

WEBINAR RULES

- You'll be **muted** all along the Webinar
- There's a '**Question**' section to ask your questions whenever you want, you don't need to wait until the end. All questions will be addressed at the **end of the webinar**.
- If you have any **technical issues** please use this chatting box, or mail us at: support@reusecompany.com
- You will receive a survey either after the webinar or by mail. Your **opinion** is **EXTREMELY VALUABLE!**
- The Webinar **will be recorded**. A link to the recording will be **sent to you** in few days.



STARTING SOON

05:00

CEST

SEMANTIC TRACEABILITY: A PASSPORT TOWARDS A DIGITAL THREAD WITHOUT BOUNDARIES

- José M. Fuentes
- Sales Manager



TRC
Intro



What we do

Tools and platforms

International Standards

Handbooks

01

What we DO

- The REUSE Company is a solution provider specialized in the
- application of semantic technologies and artificial intelligence to
- improve the digitalization of the Systems Engineering life cycle.



José Fuentes



- **Current Position:** Chief Sales Manager of The REUSE Company
- Former Product Manager of RQA and the Systems Engineering Suite
- INCOSE CSEP Certified
- Graduated in the INCOSE Institute for Technical Leadership
- Member of the board of AEIS – The Spanish chapter of INCOSE
- Active contributor to the INCOSE Guide to Writing Requirements
- Other certifications: ITIL
- Other interests: Project Management, Business Analysis, Risk Management

CONTENTS



TRACEABILITY: BASIC CONCEPTS



WHAT IS TRACEABILITY?

- › The capacity to find where a product was made
- › What raw material and added components were used
- › How it was produced
- › Where it was stored
- › How it has been released
- › All along the logistic chain
- › ...
- › From beginning to end



BASIC TRACEABILITY: WITHIN A SOFTWARE ENVIRONMENT



➤ *“A software requirements specification is traceable if
(i) the origin of each of its requirements is clear and if
(ii) it facilitates the referencing of each requirement in
future development or enhancement documentation”*

Source: ANSI/IEEE Standard 830-1984

➤ *“ A requirement is verifiable if, and only if, there exists
some finite cost-effective process with which a person or
machine can check that the software product meets the
requirement”*

Source: ANSI/IEEE Standard 830-1984

BASIC TRACEABILITY: TRACEABILITY MATRIX



Sample traceability matrix

Requirement Identifiers	Reqs Tested	REQ1 UC 1.1	REQ1 UC 1.2	REQ1 UC 1.3	REQ1 UC 2.1	REQ1 UC 2.2	REQ1 UC 2.3.1	REQ1 UC 2.3.2	REQ1 UC 2.3.3	REQ1 UC 2.4	REQ1 UC 3.1	REQ1 UC 3.2	REQ1 TECH 1.1	REQ1 TECH 1.2	REQ1 TECH 1.3
Test Cases	321	3	2	3	1	1	1	1	1	1	2	3	1	1	1
Tested Implicitly	77														
1.1.1	1	x													
1.1.2	2		x	x											
1.1.3	2	x											x		
1.1.4	1			x											
1.1.5	2	x												x	
1.1.6	1		x												
1.1.7	1			x											
1.2.1	2				x		x								
1.2.2	2					x		x							
1.2.3	2							x	x						
1.3.1	1										x				
1.3.2	1										x				
1.3.3	1											x			
1.3.4	1											x			
1.3.5	1											x			
etc....															
5.6.2	1														x



Might be good as a first step



Allows to check where every requirement comes from



Allows you to check completeness of tests



Ensures that implementation meets specification



Enough for some projects (e.g. SW)



Not enough in complex projects



No support to req. decomposition or design



Doesn't satisfy standards like: ARP4754, DO-174, DO-254, ISO26262...

TRACEABILITY IN COMPLEX PROJECTS: ARP4754



Listed below are the processes the supplier should provide to show they are meeting the **ARP4754A** objectives:

- › Requirements management process, including traceability and allocation processes
- › Requirements validation process
- › Requirements verification process
- › Safety analysis process
- › Configuration control processes (for DA data)
- › Change management process (covering change impact and regression analysis)
- › Problem reporting process
- › PA (audit/assessment process to verify adherence to the processes)

Source: DOT/FAA/TC-16/39

Safety Issues and Shortcomings With Requirements Definition, Validation, and Verification Processes Final Report



TRACEABILITY IN COMPLEX PROJECTS: ARP4754

”
“ The following objective statement is from ARP4754A, Section 5.3.1.1, Safety Requirements:

“Requirements that are defined to prevent failure conditions or to provide safety related functions should be uniquely identified and traceable through the levels of development. This will ensure visibility of the safety requirements at the software and electronic hardware design level.”

Requires to **prove** that requirements' sets are sufficiently **correct** and **complete** so that the final product will **meet the customer' needs**.

Functional Safety: IEC 61508

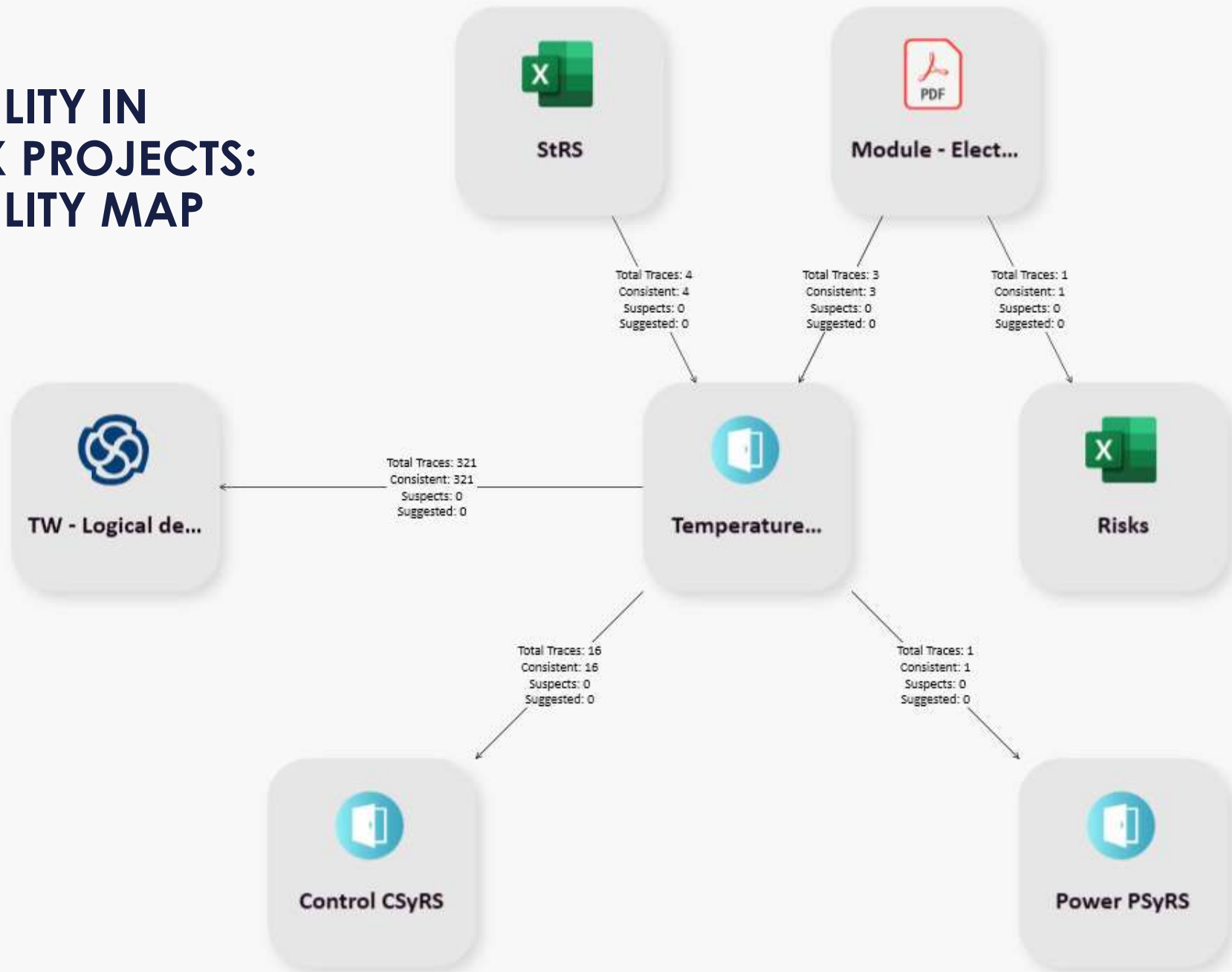
- EN 50128 Railway
- IEC 60601 Medical Equipment
- IEC 61511 Process Industry
- IEC 62061 Machinery
- EN 60880 Nuclear
- ISO 26262 Automotive



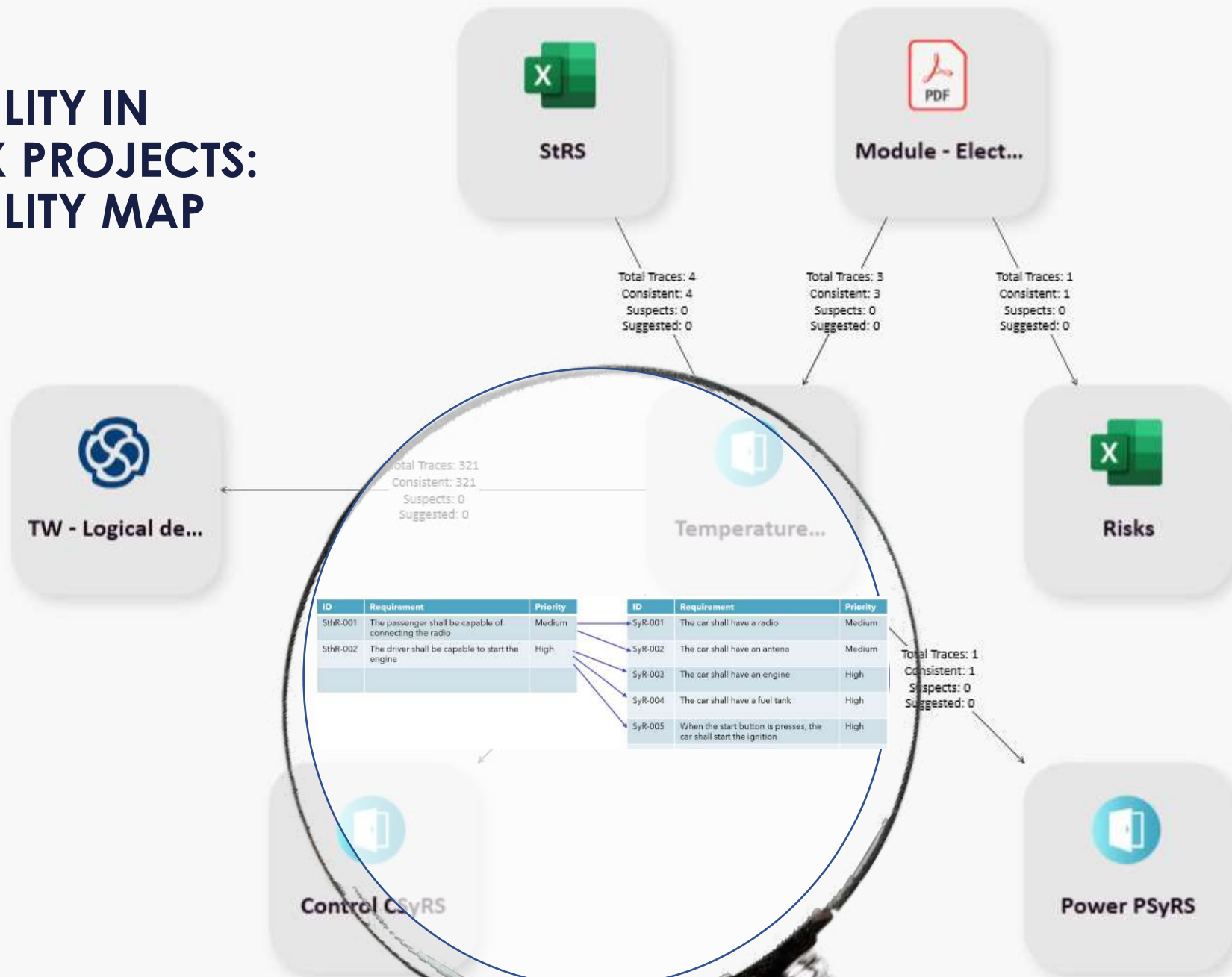
Similar requests with regards to traceability



TRACEABILITY IN COMPLEX PROJECTS: TRACEABILITY MAP



TRACEABILITY IN COMPLEX PROJECTS: TRACEABILITY MAP



P

Pros

It's a **must** in complex and safety critical projects
Requested by **standards** and **good practices**: ISO26262, ARP4754...
Provides **visibility** in complex projects

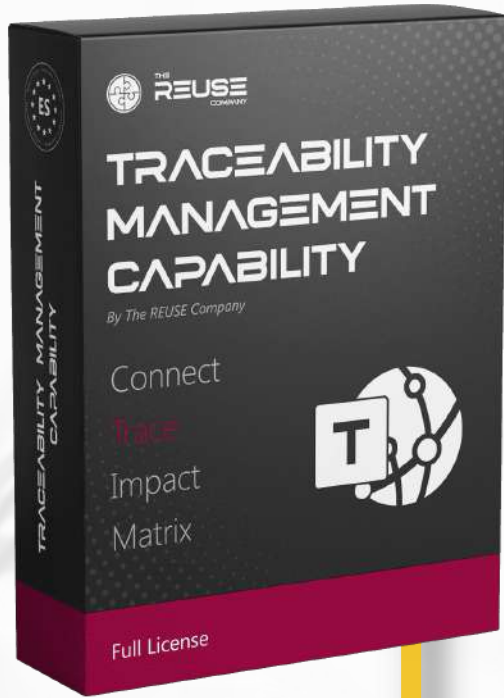


C

Cons

It's normally a **tedious** and **manual** task
Involves **connection** of tools that are not easy to connect
It has to be aware of **changes** and the evolution of the project

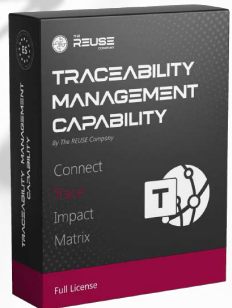




TRACEABILITY: AND THE SYSTEMS ENGINEERING SUITE



- SES can open several documents at once
- Traces rely on the HUB
- Traces can be synced with the ASoT: RMS, MBSE
- Other traceability features:
 - Cross-platform traceability management
 - Dynamic traceability matrices
 - Semantic Impact analysis
 - Flexible reporting
 - Semantic suggestion of traces



4

1

Source Id	Target Id	Source	Target	State	Trace type	Rationale
SysR-001	Item-42	SysR-001. While the Temperature Warrior is in Combat Mode, the Tempera...	Temperature Regulation	Consistent	«Realizes»	

2

State in the repository	Binding State	Visual Workproduct ID	Description
Loaded		Module - TW - Sys...	
Loaded		SysR-001	SysR-001. While the Temperature Warrior is in Combat Mode, the Temperature Warrior shall measure the physica...
Loaded		SysR-002	SysR-002. While the Temperature Warrior is in Combat Mode, the Temperature Warrior shall modify the physica...
Loaded		SysR-003	SysR-003. While the Temperature Warrior is in Combat Mode, the Temperature Warrior shall increase the physica...
Loaded		SysR-004	SysR-004. While the Temperature Warrior is in Combat Mode, the Temperature Warrior shall decrease the physica...
Loaded		SysR-005	SysR-005. While the Temperature Warrior is in Combat Mode, the Temperature Warrior shall register the time defined thresholds. New text
Loaded		SysR-006	SysR-006. While the Temperature Warrior is in Combat Mode, the Temperature Warrior shall display on a screen
Loaded		SysR-007	SysR-007. While the Temperature Warrior is in Combat Mode, the Temperature Warrior shall display on a screen
Loaded		SysR-008	SysR-008. While the Temperature Warrior is in Combat Mode, the Temperature Warrior shall display on a screen
Loaded		SysR-009	SysR-009. At the end of each round, the Temperature Warrior shall display on the screen the total time within the
Loaded		SysR-010	SysR-010. The Temperature Warrior shall have a Control System.
Loaded		SysR-011	SysR-011. The Temperature Warrior shall have a Management System.

3

State in repository	Binding State	Name	Description
Loaded		Operational Analysis	
Loaded		Operational Activities	
Loaded		Requirements	
Loaded		Operational Capabilities	
Loaded		Relations	
Loaded		Receive Attack	
Loaded		Display Data	
Loaded		Allow Configuration	
Loaded		Temperature Regulation	
Loaded		[DCB] System's Overall Capabilities	
Loaded		Interfaces	
Loaded		Data	
Loaded		Roles	
Loaded		Operational Entities	
Loaded		System Analysis	

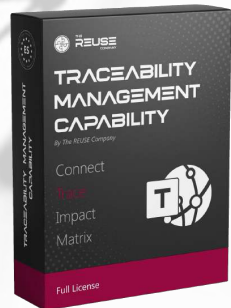
1

2

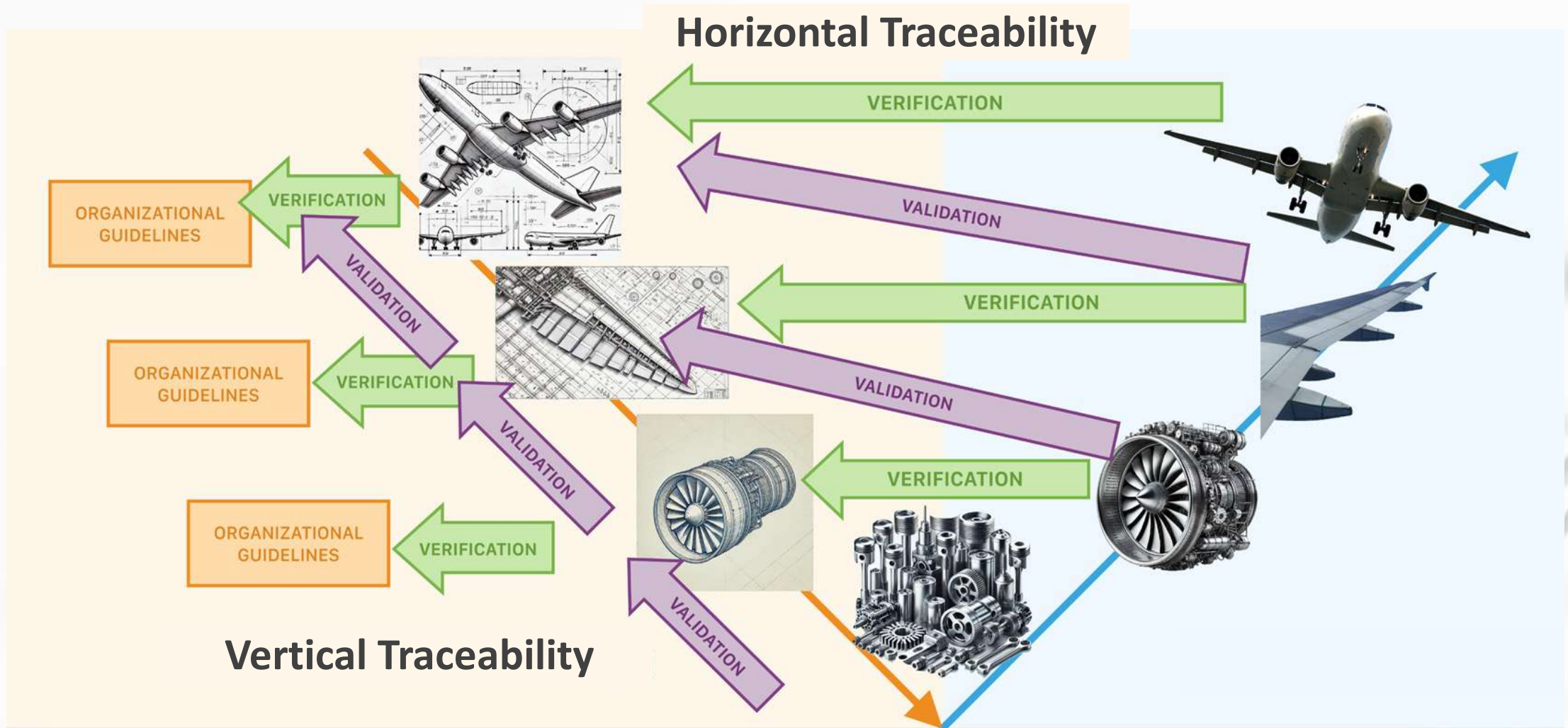
3

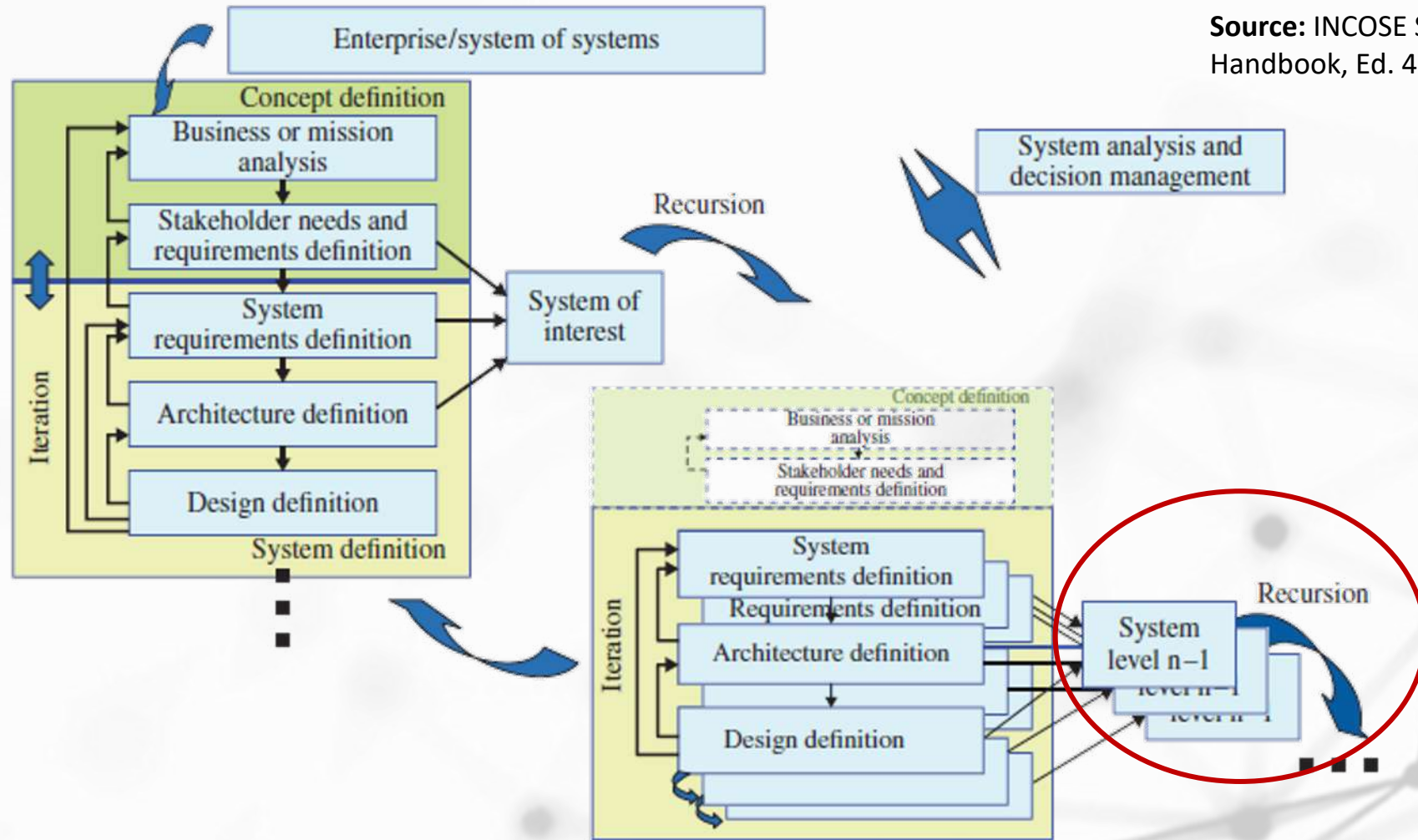
4

Introduction to The REUSE Company



- Granularity in RMT, ALM, PLM
 - Every configuration item shall become a CI in the HUB
- Granularity for models: at different levels for traceability purposes
 - model,
 - diagram,
 - model element
- Granularity for non-structured sources: PDF, Word
 - Advanced parsing mechanisms to identify the meaningful blocks
 - Every of those identified items shall become a CI in the HUB





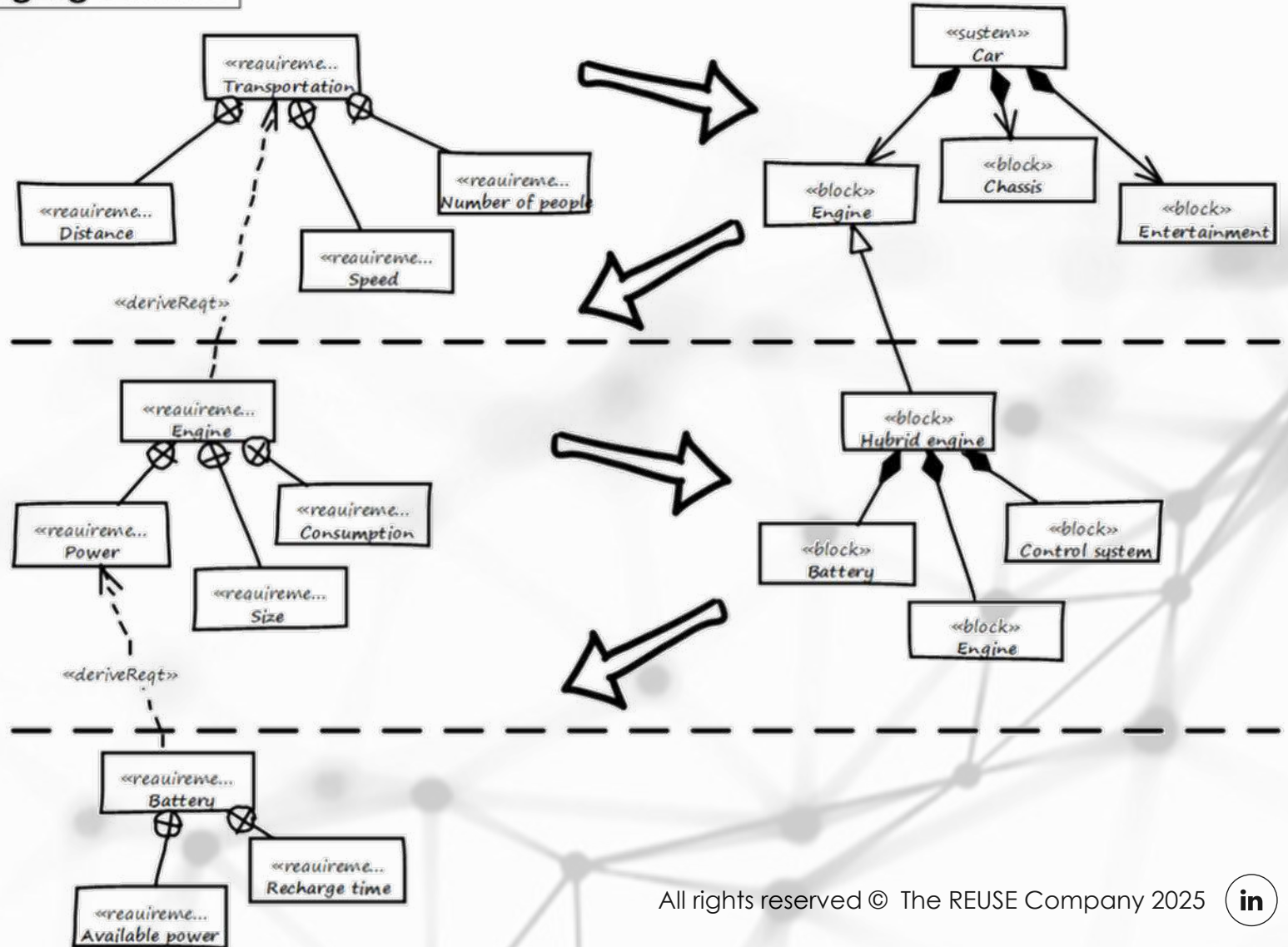
Source: INCOSE Systems Engineering Handbook, Ed. 4

FIGURE 3.5 Iteration and recursion. Reprinted with permission from Garry Roedler. All other rights reserved.

Source:

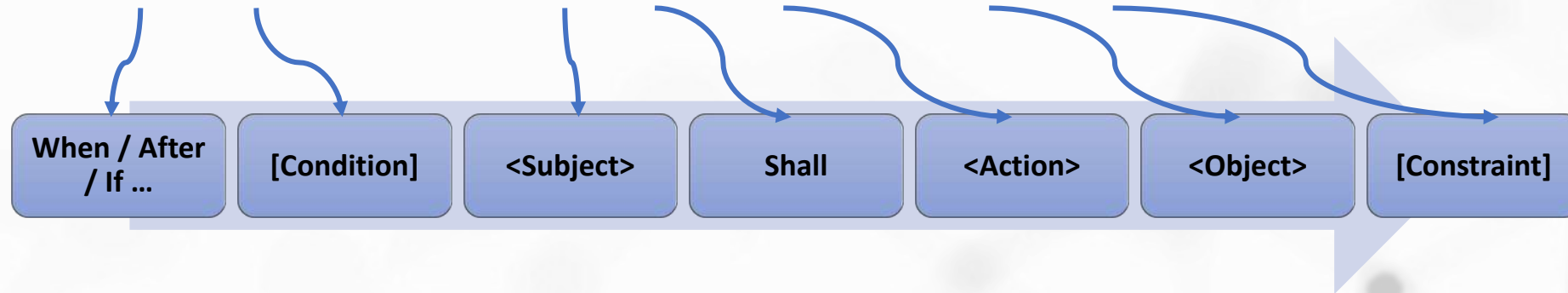
<https://mbse4u.com/2012/03/26/the-sysmod-zigzag-pattern/>

**SYSMOD-
Zigzag-Pattern**

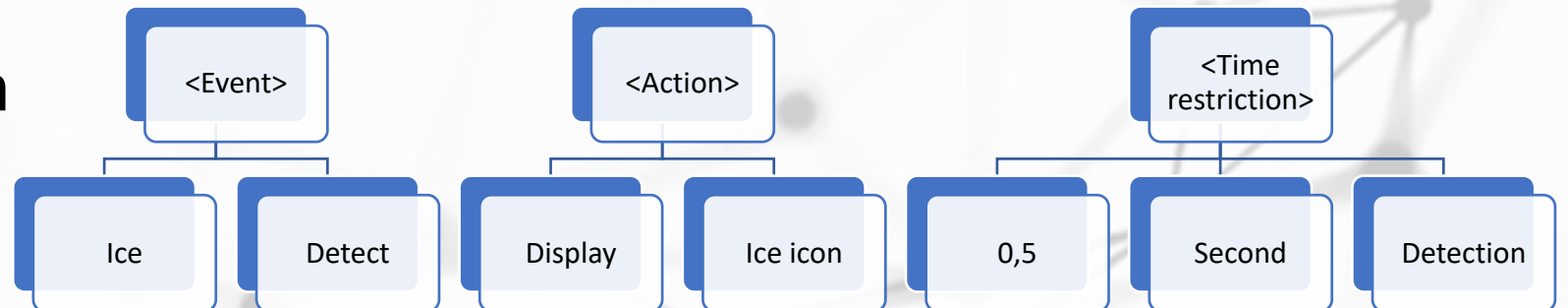


➤ Inputs and outputs:

SR0254: “When ice is detected, the car shall show an ice icon in less than 0,5 s from its detection”



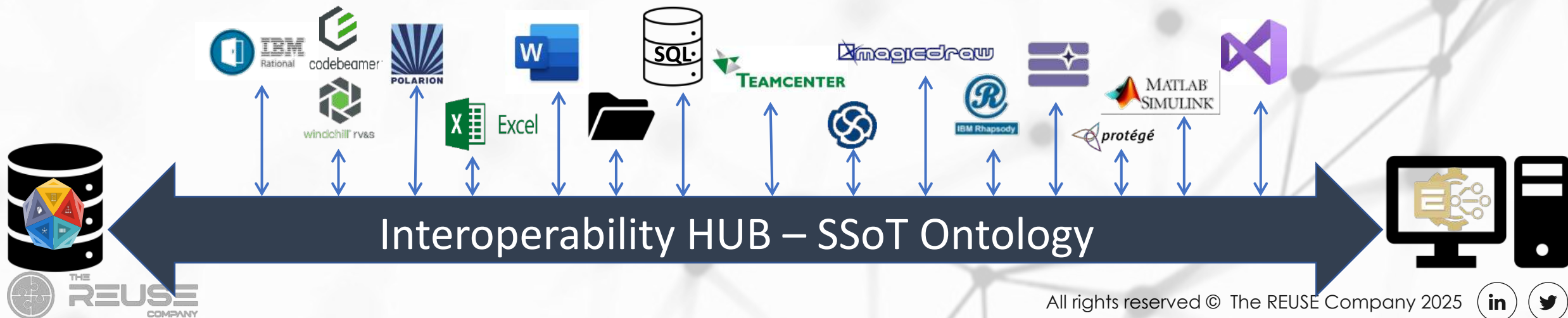
Semantic formalization
(knowledge graph):



AND NOW WHAT: THE INTEROPERABILITY HUB



- SES ENGINEERING Studio has implemented the notion of ***Interoperability HUB (SSoT – Synchronized Source of Truth)***:
 - No one-to-one connector: every tool connects to the hub
 - Bidirectional transformation from every source to the HUB upper ontology
 - Source tools from many different disciplines: RMS, MBSE, PLM, ALM, MS Office, PDFs, DBMS
 - No *wipe-out* approach at all, those source remain as the *Authoritative Source of Truth (ASoT)*
 - Changes in the source are notified in the SES ENGINEERING Studio and arise the notion of suspect links
 - Changes in the SES ENGINEERING Studio are persisted in the corresponding source tool (ASoT)



THE PILLARS OF

Interoperability HUB

Digital thread
without frontiers

1

2

3

4

5

6

CONNECTIVITY

+50 tools: RMS, MBSE, ALM, PLM tools, PDF, MS Office...
Semantic parsing of unstructured sources



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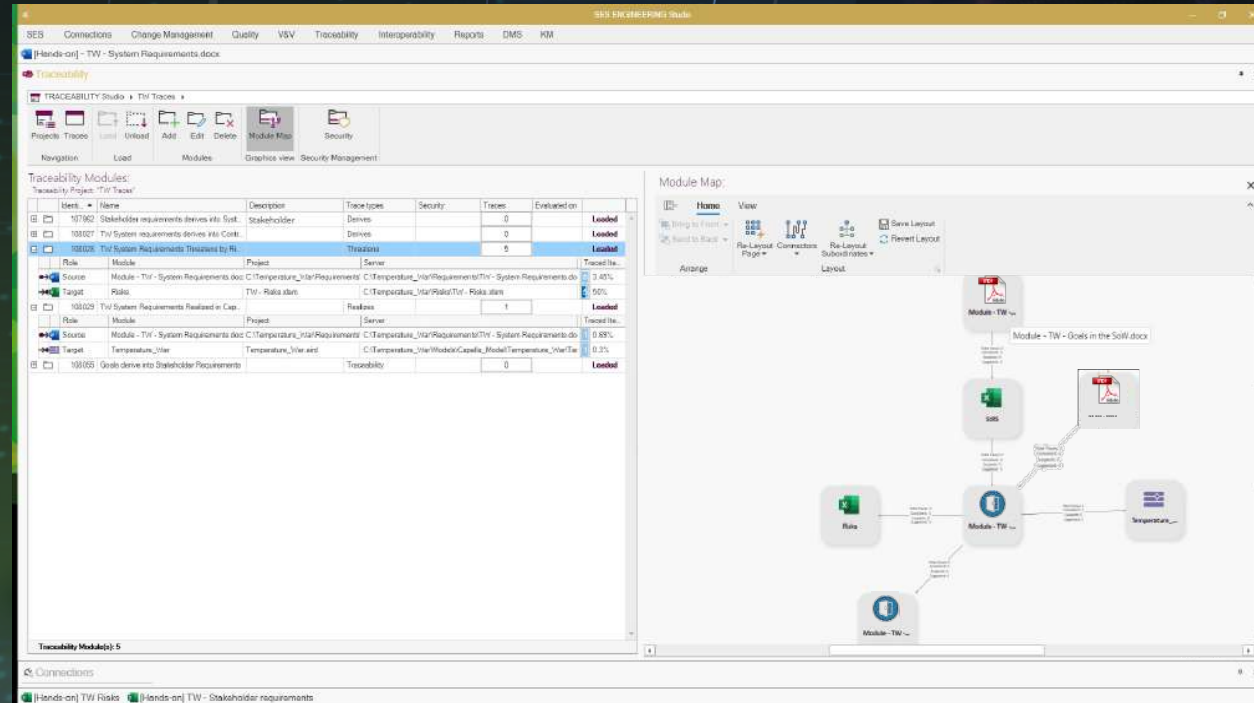
6

CONNECTIVITY

+50 tools: RMS, MBSE, ALM, PLM tools, PDF, MS Office...
Semantic parsing of unstructured sources

SEMANTIC TRACEABILITY

Traces into heterogeneous environment
Automatic detection/suggestion of traces



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CONNECTIVITY

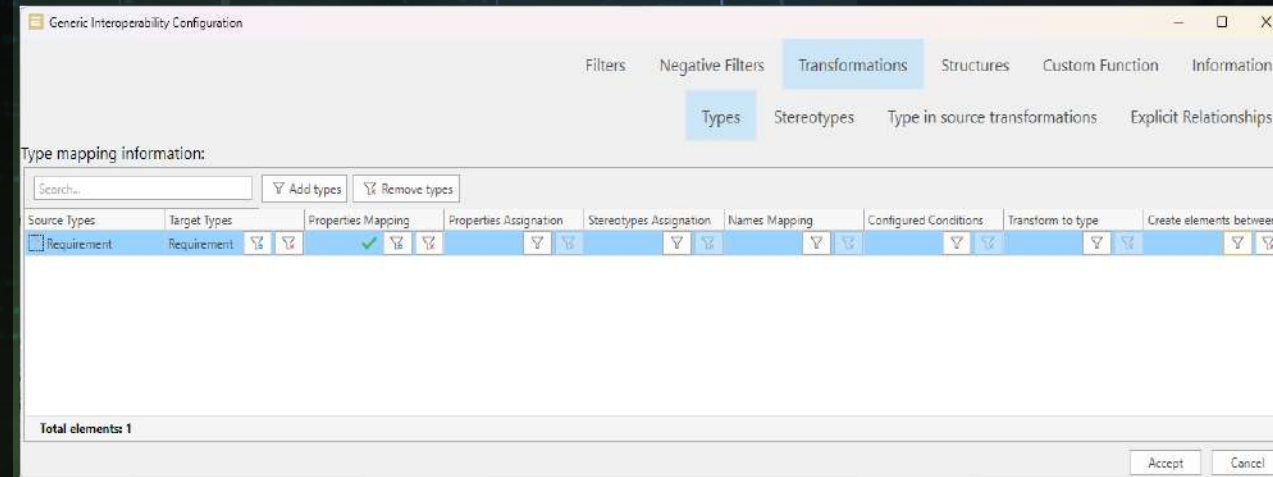
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COPYING/MOVING/SYNCHRONIZING WORK PRODUCTS

No change of metamodel between source and target
Just moving among different tools



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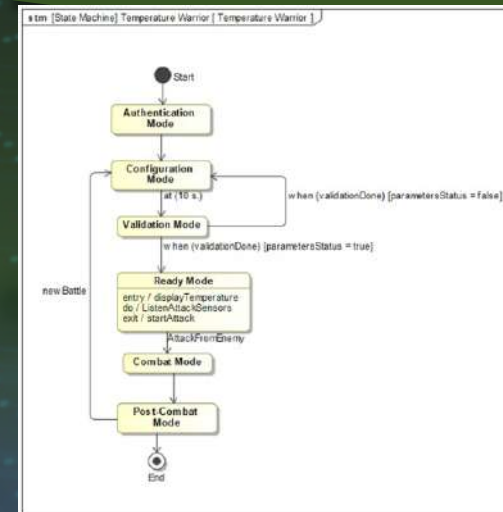
Traces into heterogeneous environment
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TRANSFORMING WORK PRODUCTS

Change of metamodel between source and target work products
Textual requirements to models, SysML to Capella...



ID	Quality	Quality Date	Quality Severity
1	High	15/05/2014	
2	High	15/05/2014	
3	High	15/05/2014	
4	High	15/05/2014	
5	High	15/05/2014	
6	High	15/05/2014	
7	High	15/05/2014	
8	High	15/05/2014	
9	High	15/05/2014	
10	High	15/05/2014	
11	High	15/05/2014	
12	High	15/05/2014	
13	High	15/05/2014	
14	High	15/05/2014	
15	High	15/05/2014	
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17	High	15/05/2014	
18	High	15/05/2014	
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48	High	15/05/2014	
49	High	15/05/2014	
50	High	15/05/2014	

THE PILLARS OF

Interoperability HUB

Digital thread
without frontiers

Semantic Traceability



1

CONNECTIVITY

*+50 tools: RMS, MBSE, ALM, PLM tools, PDF, MS Office...
Semantic parsing of unstructured sources.*

2

SEMANTIC TRACEABILITY

*Traces into heterogeneous environment
Automatic detection/suggestion of traces.*

3

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Just moving among different tools.*

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TRANSFORMING WORK PRODUCTS

*Change of metamodel between source and target work products
Textual requirements to models, SysML to Capella...*

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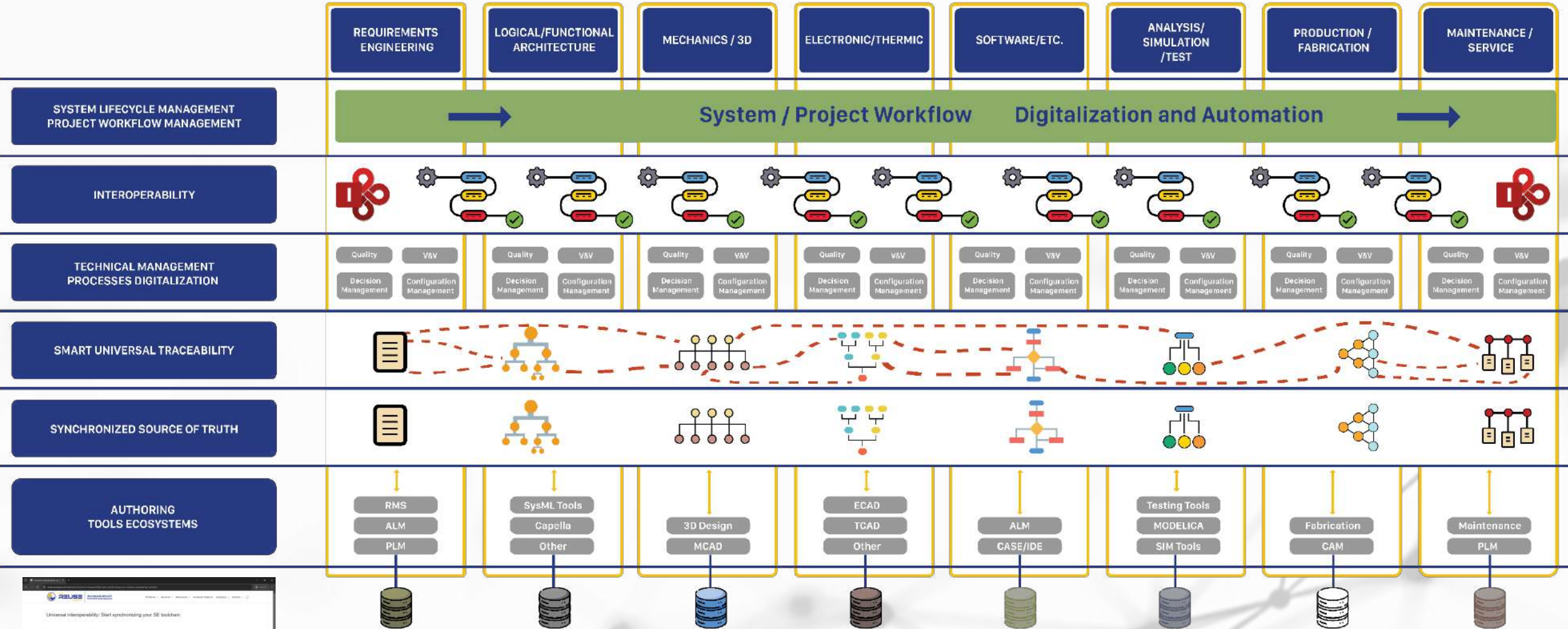
BINDING WORK PRODUCTS

Changes in one work product triggering changes to target work products.

6

REMOTE CONNECTIVITY

*Collaborative access to the content of repository even from an external
infrastructure.*



The screenshot displays the SES ENGINEERING Studio - x64 - 23.4.0.0 interface. The top menu bar includes: SES, Connections, PWM, Change Management, Quality, V&V, Traceability, Interoperability, Reports, DMS, KM, PLE. The main workspace is divided into several panes:

- Traceability** pane: Shows project traces and a toolbar with icons for Projects, Traces, Load, Unload, Add, Edit, Delete, Module Map, and Security.
- Module Map** pane: Currently displays a large red play button icon.
- [TRACE_WEBINAR] TW - System Requirements** pane: Contains a tree view of requirements and a table of workproducts.
- [TRACE_WEBINAR] Architecture in EA** pane: Contains a tree view of architectural elements and a table of workproducts.

Table 1: [TRACE_WEBINAR] TW - System Requirements

State in repository	Object Identifier	Object Headin	Object Description
Loaded	Temperature Warrior Sy		
Loaded	SysR-1	Introduction	
Loaded	SysR-150		The Temperature War project aims to define, specify, c
Loaded	SysR-151	Scope	
Loaded	SysR-274		This section describes the scope of a project for the imple
Loaded	SysR-94		The Temperature Warrior shall compete according to th

Table 2: [TRACE_WEBINAR] Architecture in EA

State in repository	Name	Type
Loaded	TW - Logical decomposition	Module
Loaded	TW - Logical decomposition	
Loaded	Temperature Warrior	Class
Loaded	Configure System	Class
Loaded	Control System	Class
Loaded	Temperature Controller	Class
Loaded	Time Controller	Class
Loaded	<>>	Part



Q & A



THE REUSE COMPANY ENABLING SMART SYSTEMS ENGINEERING

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Inter-connecting the complete Tools Ecosystem of your organization
 Enabling digital support to all the Technical Management processes (ISO 15288) for the engineering items of your tools ecosystem
 Integrating document centric (Documentation), knowledge driven (Reuse) and model-based (MBSE) approaches in one Hub

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