TRC

WEBINARS 2020

Getting started with Requirements Quality Assessment

Wednesday, 25 September 2024

Presenters' profile

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Introduction: Webinar rules

- Webinar rules:
  - You'll be muted all along the Webinar
  - There's a chatting box to ask your questions or send your comments when you want
  - Please address these comments and questions to the user "The REUSE Company" and not to the presenter directly
  - If you have any technical issue please use this chatting 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

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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 (Spain)

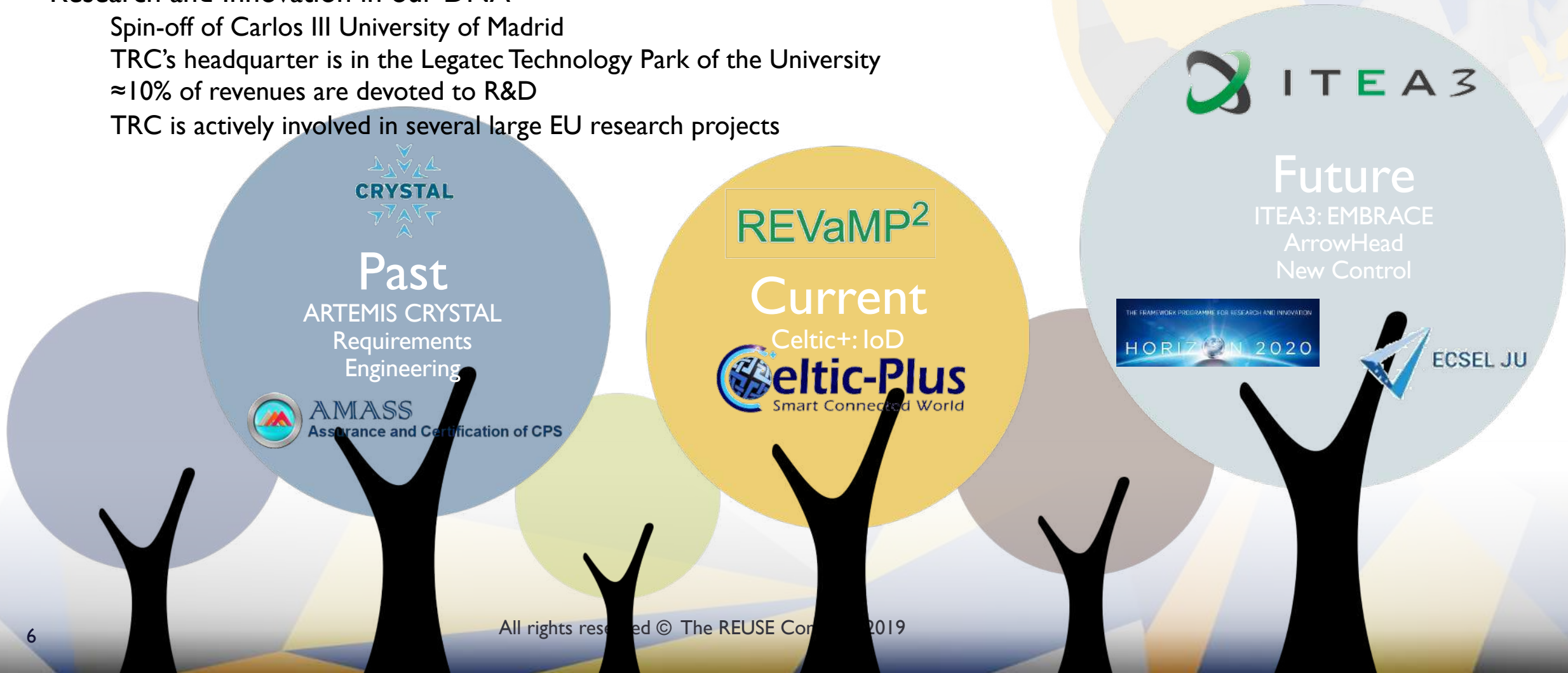
International offices: London (UK) Stockholm (Sweden)

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

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

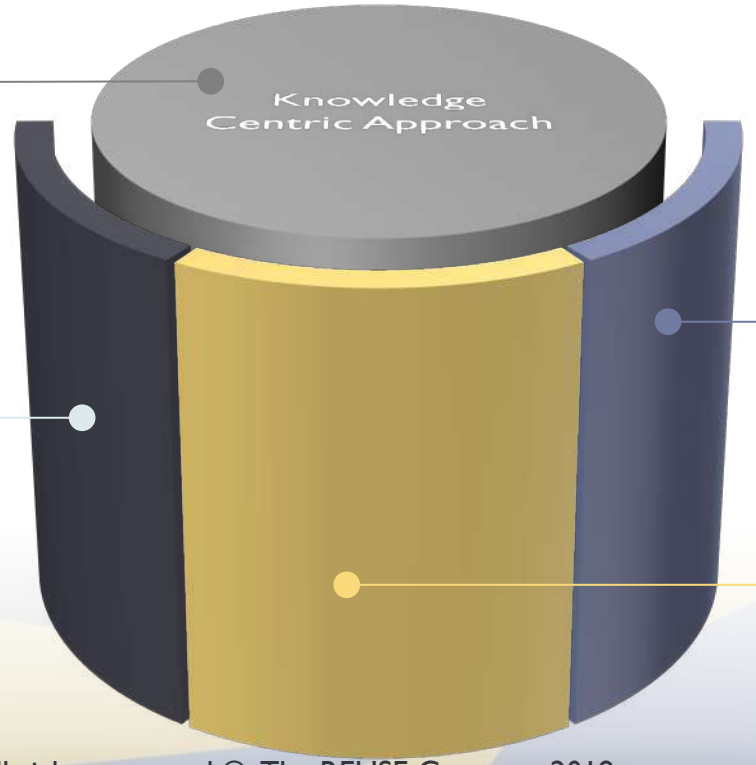


Introduction to The REUSE Company

the REUSE company

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

Leveraging Systems Engineering activities



TRACEABILITY

QUALITY

REUSABILITY

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
acciona Agua
orange
rtve
ELRA European Land Registry Association
tirant lo blanch

Borja López

- Responsible for the **Innovation Development** (next year's commercial releases) at The REUSE Company.
- Borja has experience in Systems Engineering in the aerospace, defense, railway and automotive industries.
- Borja is leading **technical solutions** that help improve Requirements Verification automation along the Systems Engineering processes.
- His topics of interest include **knowledge** management, **information** retrieval, **requirements** engineering, software engineering and domain architectures.

The impact of poor-quality requirements

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: 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: 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 fleet 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 simultaneously**.
- "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

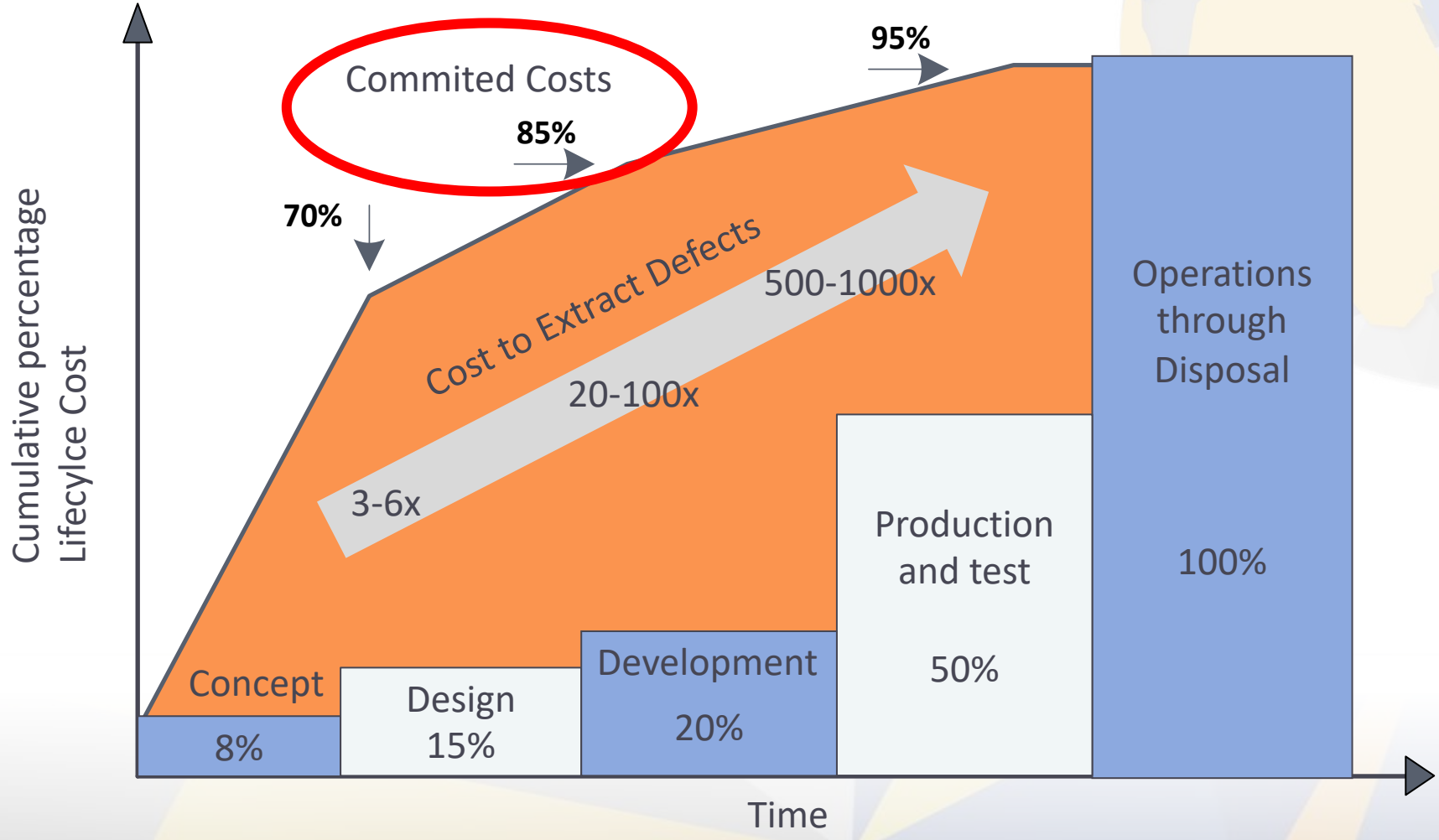
- Example of a systems requirement error where the ADIRU would reinstate known failed accelerometers

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**:

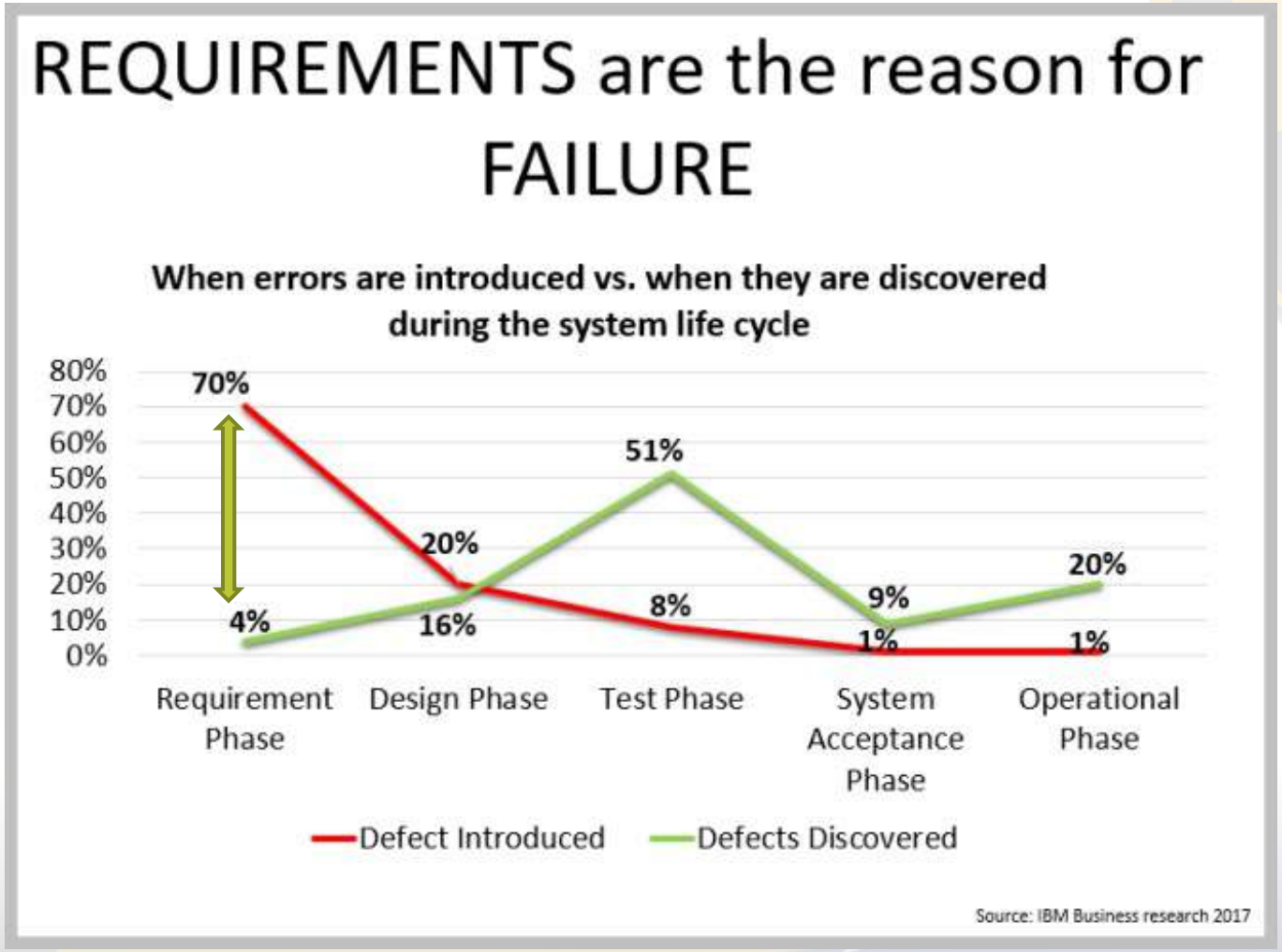
- **How to fix this:** following the adequate set of tips to write requirements:
  - To reduce miscommunication
  - To streamline the writing of textual requirements, and thus increasing time to study engineering decisions
  - To ease the detection of wrong engineering decisions
  - Even to detect those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

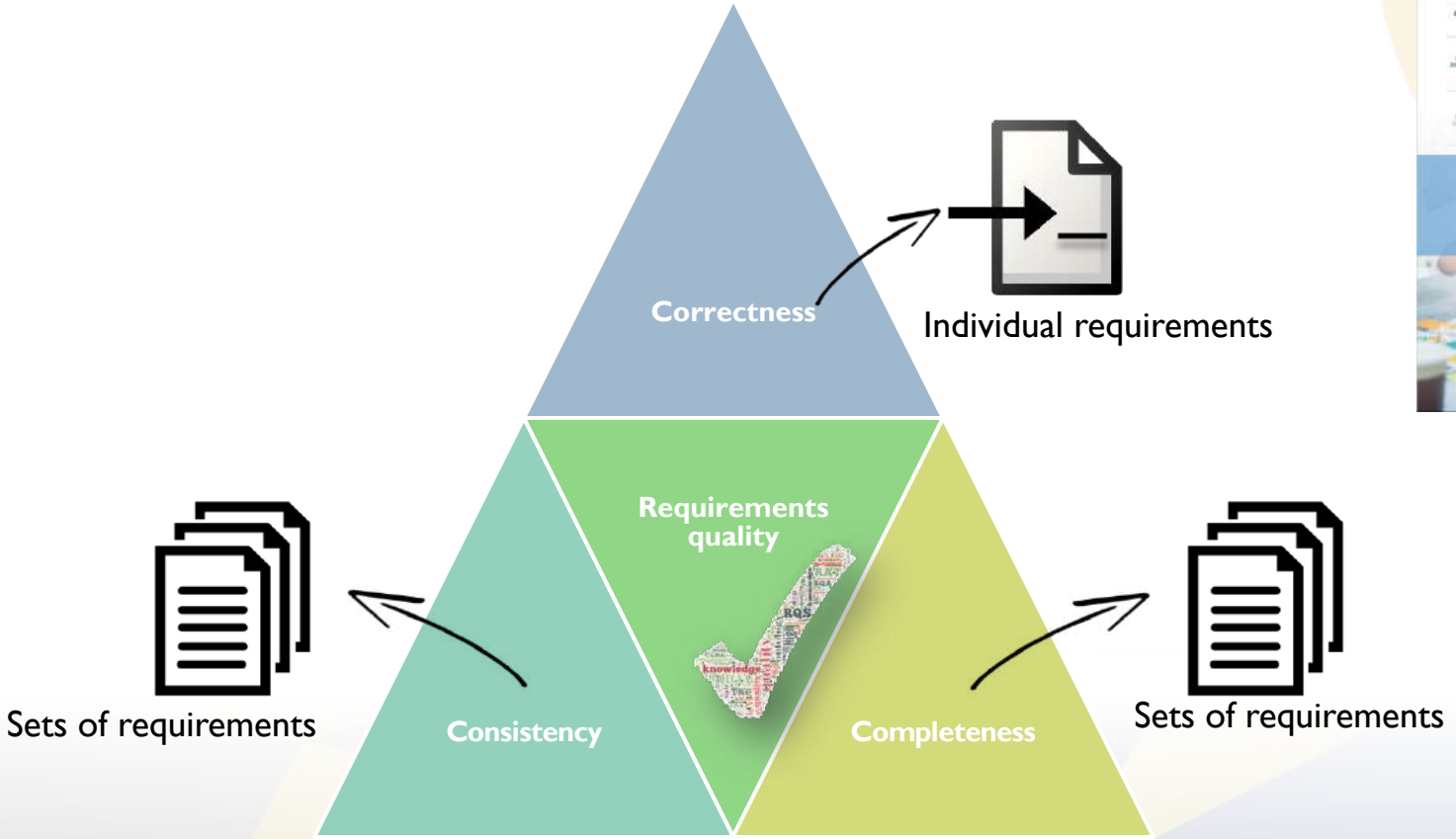
8.2.5 Uniqueness

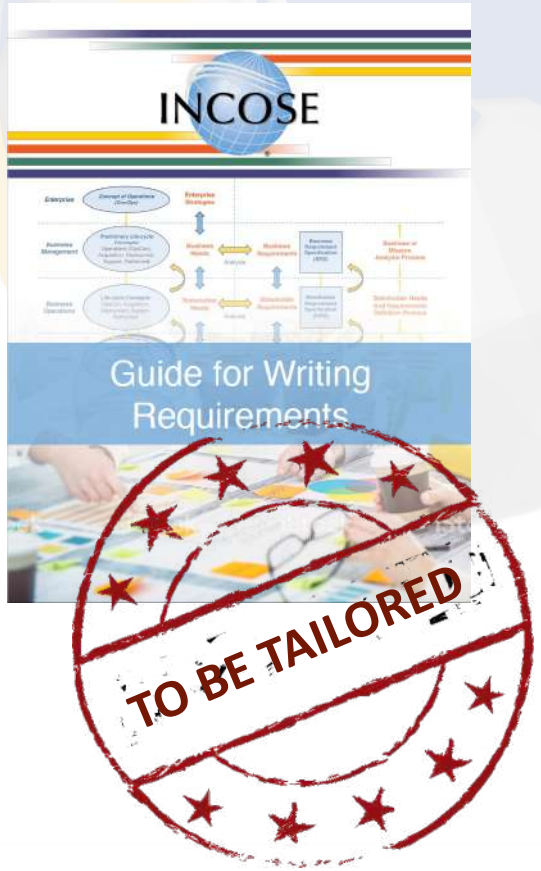
a. Each technical requirement shall be unique.

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

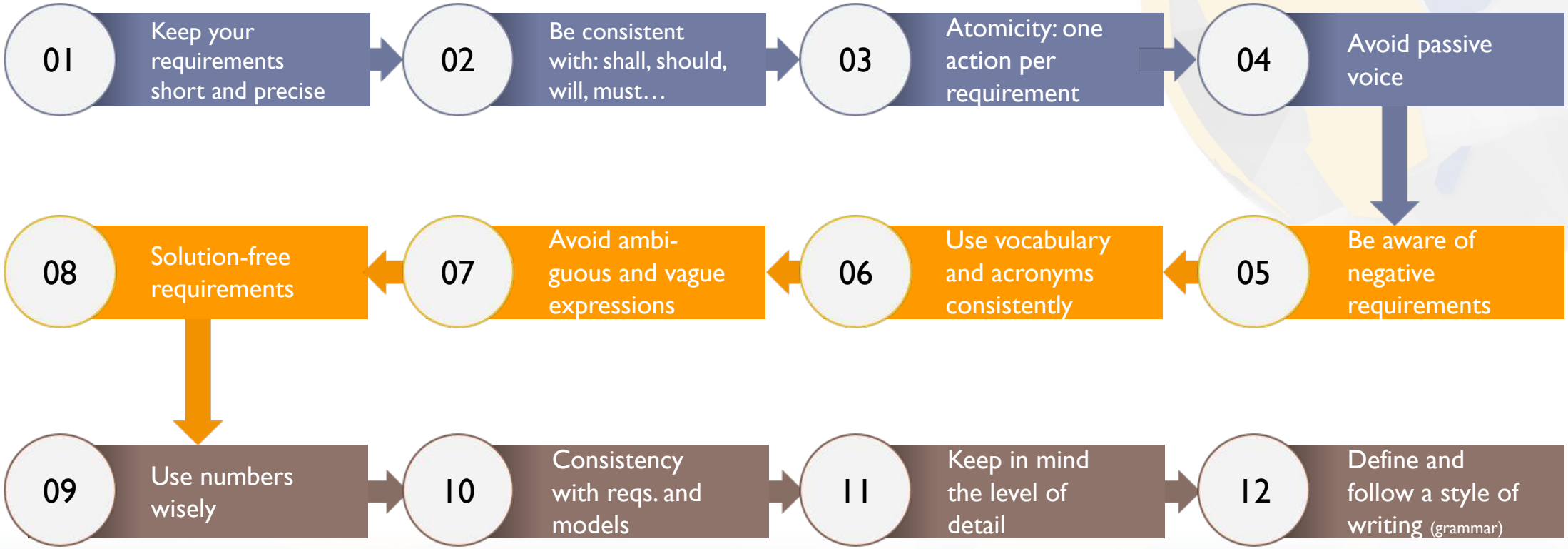
Requirements quality metrics: CCC Approach

- CCC – Correctness, Consistency and Completeness





Rules for writing good requirements: summary



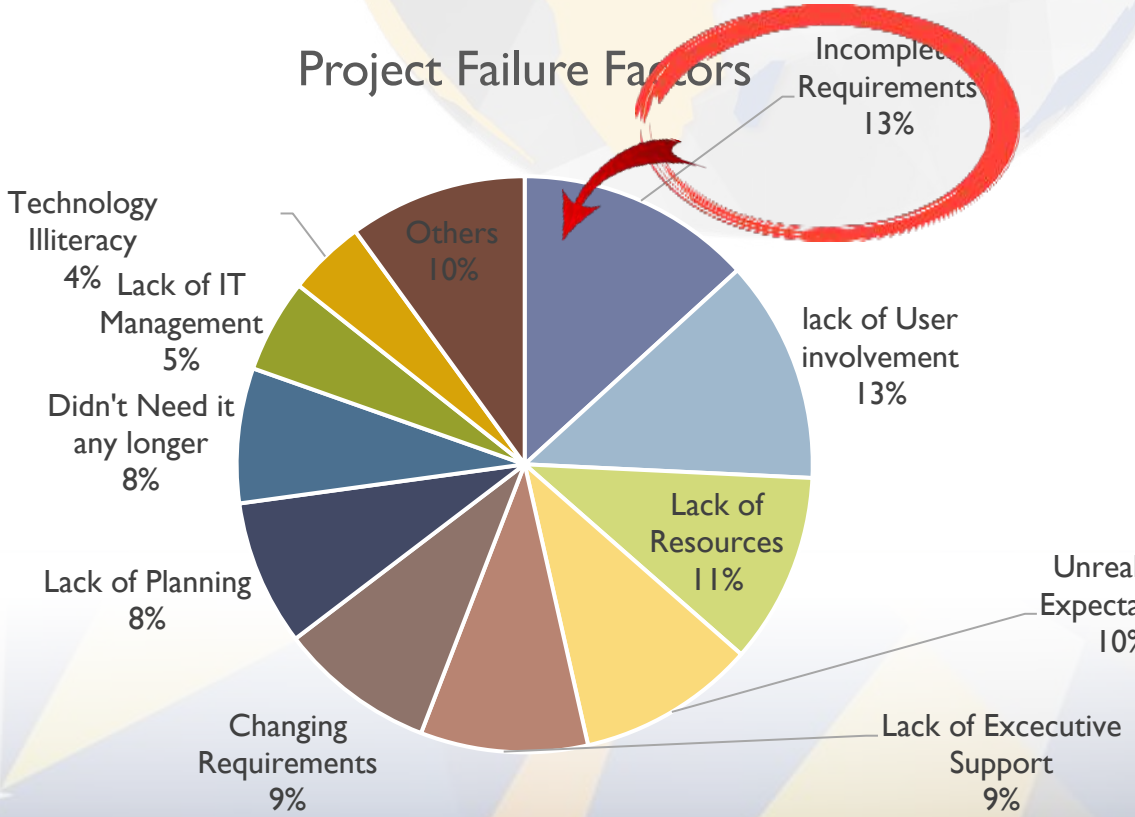
Rules for writing requirements

- **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

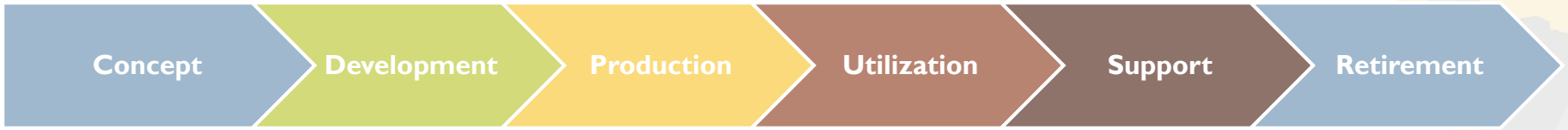
Project Success Factors	% of Responses
1. User Involvement	15.9%
2. Executive Management Support	13.9%
3. Clear Statement of Requirements	13.0%
4. Proper Planning	9.6%
5. Realistic Expectations	8.2%
6. Smaller Project Milestones	7.7%
7. Competent Staff	7.2%
8. Ownership	5.3%
9. Clear Vision & Objectives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

Chaos Report

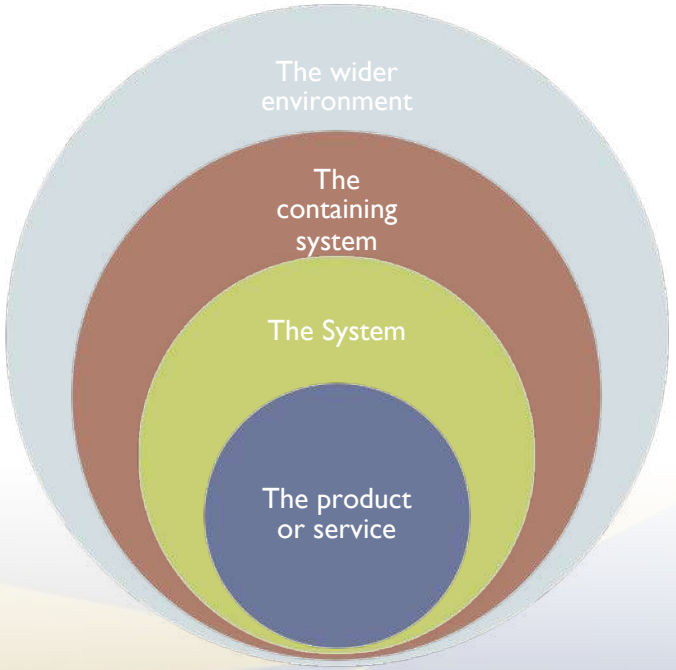


Requirements quality criteria: Completeness

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



- Did you consider every stakeholder?



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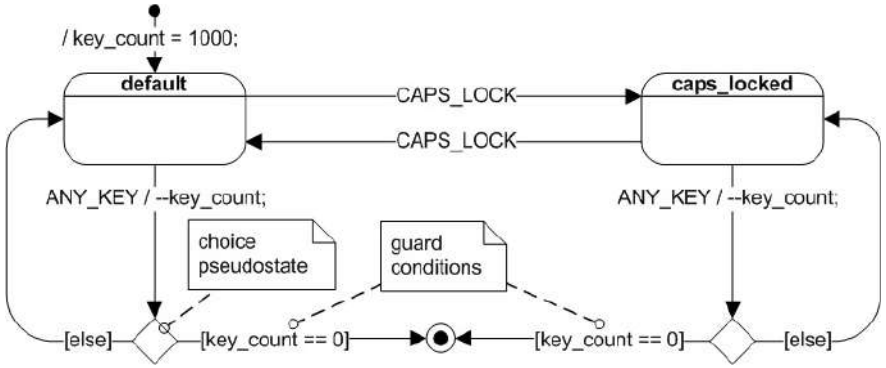
Quick tips to improve the quality of your requirements

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 Taxonomy of requirements: 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!

KM -Knowledge Management

Capture, creation, **representation**, and **exchange of knowledge** across targeted groups of **stakeholders**

Traceability

Support the **integration** among assets through semantic **interoperability** to ensure the **traces** between similar elements

RAT - Requirements

Enhance Requirements **writing** engineering skills and ensure **CCC** based on the organizational **know-how**

RQA - Quality Management

Define, implement and perform **measures** to meet the **quality priorities** that satisfy the **verification** of any engineering element

CCC: Correctness, Completeness and Consistency

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Live Demo

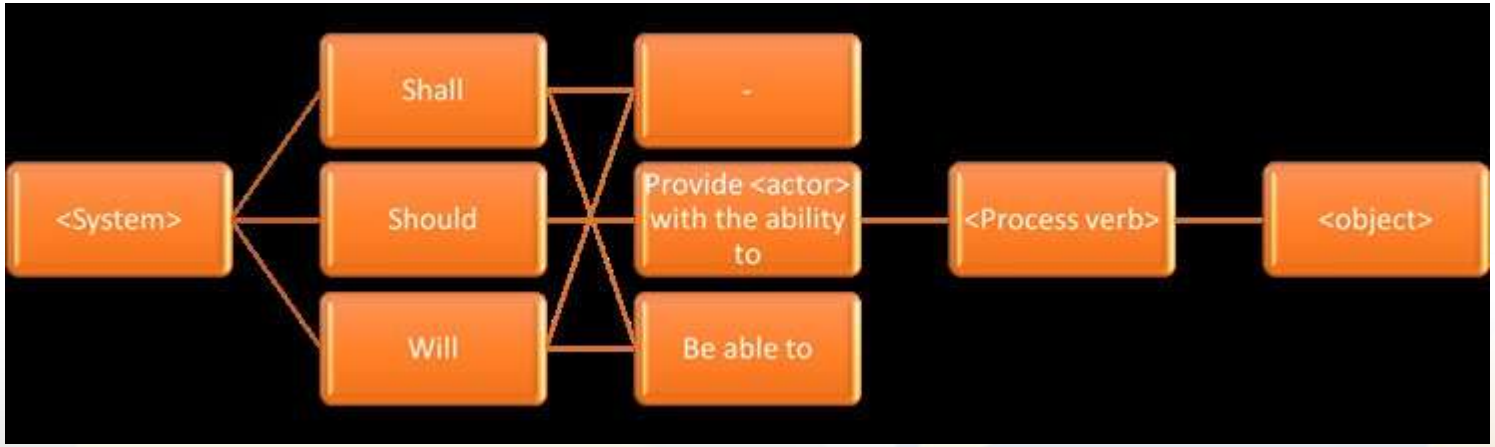
Thank you!

You can reach me at borja.lopez@reusecompany.com


Q&A

Next webinar

- **Ensuring completeness, consistency, and correctness with the MASTER patterns by Sophist and RAT – Authoring Tools**
- The use of patterns to write structured requirements is strongly recommended in Requirements Engineering in order to avoid defects in engineering systems development that are mainly traced back to unprecise, unclear, or incomplete requirements.
- Since the 1990s, the members of the **SOPHIST GmbH** (usually called "The Sophists") have been in the forefront of consulting and training services in the area of requirements engineering. The **Sophist patterns** comprise both functional and non-functional requirement patterns, as well as patterns to express conditions and properties of systems.
- The objective of this webinar is to introduce you to the newly integrated **Sophist patterns** into our RAT - Authoring Tools, with examples of real-time writing assistance enabled by the tool in order to check the compliance with the structure of the selected pattern.
  - **Dates:**
  - February 26 and 27




Q&A

contact@reusecompany.com