Design issues: 125 ton overweight, thus endangering floatability and requiring an increase in length as well

OpsCon issues: size of the deck (78 m for the old deck, 81 for the submarine)

https://elpais.com/politica/2018/07/24/actualidad/1532442691_488520.html

The consistency problem in systems engineering: Boeing 777-200

- In-flight issue on the 1st August 2005, flight from Perth to Kuala Lumpur
- The airspeed display indicating aircraft **speed close to overspeed and the stall speed limit simultaneisly**.
- "The Australian ATSB concluded that a contributing safety factor was that *an anomaly existed in the component software hierarchy that allowed inputs from a known faulty accelerometer to be processed by the air data inertial reference unit (ADIRU) and used by the primary flight computer, autopilot and other aircraft systems*."

https://www.atsb.gov.au/publications/investigation_reports/2005/AAIR/aair200503722.aspx

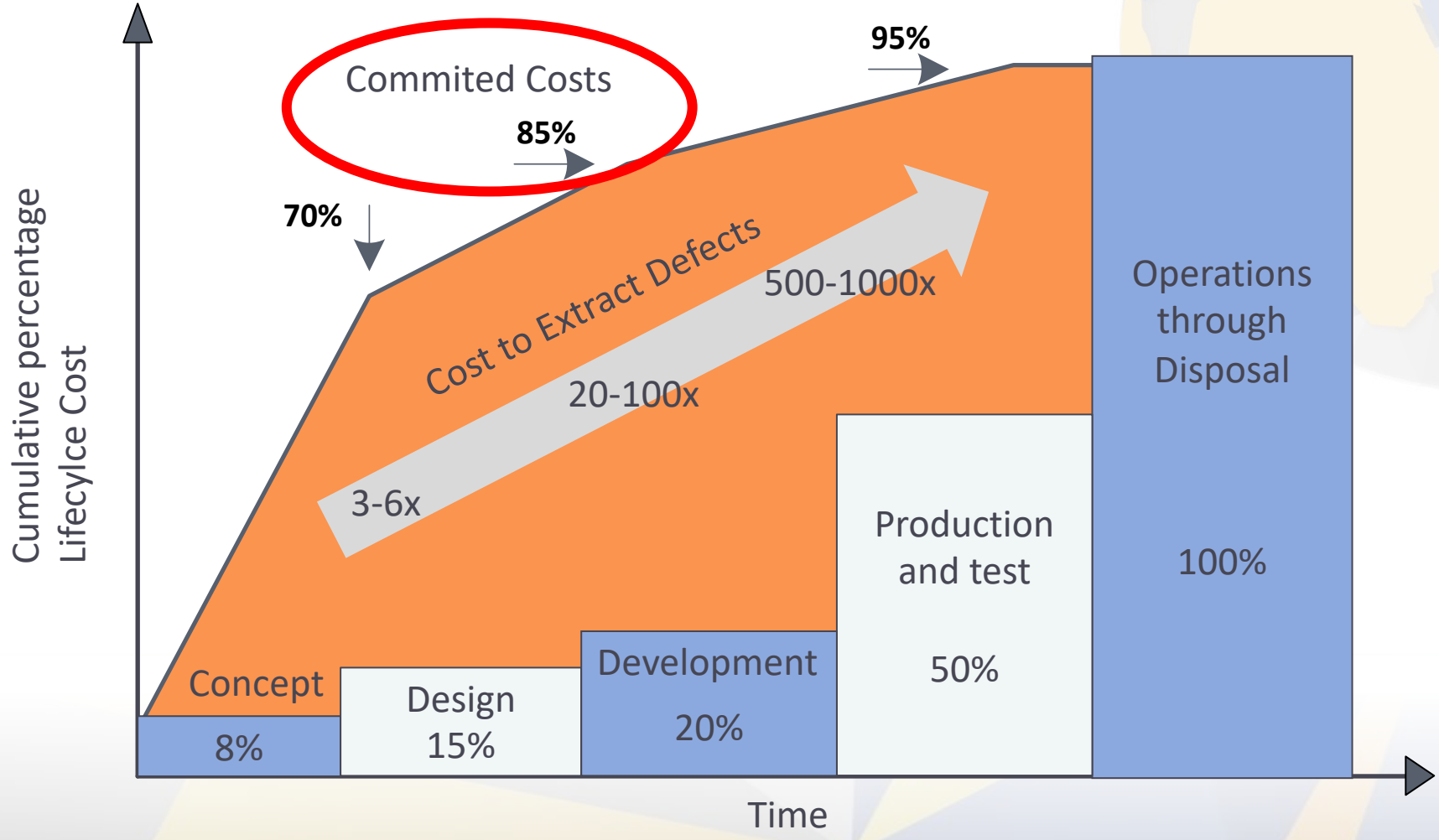
- Example of a systems requirement error where the ADIRU would reinstate known failed accelerometers

The impact, and the source

- Some of these issues were reported as **software issues**…
- … while the source was clearly **requirements**
- And the root cause can be twofold:
  - Wrong engineering decisions
  - Miscommunication and ambiguous requirements
- No matter what the root cause is, **the impact huge**:

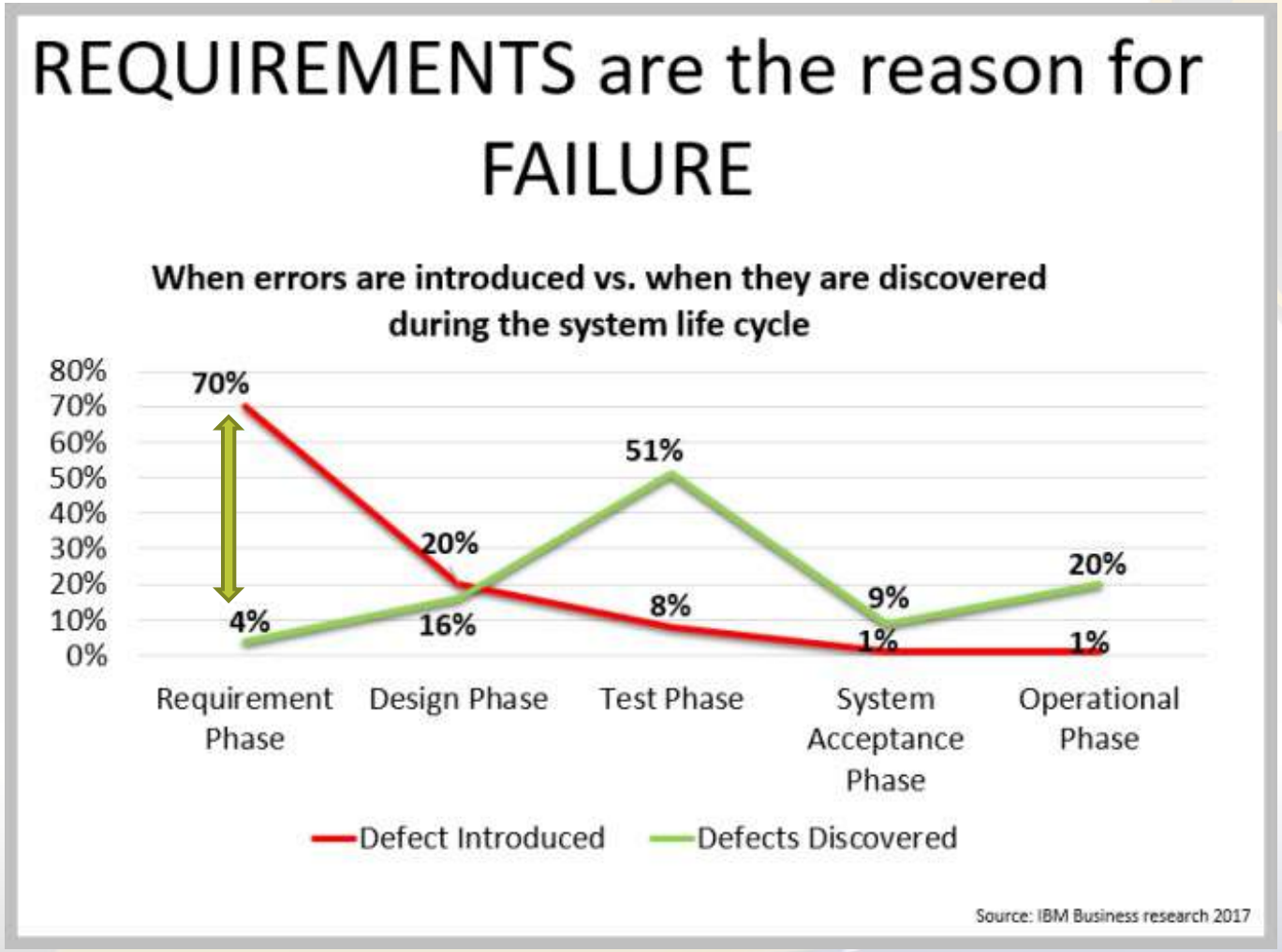
- **How to fix this:** following the adequate set of tips to write requirements:
  - To reduce miscommunication
  - To streamline the writing of textual requirements, and thus increasing time to study engineering decisions
  - To ease the detection of wrong engineering decisions
  - Even to detect those issues automatically, in real-time

The impact, and the source (…cont.)



Source : INCOSE SE Handbook V4

The impact, and the source (…cont.)



Quick tips to improve the quality of your *Requirements specifications*

Why focusing on the quality of textual requirements?

- Because communication is not always that easy:

Requirements quality characteristics vs quality metrics

- Well-known requirements quality characteristics
  - IEEE Std. 830:
    - Correct
    - Unambiguous
    - Complete
    - Consistent
    - Ranked
    - Verifiable
    - Modifiable
    - Traceable
  - ECSS-E-ST,
    ISO/IEC 29148, others:
    - Pretty much the same characteristics

"I believe that this nation should commit itself to achieving the goal, before this decade is out, of landing a man on the Moon and returning him safely to Earth"

8.2.4 Ambiguity

a. The technical requirements shall be unambiguous.

8.2.5 Uniqueness

a. Each technical requirement shall be unique.

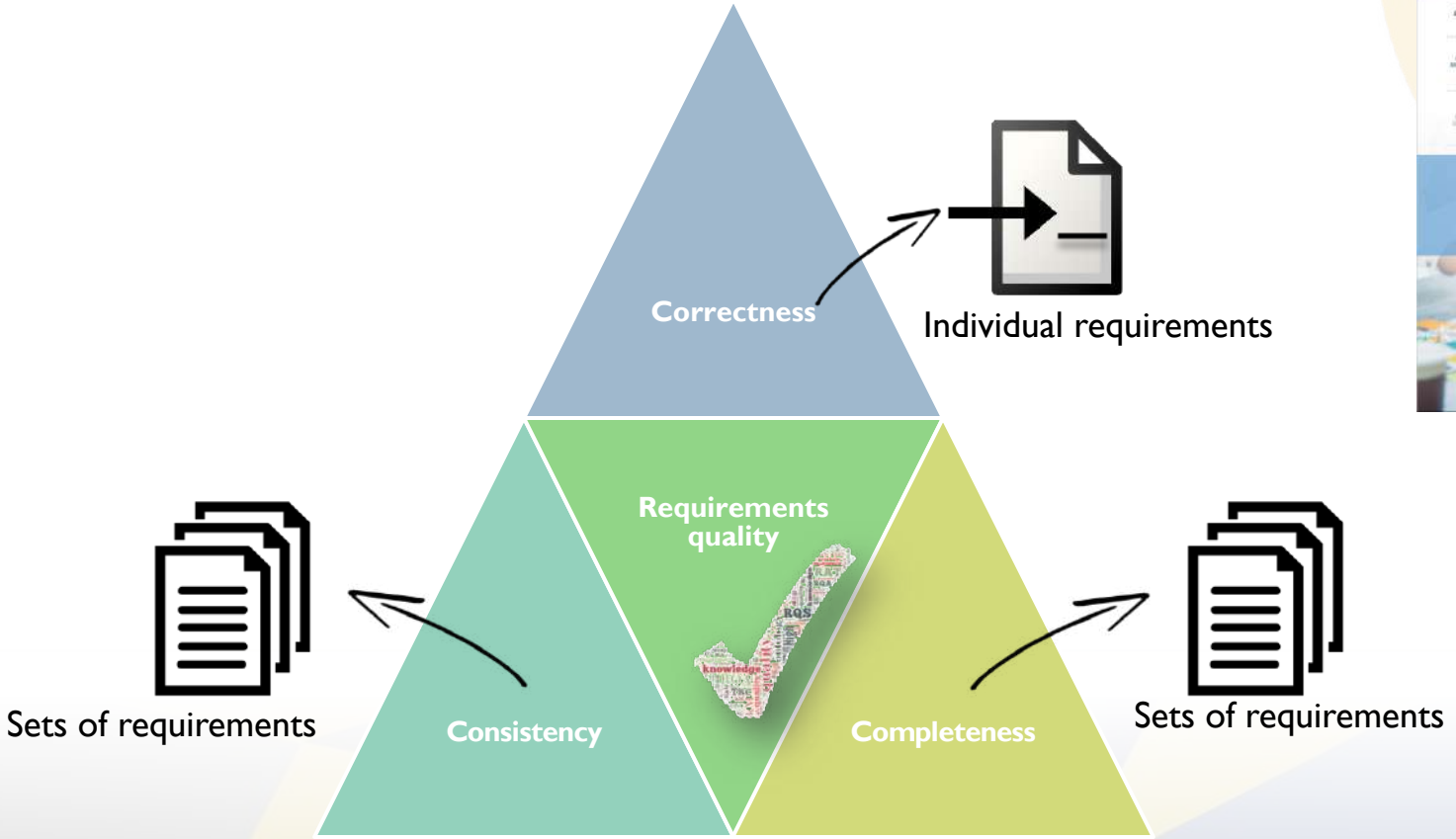
ECSS-E-ST-10-06C 6 March 2009

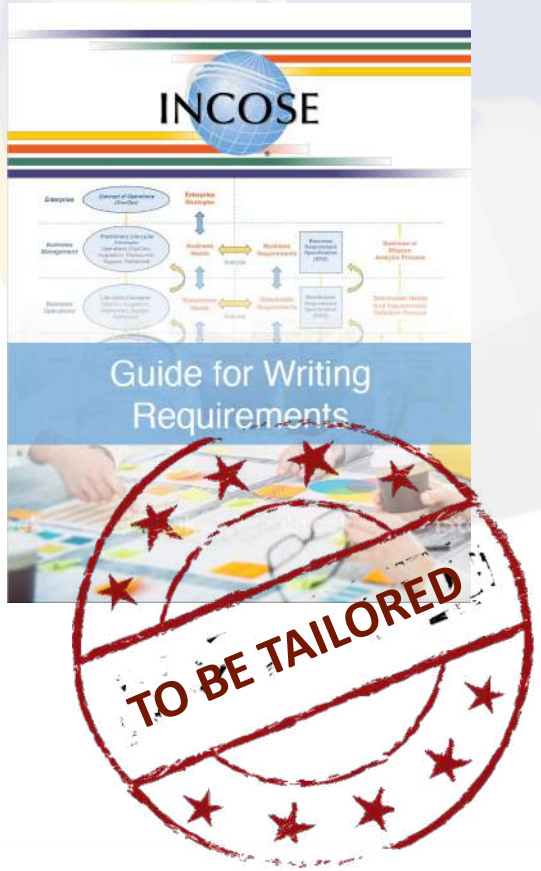
Requirements Quality Papers

- Ivy Hooks - "Writing Good Requirements" Proceeding's of the Third International Symposium of the INCOSE Volume 2 1993
- P. Kar and M. Bailey "Characteristics of Good Requirements" Presented at the 1996 INCOSE Symposium.
- William M. Wilson – "Writing Effective Natural Language Requirements Specifications" The Journal of Defense Software Engineering February 1999
- Karl E. Wiegers "Writing Quality Requirements" published in Software Development, May 1999.

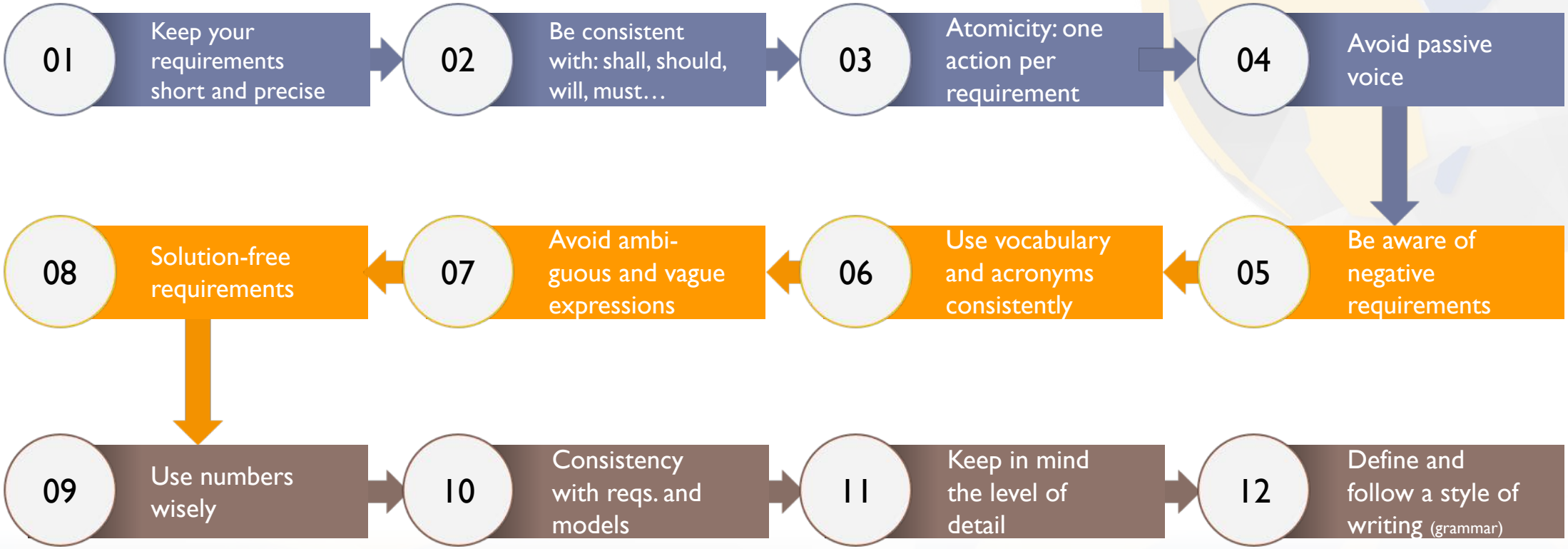
Requirements quality metrics: CCC Approach

- CCC – Correctness, Consistency and Completeness





Rules for writing good requirements: summary

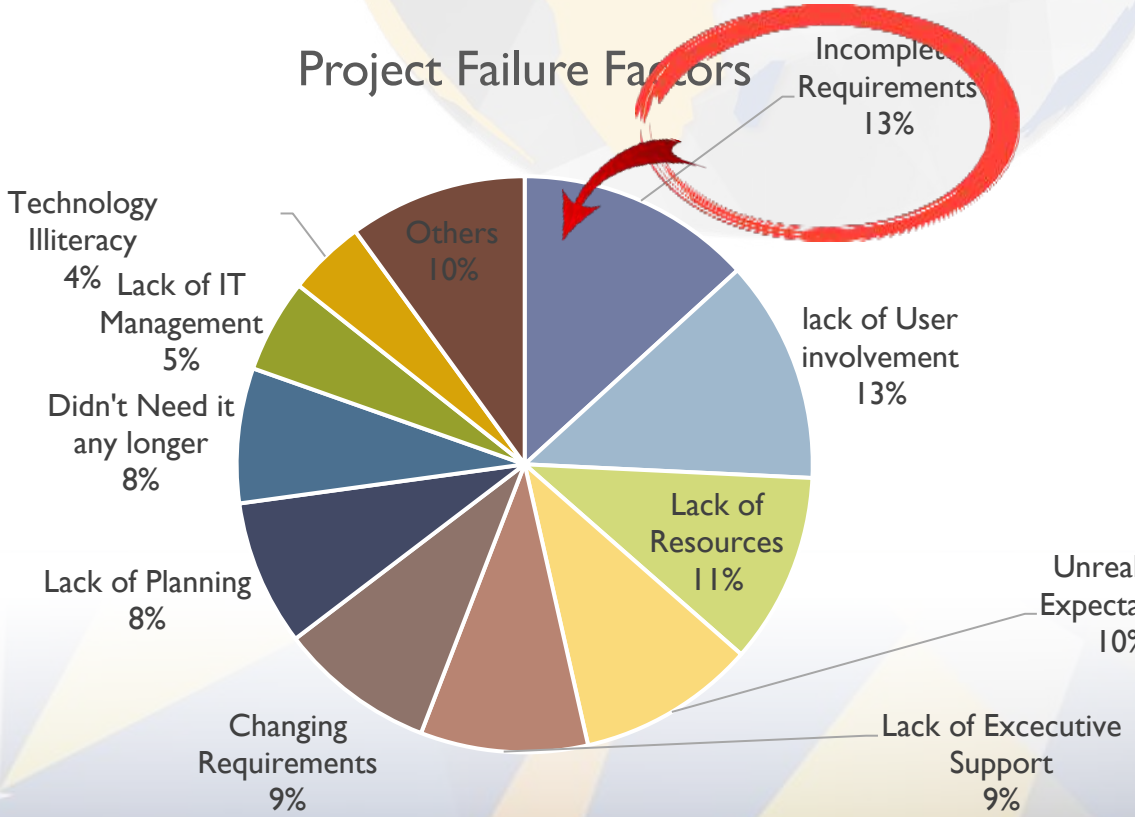


Rules for writing requirements

- **The most important rule**:
  - Use the **common sense**
  - Don't try to match **all** these rules in **all** your documents/requirements
  - Don't try to use all these rules from the first day, better to take small steps towards your goal
  - These **are not** the *12 commandments!!*

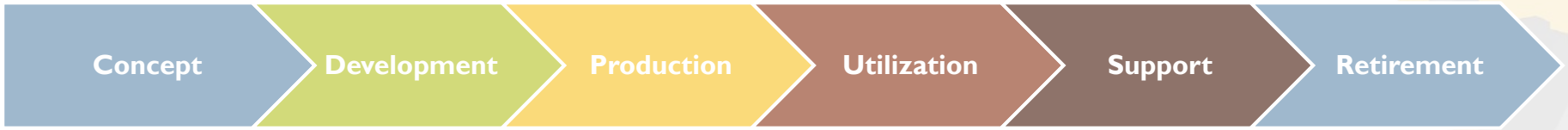
Requirements quality criteria: Completeness

Project Success Factors	% of Responses
1. User Involvement	15.9%
2. Executive Management Support	13.9%
3. Clear Statement of Requirements	13.0%
4. Proper Planning	9.6%
5. Realistic Expectations	8.2%
6. Smaller Project Milestones	7.7%
7. Competent Staff	7.2%
8. Ownership	5.3%
9. Clear Vision & Objectives	2.9%
10. Hard-Working, Focused Staff	2.4%
Other	13.9%

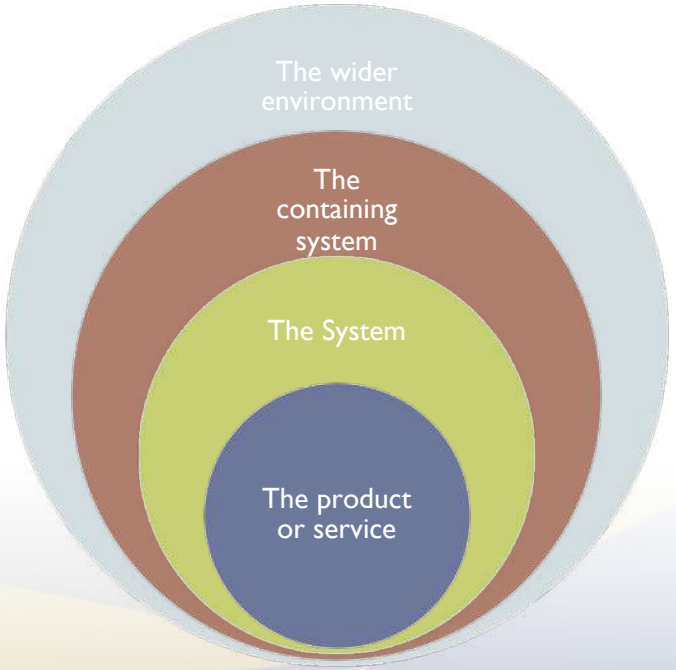


Requirements quality criteria: Completeness

- Are all the different product stages covered in your requirements?



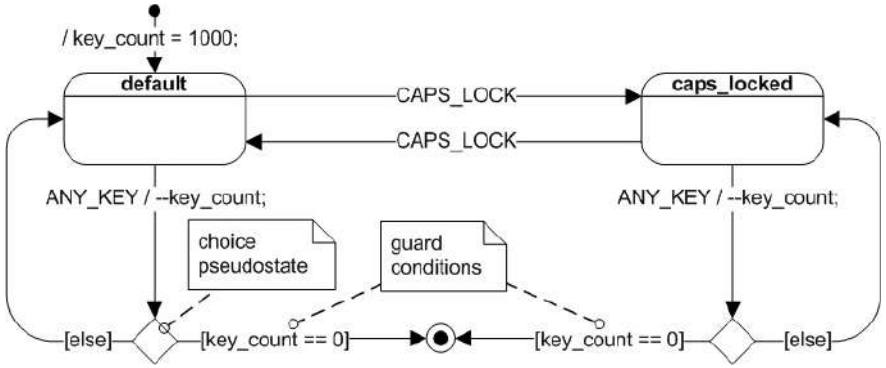
- Did you consider every stakeholder?



Requirements quality criteria: Completeness (ii)

Check out our Webinar on Requirements Completeness

- Are all the different states and modes covered?



- Happy-path requirements are easy to identify. What about alternative or exception handling requirement?

- Functional requirements represent just a part of the requirements you need:

NASA Taxomony of requiremnets: from NASA Systems Engineering Handbook

Technical Requirements – Allocation Hierarchically to PBS
Functional Requirements
Performance Requirements
Interface Requirements

Operational Requirements – Drive Functional Requirements
Mission Timeline Sequence
Mission Configurations
Command and Telemetry Strategy

Reliability Requirements – Project Standards – Levied Across Systems
Mission Environments
Robustness, Fault Tolerance, Diverse Redundancy
Verification
Process and Workmanship

Safety Requirements – Project Standards – Levied Across Systems
Orbital Debris and Reentry
Planetary Protection
Toxic Substances
Pressurized Vessels
Radio Frequency Energy
System Safety
…

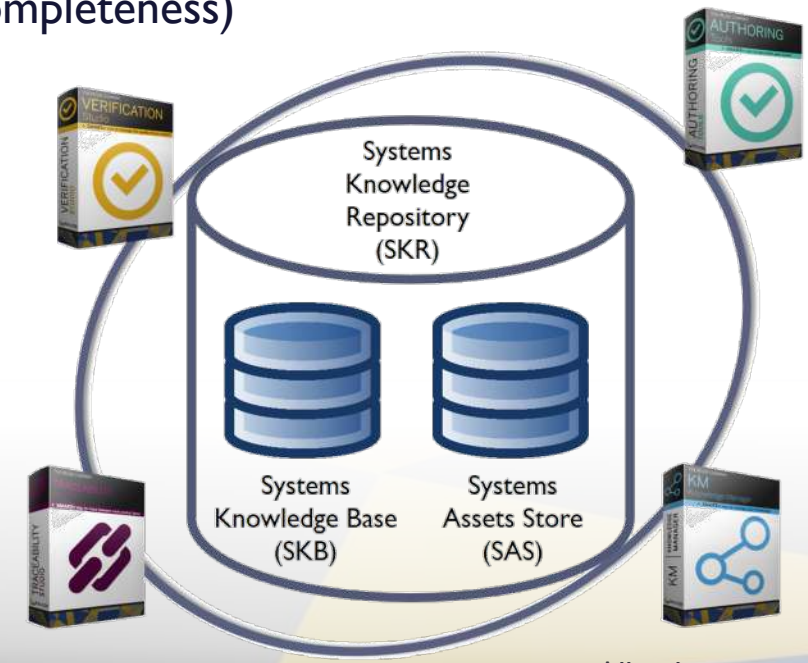
Specialty Requirements – Project Standards – Drive Product Designs
Producibility
Maintainability
Asset Protection
…

Improving the quality of your requirements

At your fingertips!

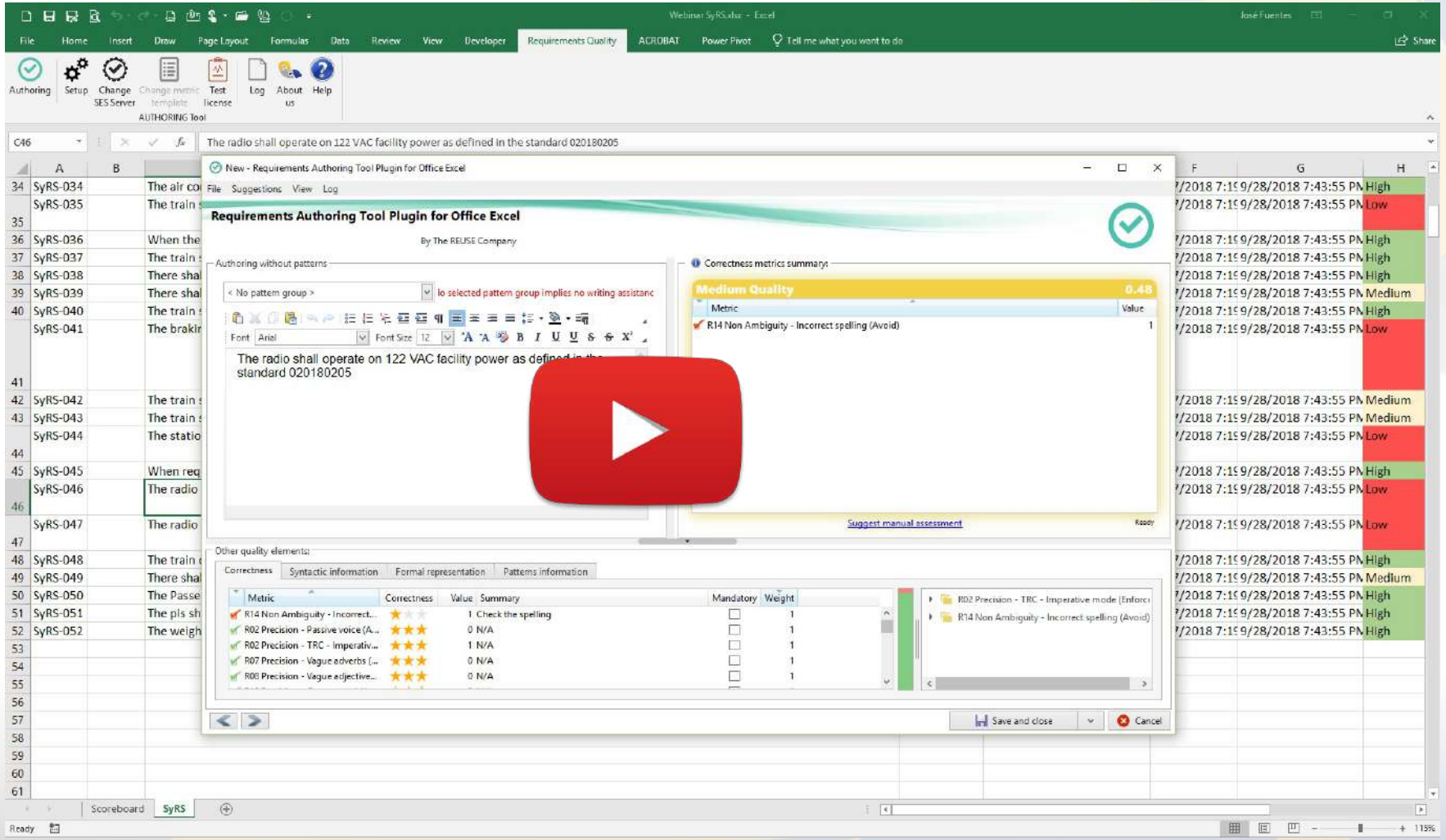
The TRC Systems Engineering Suite

- The Systems Engineering Suite intends to tackle requirements quality management by offering a set of tools and processes
- Automatic measurement of requirements quality metric
- Support to Requirements Authoring
- SES Suite models requirements quality metrics using the CCC approach (Correctness, Consistency and Completeness)



- **VERIFICATION Studio:** to setup, check and manage the quality of a requirements specification
- **Rich Authoring Tool (RAT):** to assist authors while they are creating or editing requirements
- **Knowledge Manager (KM):** to manage knowledge around a requirements specification: dictionaries, glossaries, concept maps, knowledge models, ontologies, patterns…
- **TRACEABILITY Studio:** to link together all the different types of artifacts managed with the rest of the tools

Live demo




Q&A

Next webinar

- **Topic:** Knowledge and Quality management milestones in a SE organization
- **Content:**

Ambiguity is a factor that can jeopardize the optimal development of a project, as decisions over the requirements statement are made subjectively. There are four main aspects that aids KCSE (Knowledge Centric Systems Engineering) implementation within an organization, which are:

  - Discovering the **organizational know-how** in Requirements Documents
  - Controlled information to **unify requirements interpretation**
  - Identifying **strengths and challenges** in requirements documents
  - Performing **smarter and quicker verification** analysis

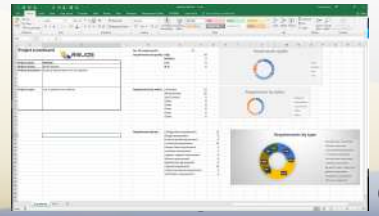
- **Dates:**
  - Tuesday, 30th October at 5.00 pm CET
  - Wednesday, 31st October at 9.00 am CET

WEBINAR ID	NAME	DATES	TIME
		16/01/2018	5.00 pm CET
TRCW-01	Requirements Quality along the supply chain	18/01/2018	9.00 am CET
		20/02/2018	5.00 pm CET
TRCW-02	Managing the quality ecosystem: DOORS, Rhapsody, Simulink and Modelica	22/02/2018	9.00 am CET
		13/03/2018	5.00 pm CET
TRCW-03	Requirements Quality with Logical & Physical models (Rhapsody & Simulink) and Ontolog	15/03/2018	9.00 am CET
		10/04/2018	5.00 pm CET
TRCW-04	Can script based languages, like DXL, hack Natural Language Processing?	12/04/2018	9.00 am CET
		29/05/2018	9.00 am CET
TRCW-05	Procuring systems: PQS for SMARTer acquisition	31/05/2018	5.00 pm CET
		02/10/2018	9.00 pm CET
TRCW-06	First steps to improve the quality of your requirements	04/10/2018	5.00 am CET
		30/10/2018	5.00 pm CET
TRCW-07	Knowledge and Quality management milestones in a SE organization	31/10/2018	9.00 am CET
		13/11/2018	9.00 pm CET
TRCW-08	A practical way to implement ISO 15288 V&V processes: The VERIFICATION Studio	15/11/2018	5.00 am CET
		11/12/2019	5.00 pm CET
TRCW-09	Writing requirements in DOORS and Integrity using the EARS patterns	13/12/2019	9.00 am CET
		15/01/2019	5.00 pm CET
TRCW-10	Automatic checking of quality metrics for logical and physical models	17/01/2019	9.00 am CET
		12/02/2019	5.00 pm CET
TRCW-11	Streamlining traceability domain: Managing and suggesting traces using Traceability Stud	14/02/2019	9.00 am CET
		12/03/2019	5.00 pm CET
TRCW-12	Extending RQA with custom quality rules: A one-hour practical approach	14/03/2019	9.00 am CET

Additional resources

- Our Quality database in different languages (rules and patterns): https://bit.ly/2OX32Dw
- Where to learn more about our rules (CCC approach):
  - Correctness:

  - Consistency:
  - Completeness:
  - Patterns:
- Requirements template:



TRC WEBINARS 2018

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the REUSE company