

Universal Interoperability

Start Synchronizing
your Systems Engineering toolchain



Ilyes Yousfi

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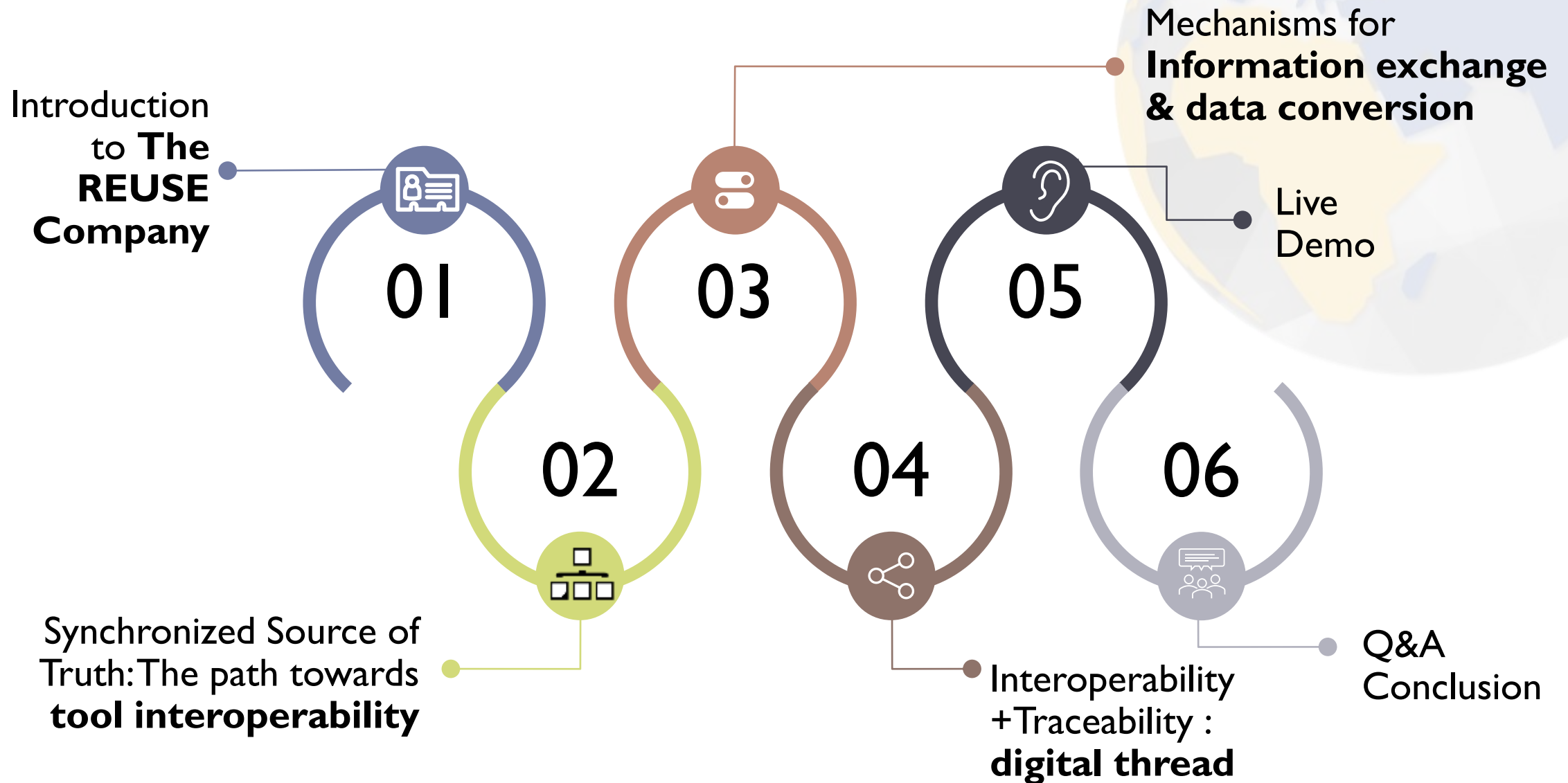


Cecilia Karlsson

Marketing & Communication
The REUSE Company
cecilia.karlsson@reusecompany.com



THE
REUSE
COMPANY





The REUSE Company is a tool vendor specialized in the application of **semantic technologies** and artificial intelligence to improve the **digitalization of the Systems Engineering** processes.



- RQA – QUALITY Studio
- RAT – AUTHORIZING Tool
- KM – Knowledge Manager
- TRACEABILITY Studio
- V&V Studio
- REx – REQUIREMENTS Engineering Tool for MS Word
- SES ENGINEERING Studio



Ilyes Yousfi

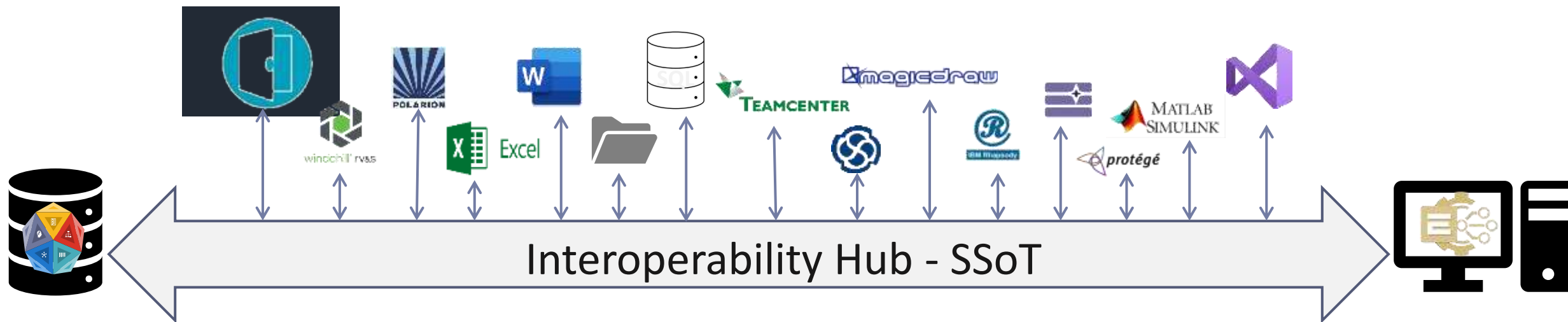
- **Current position:** Senior Key Account Manager at The REUSE Company
- Master's degree from the University of Montreal (Canada) and the IMT Atlantique School of Engineering (France).
- Background in energy and mechanical engineering
- Involved in a research project around the environmental impacts of end-of-life management of aircrafts (2014)
- Consulting services to help industry actors leverage and digitalize Systems Engineering activities.
- Passionate about international projects and learning languages, Ilyes speaks 4 languages fluently: English, French, German and Spanish.



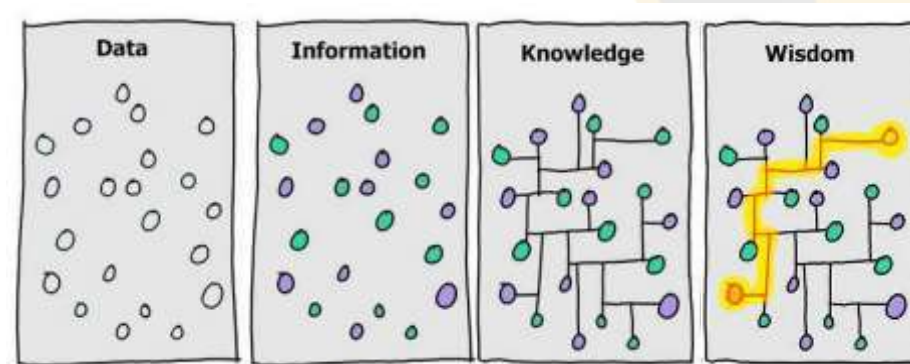
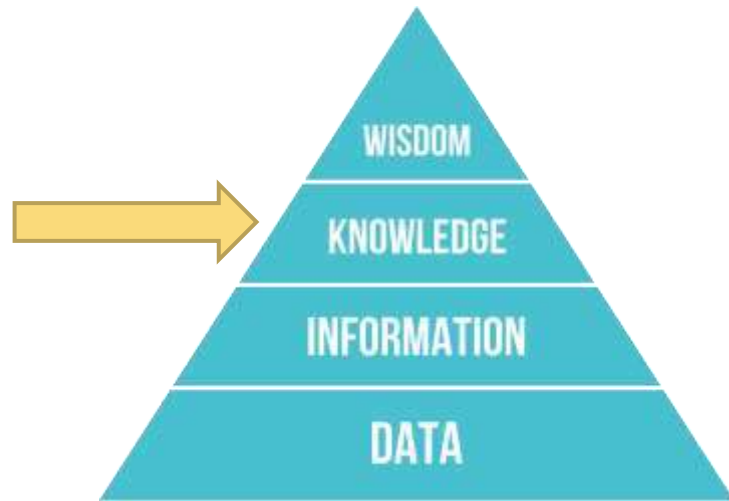
**Synchronized
Source of Truth**

**The path towards
Tool
Interoperability**

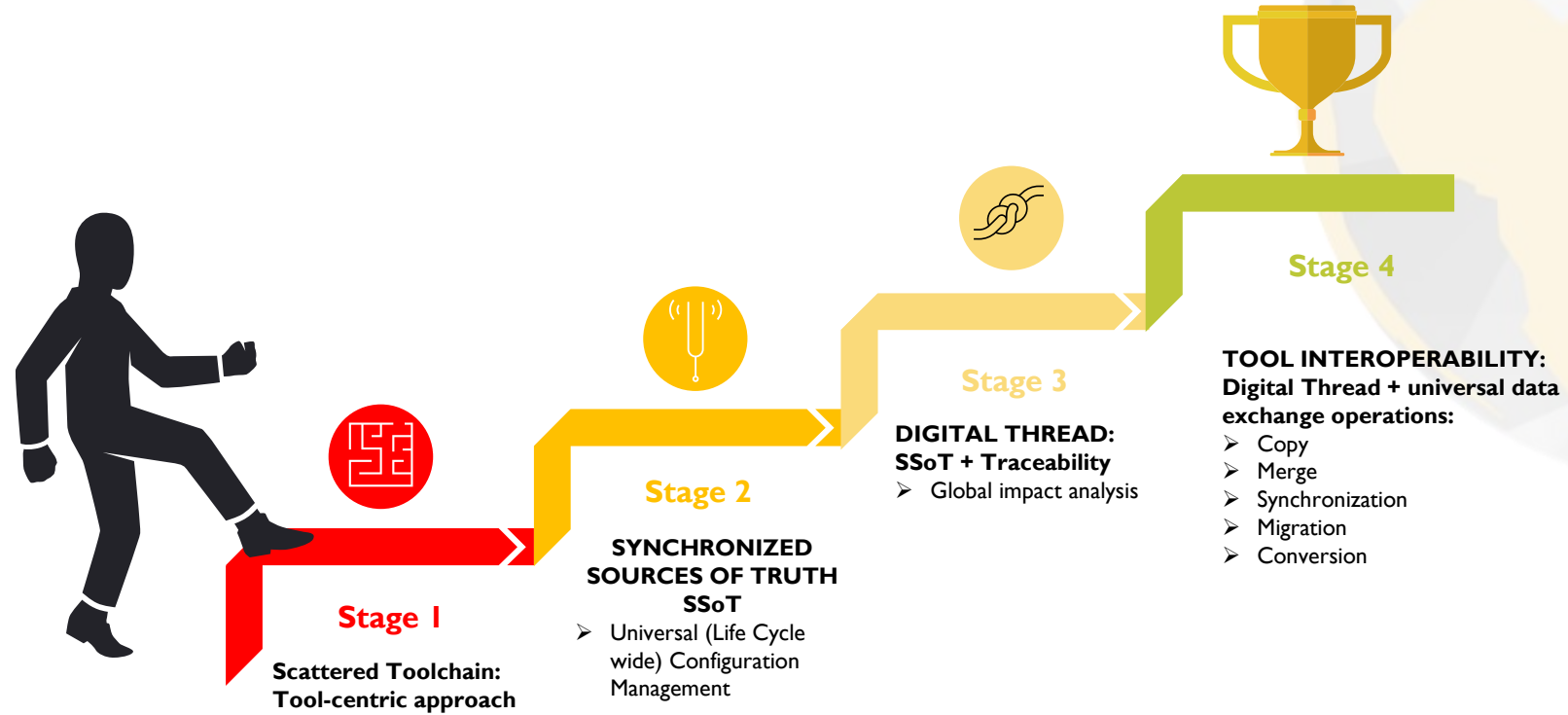
- SES ENGINEERING Studio implements the notion of **Interoperability hub (SSoT – Synchronized Source of Truth)**:
 - No one-to-one connector: every tool connects to the hub. Destroying silos
 - No **wipe-out** approach: each individual source synchronized in SES remains the *Authoritative Source of Truth (ASoT)*
 - Source tools from many different disciplines: textual, modelling, code editor, testing....



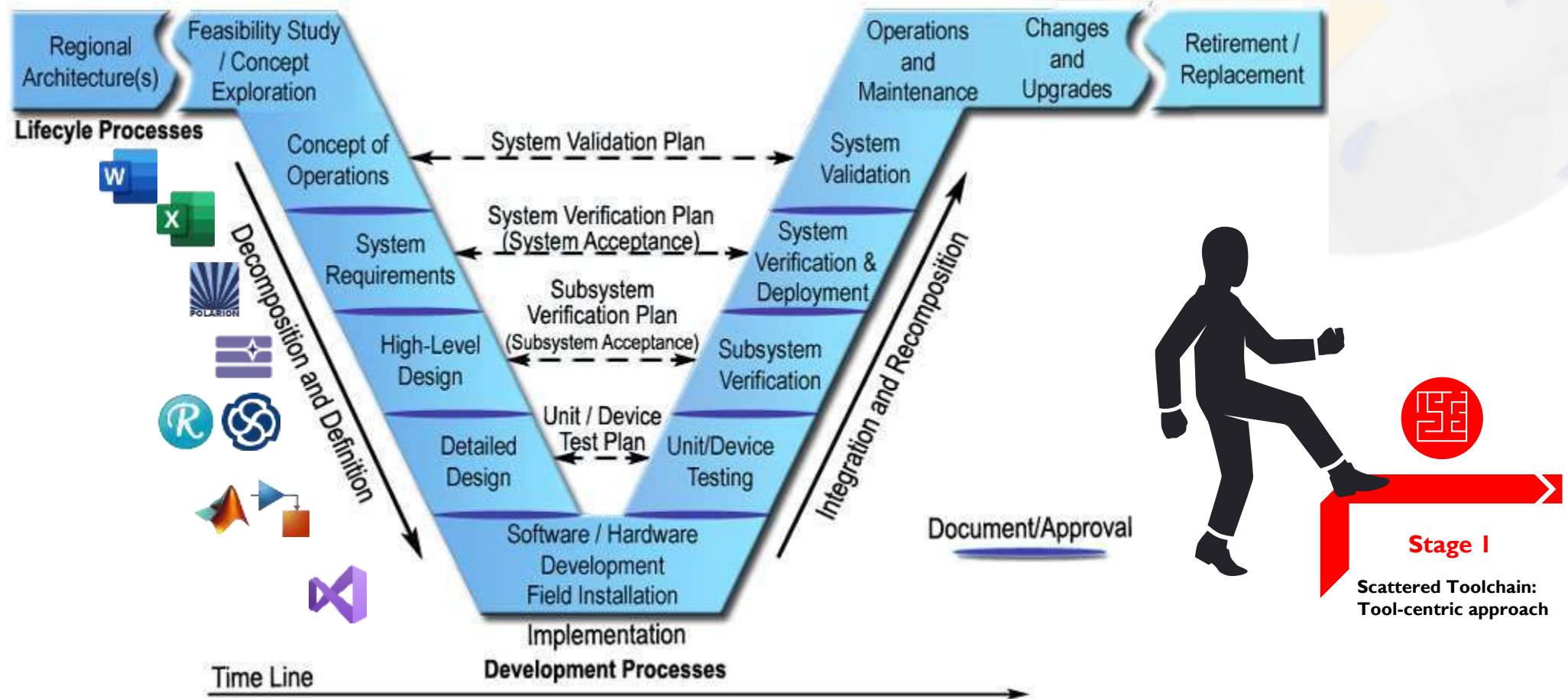
➤ Data -> Knowledge



Source: The[i]Factory

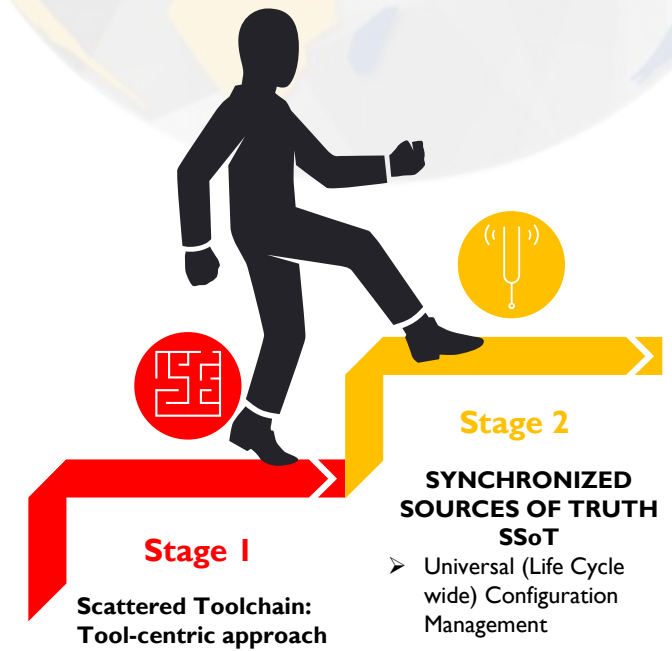
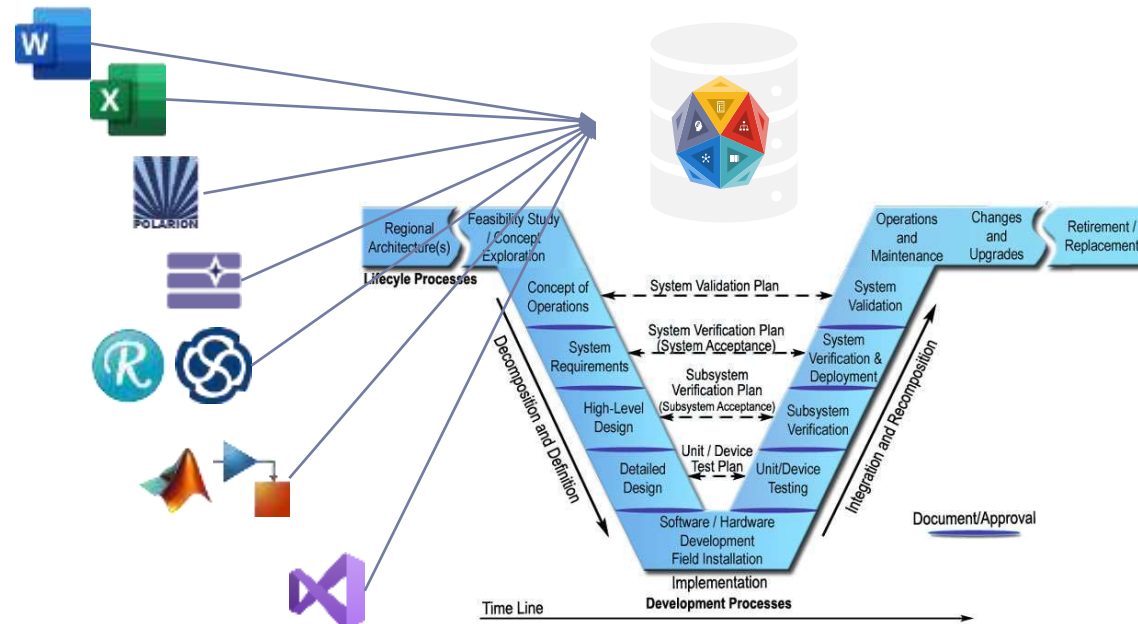


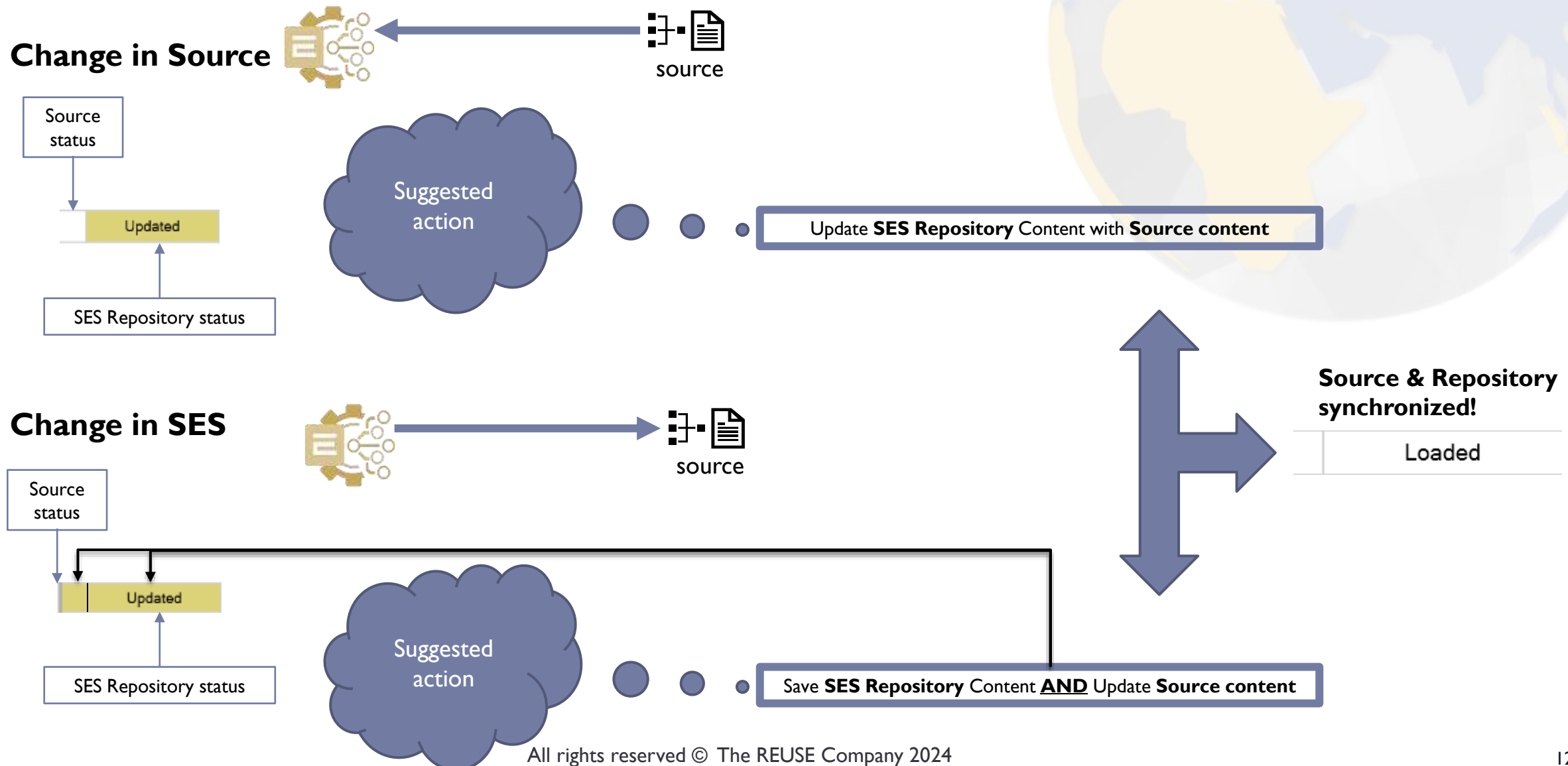
Stage I: Scattered SE tool-chain : Tool-centric approach



Stage 2: Synchronized Sources of Truth

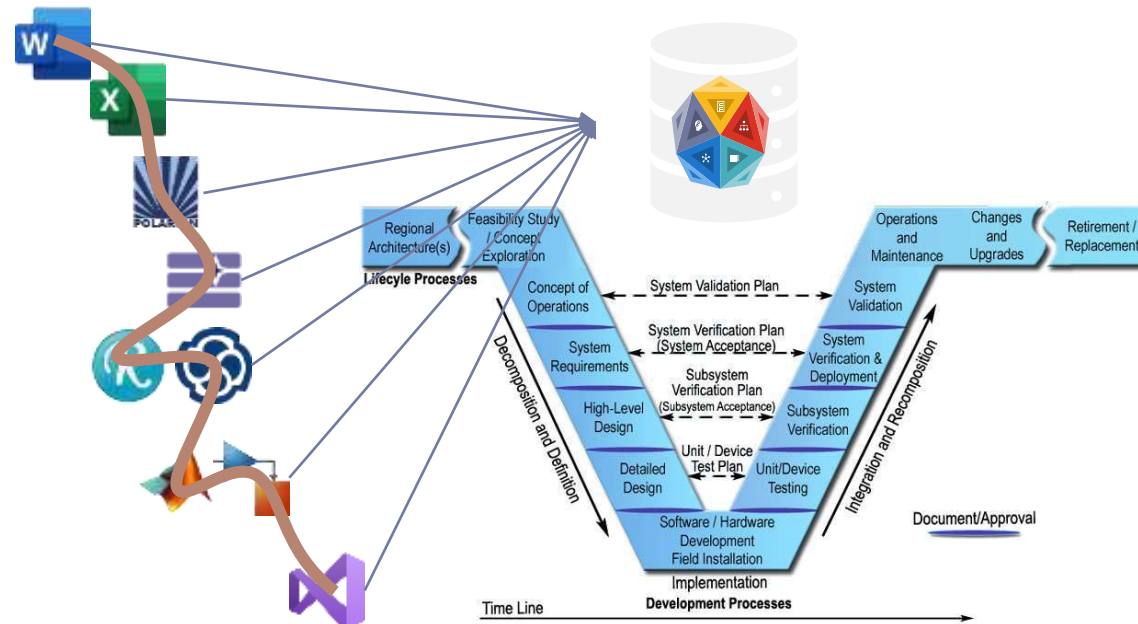
- Universal configuration management for all the assets.
- Back-up copy





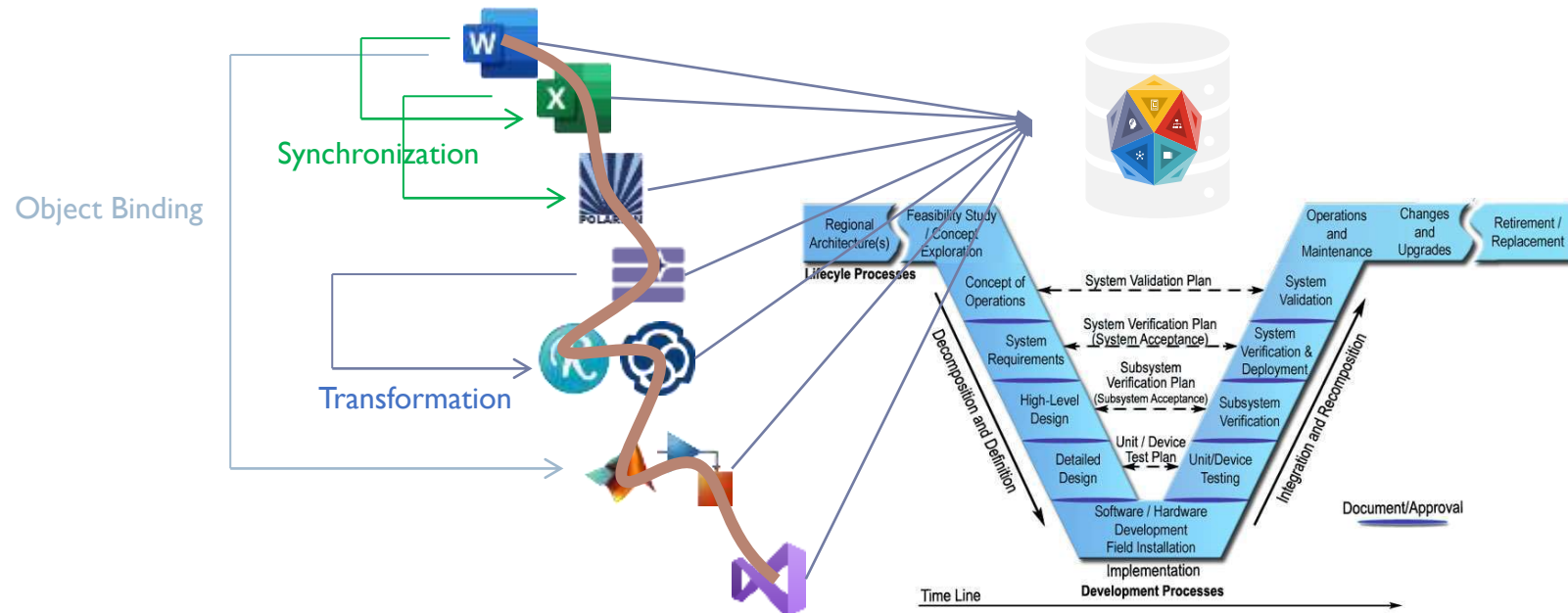
Stage 3: Digital Thread

- End-to-end traceability
- Global Impact analysis and suspect links detection



Stage 4: Interoperability

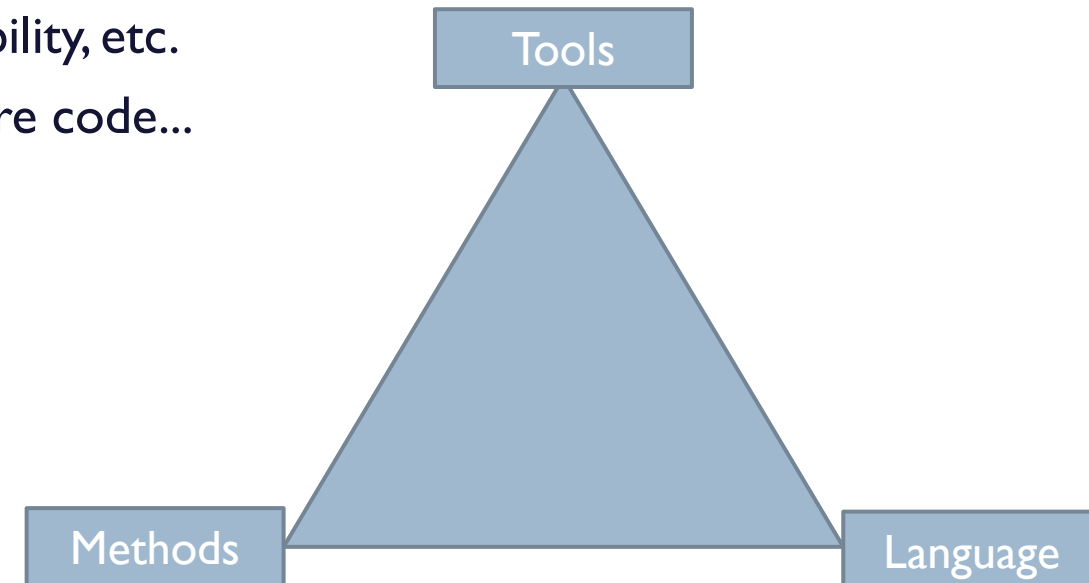
- Information Exchange: Copy/Merge/Synchronize
- Object Binding

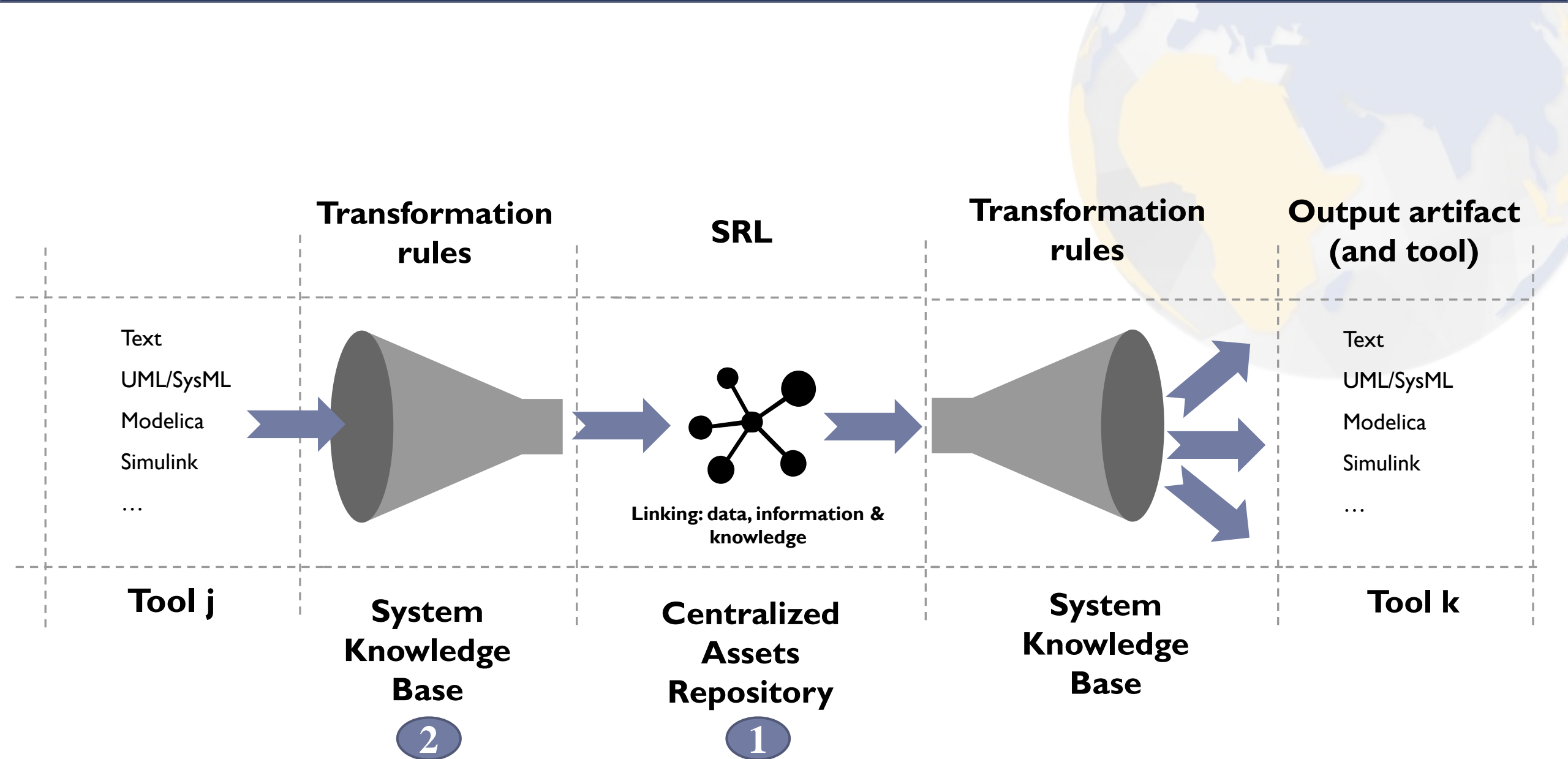


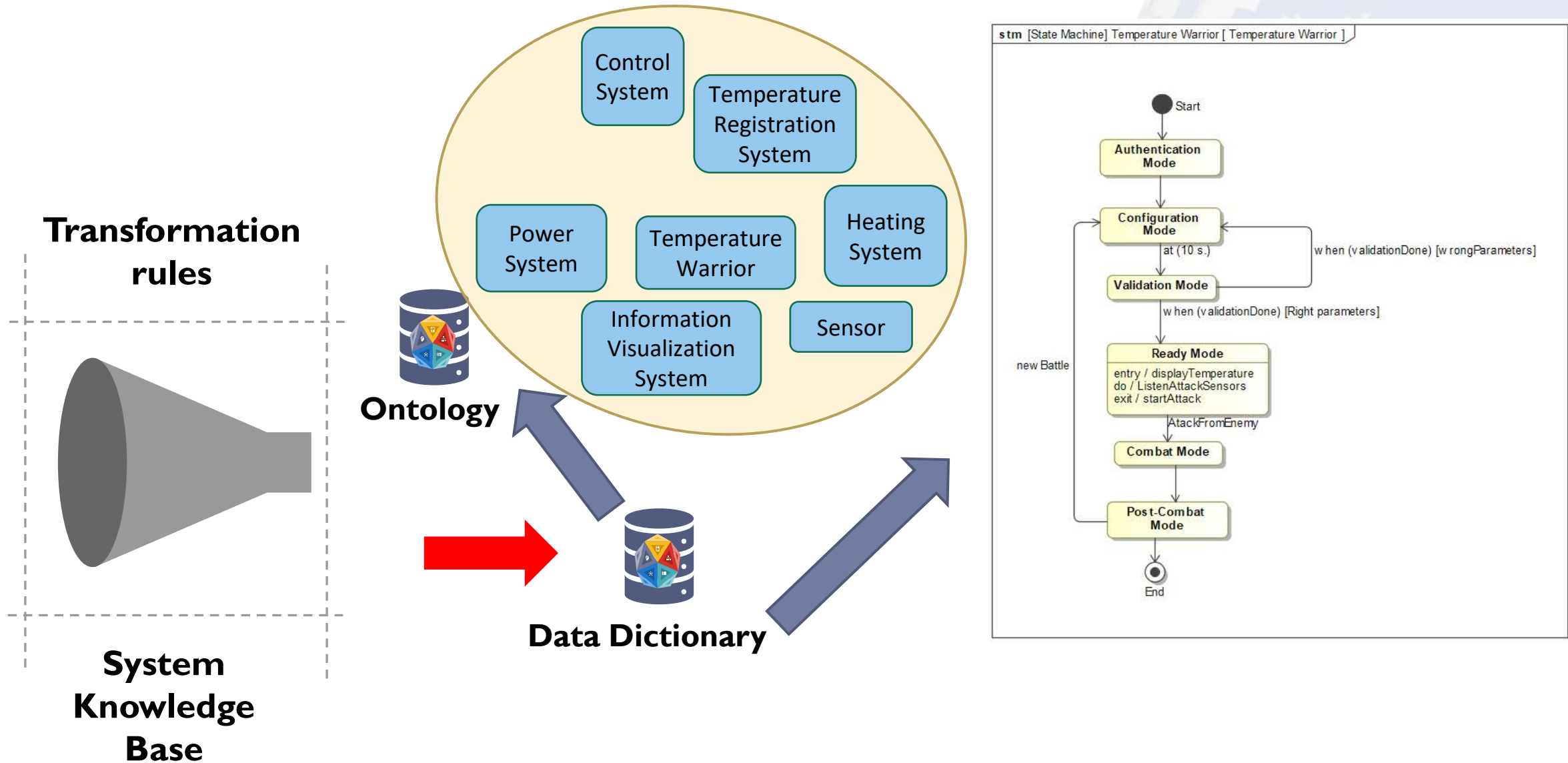
- Stage 3**
- DIGITAL THREAD:**
SSoT + Traceability
- Global impact analysis
- TOOL INTEROPERABILITY:**
Digital Thread + universal data exchange operations:
- Copy
 - Merge
 - Synchronization
 - Migration
 - Conversion

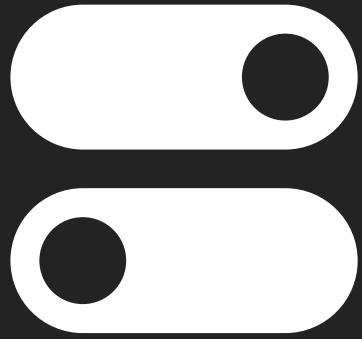


- MBSE: 3 pillars :Tools-Methods-Language (T-M-L)
 - ...but there are other Tools, Methods, Language involved throughout the system life cycle.
- Need for a common representation framework that neutralizes those 3 pillars all over the life cycle, regardless of:
 - The **tool** used : PLM,ALM, Requirements Management, MS Office Suite...
 - The **method** used:Architecture frameworks, traceability, etc.
 - The **language** used: Natural language, SysML, software code...









Mechanisms for Exchange

1

Transfer Workproducts

*No change of data model between source and target
Only migrate between same or different tools*

2

Convert workproducts

*Change of data model between source and target workproducts
Textual requirements to models, SysML to Capella ...*

3

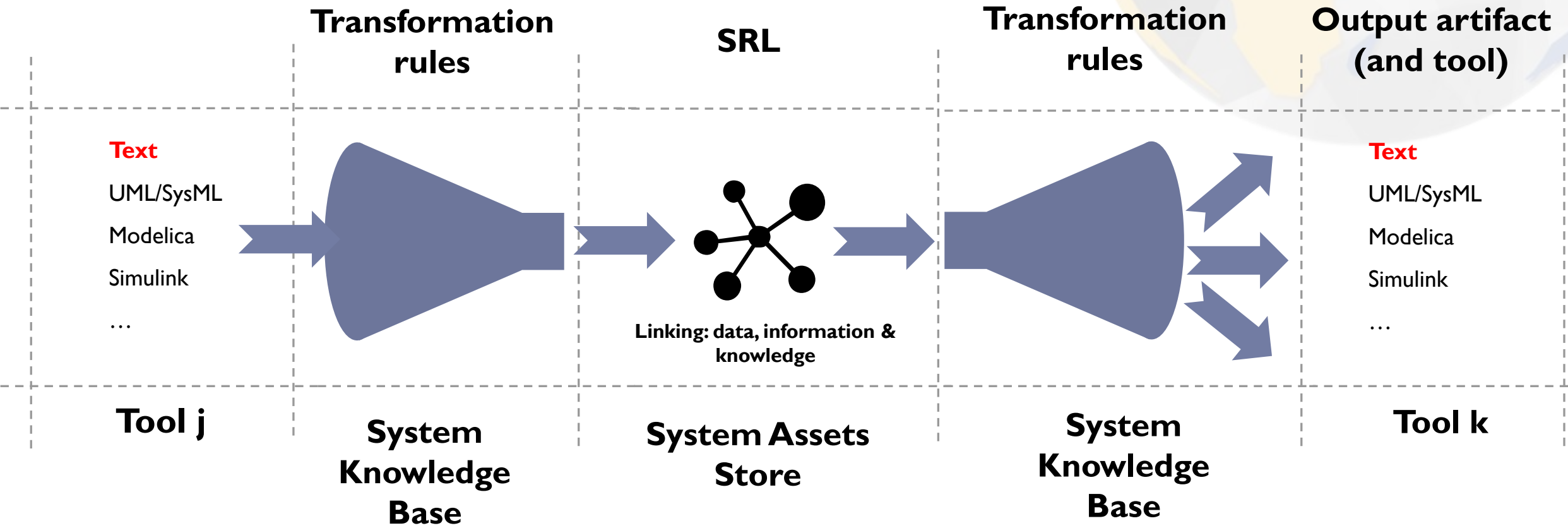
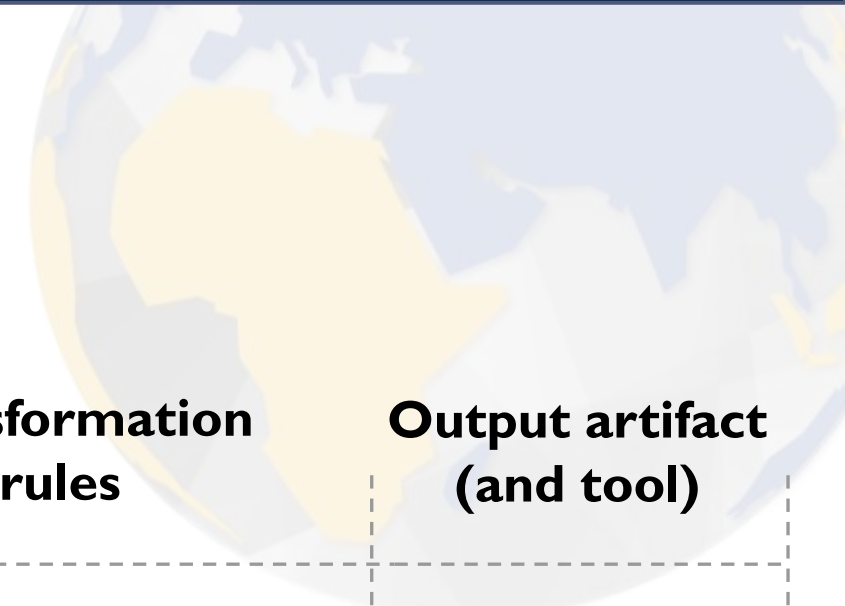
Binding workproducts

Changes in one workproduct triggering changes to target workproducts

I

Transfer Workproducts

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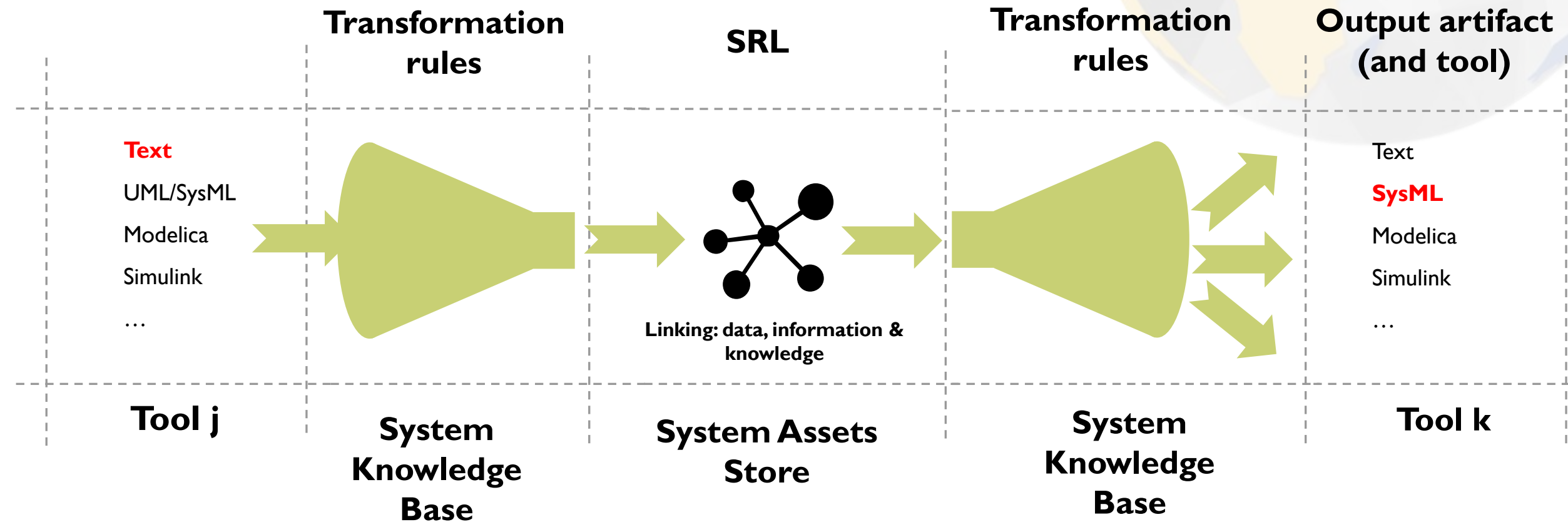
Binding workproducts

Changes in one workproduct triggering changes to target workproducts

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Convert workproducts

*Change of data model between source and target workproducts
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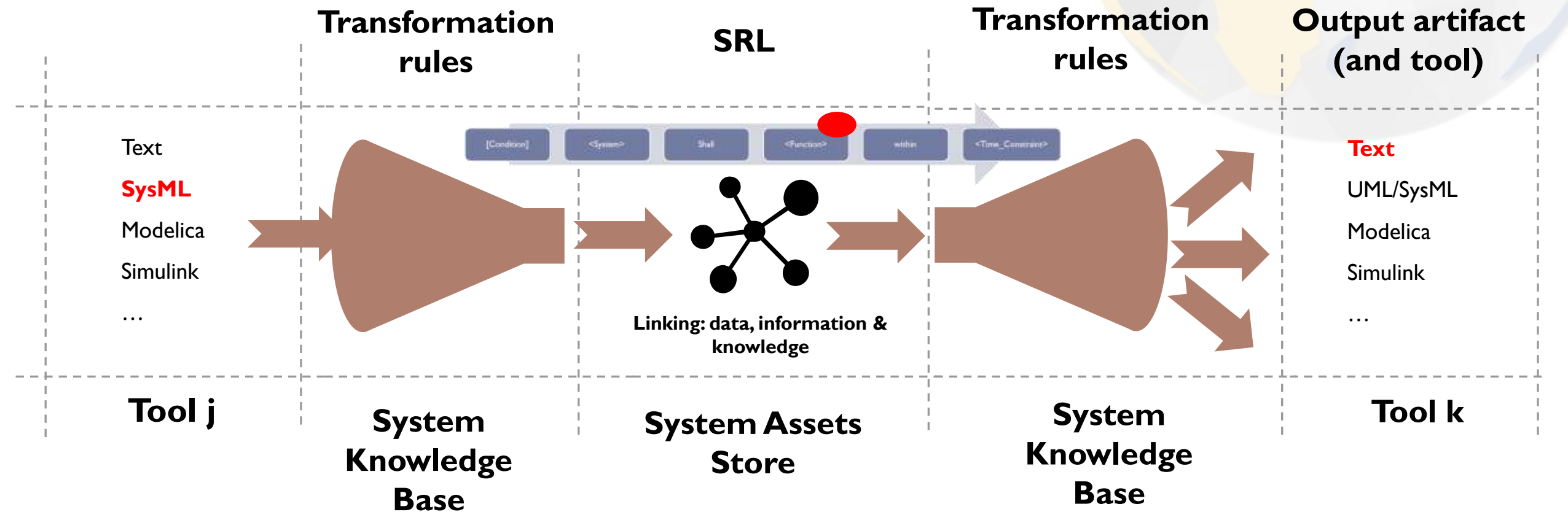
Binding workproducts

Changes in one workproduct triggering changes to target workproducts

3

Binding workproducts

Changes in one workproduct triggering changes to target workproducts



3

Binding workproducts

Changes in one workproduct triggering changes to target workproducts

[Condition]

<System>

Shall

<Function>

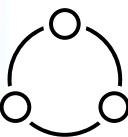
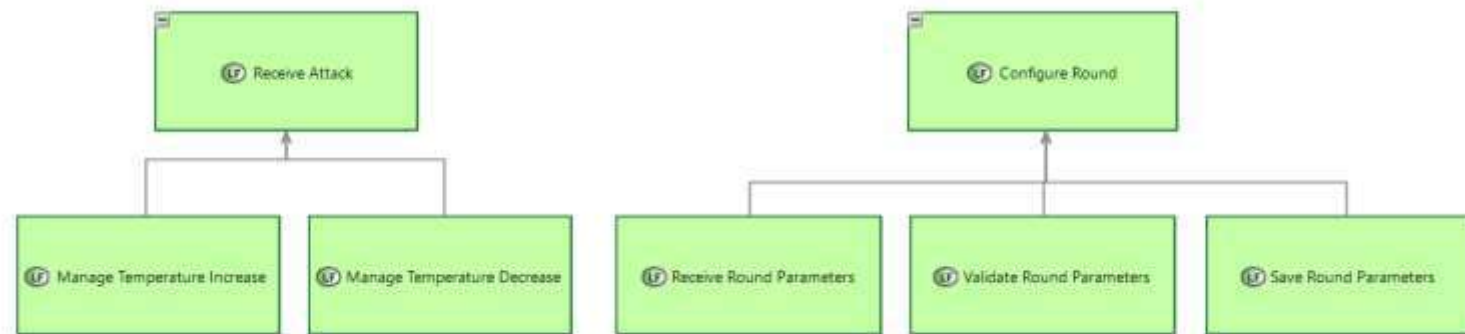
within

<Time_Constraint>

Object-level Interoperability:

If **<Function>** changes in the Model;

- **<Function>** is updated in all the textual items bound to the model function.

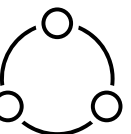
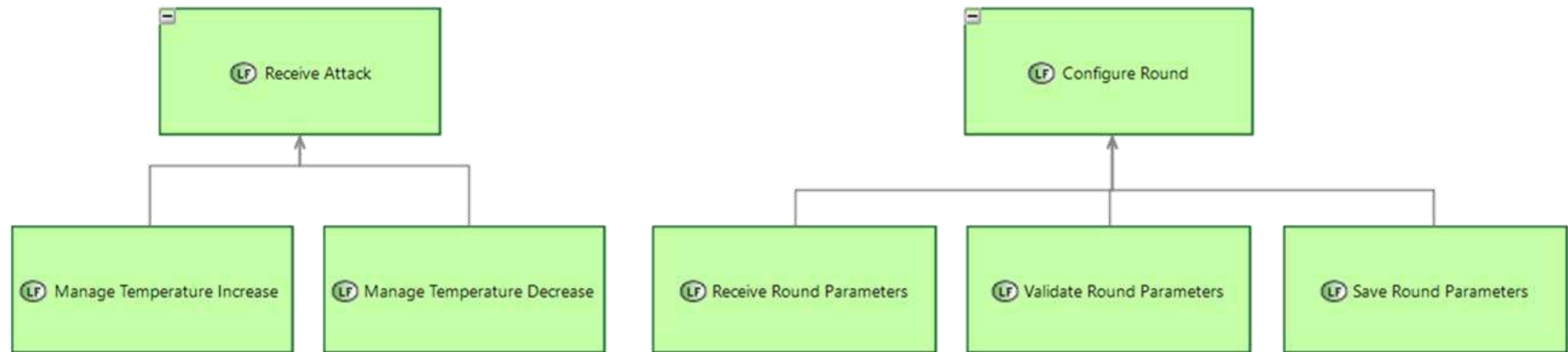


3

Binding workproducts

Changes in one workproduct triggering changes to target workproducts

While in Ready Mode, The Temperature Warrior shall **Configure Round** during 15 seconds.

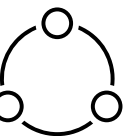
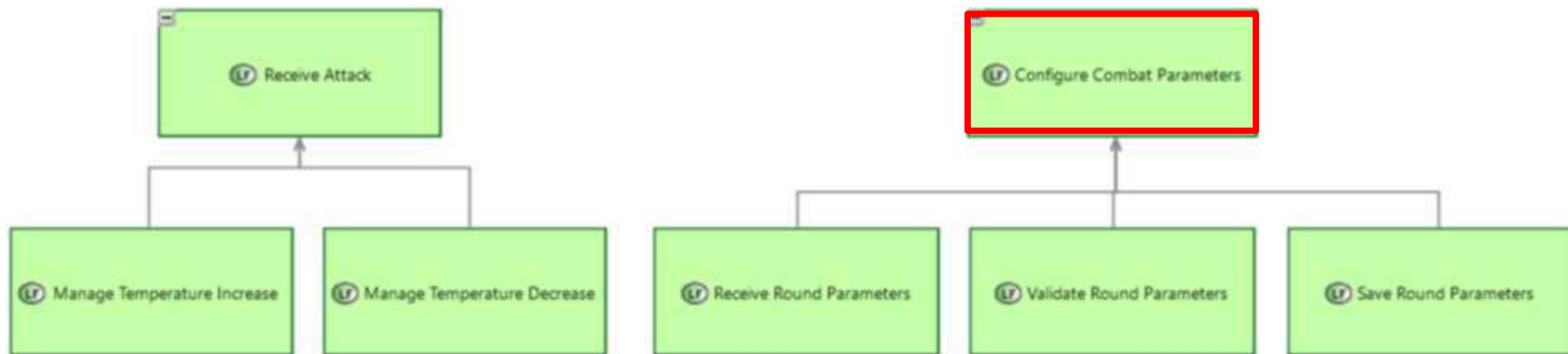


3

Binding workproducts

Changes in one workproduct triggering changes to target workproducts

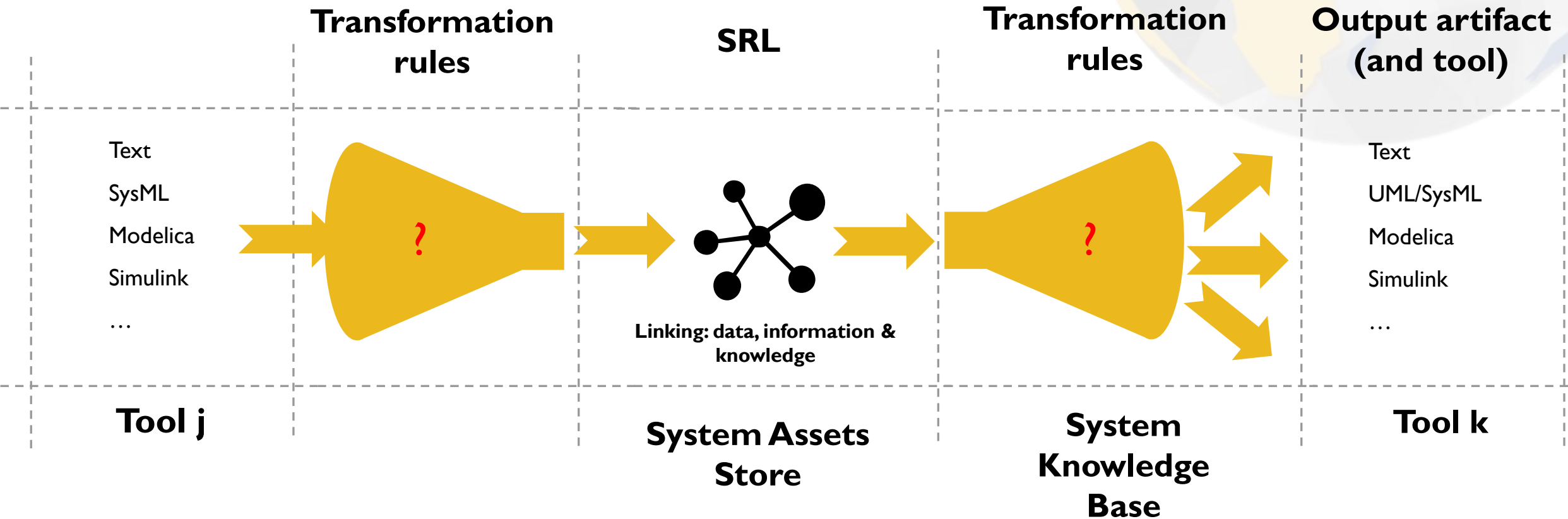
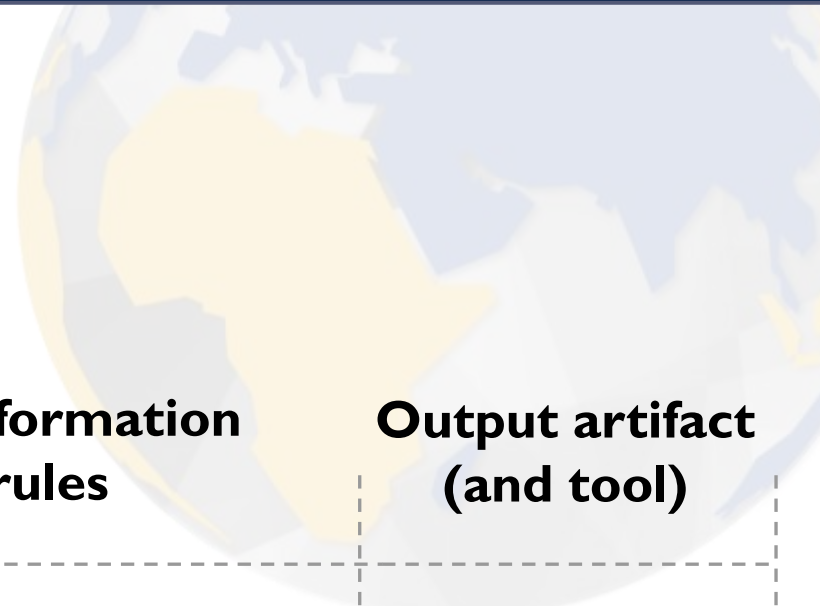
While in Ready Mode, The Temperature Warrior shall **Configure Combat Parameters** during 15 seconds.

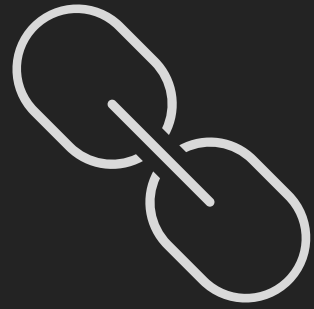




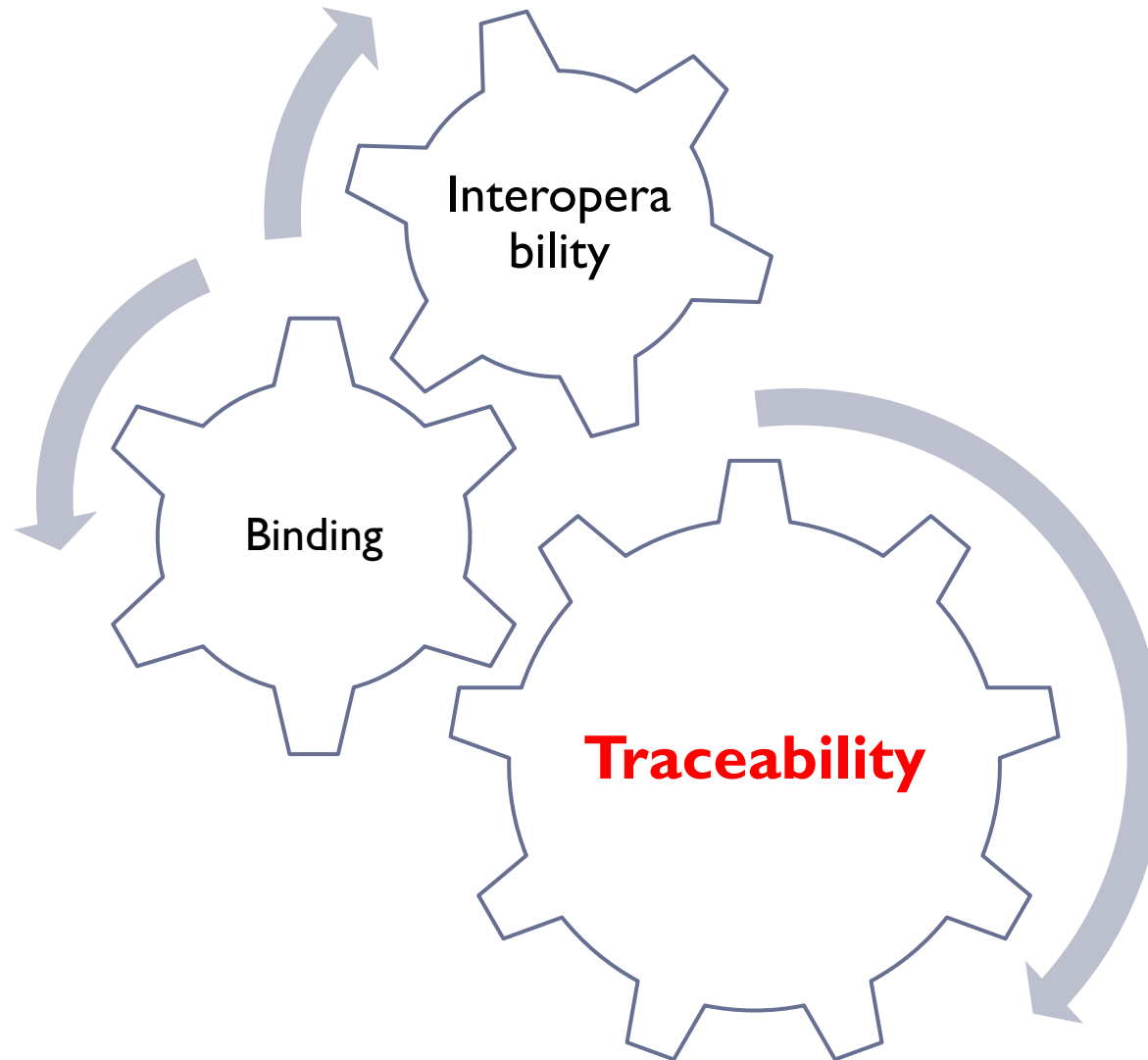
Custom Interoperability

C# source code operation / transformation using the exchange data model (SRL – System Representation Language)





**Interoperability +
Traceability
The digital
thread**

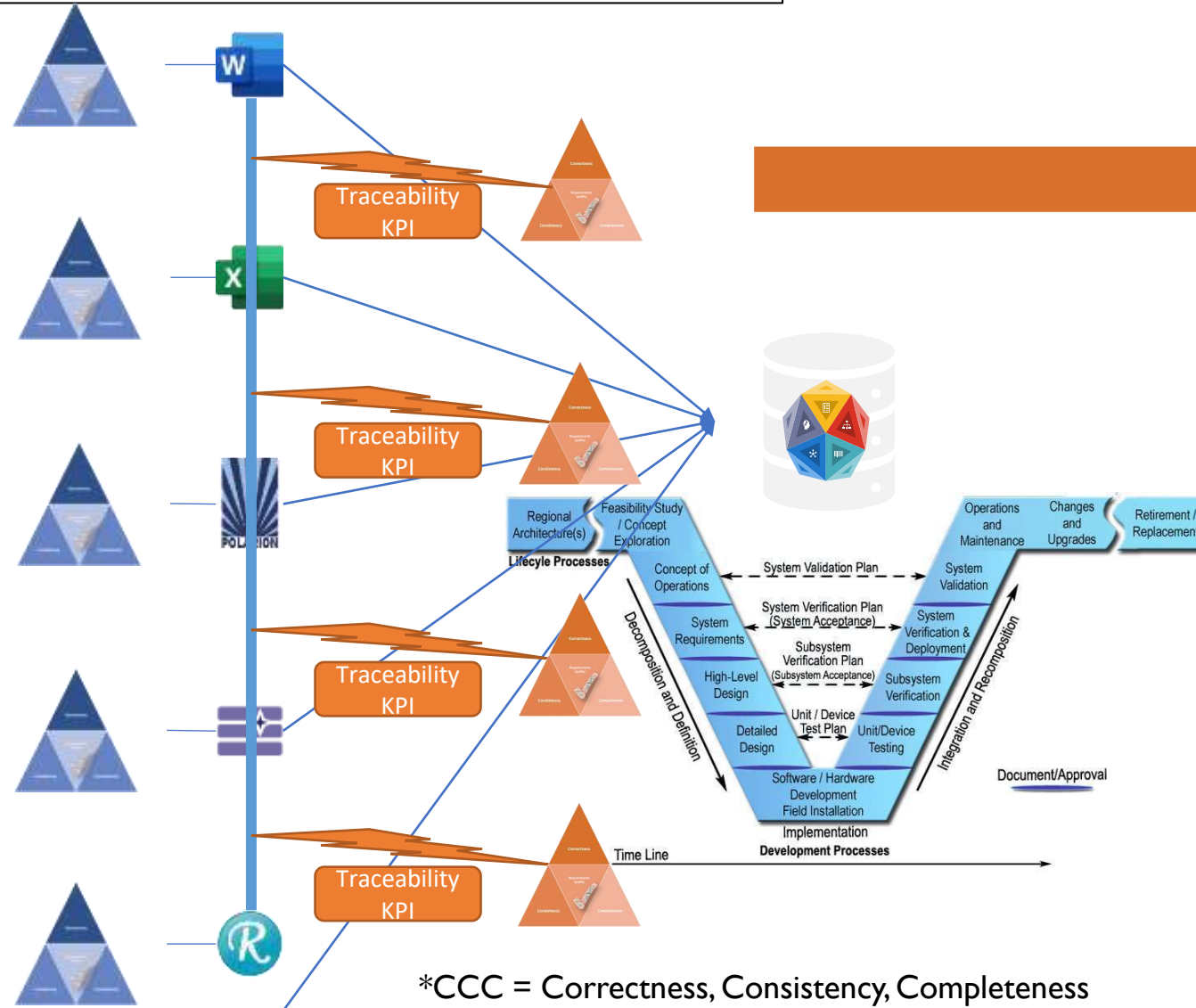


Want to learn more about this topic?



- **Tool-neutral**
- **Powered by semantic algorithms**
- **Fuelled with synchronized project data dictionary (knowledge domain)**

Document centric CCC* vs. Data-centric CCC*



Traceability KPI

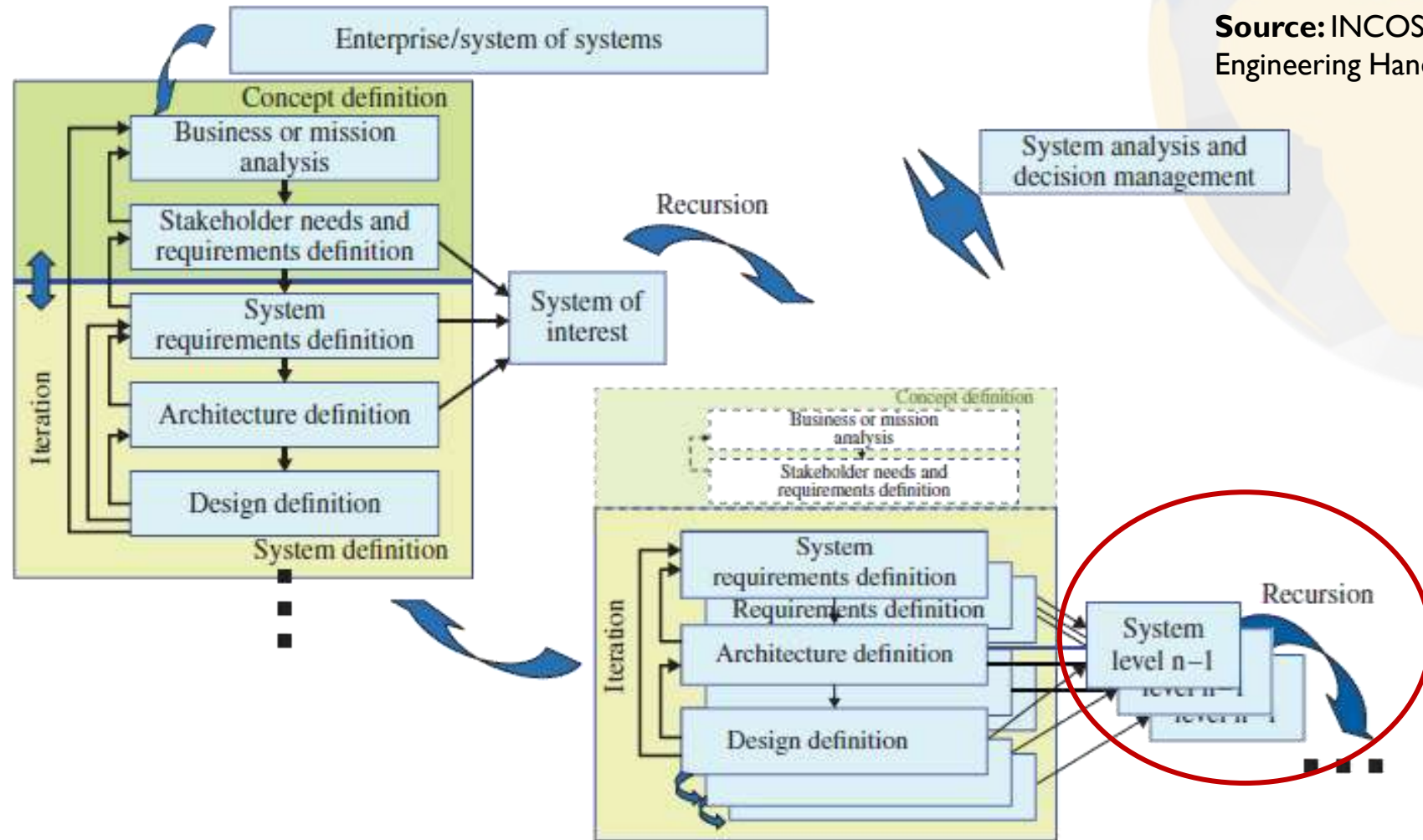
- Completeness:** ●

 - % traced elements
- Correctness:** ●

 - link type by traceability link
- Consistency:** ●

 - % Suspect links

*CCC = Correctness, Consistency, Completeness



Source: INCOSE Systems Engineering Handbook, Ed. 4

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

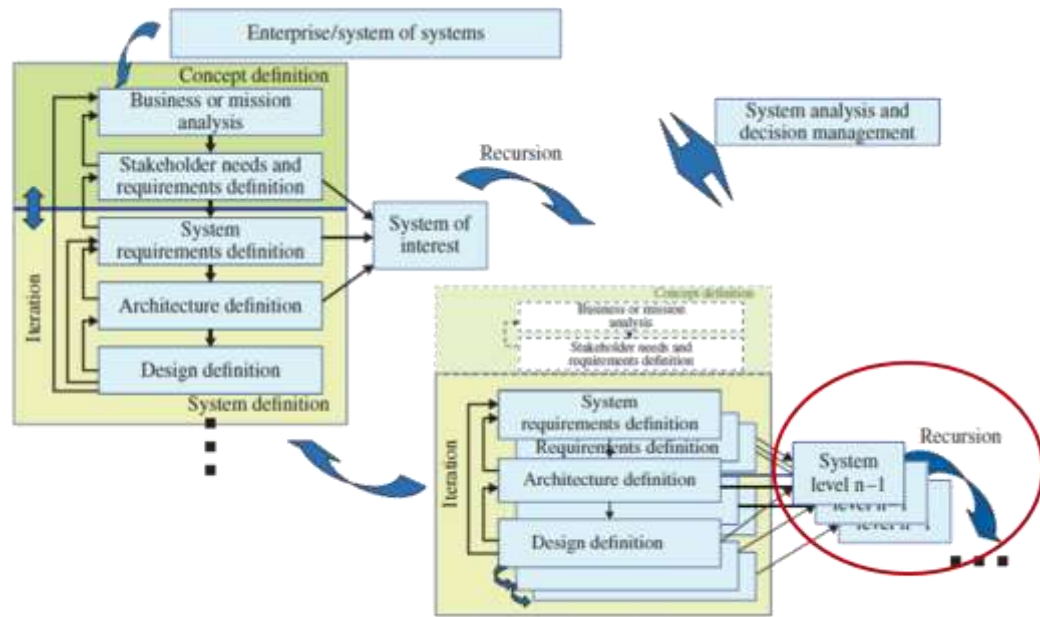
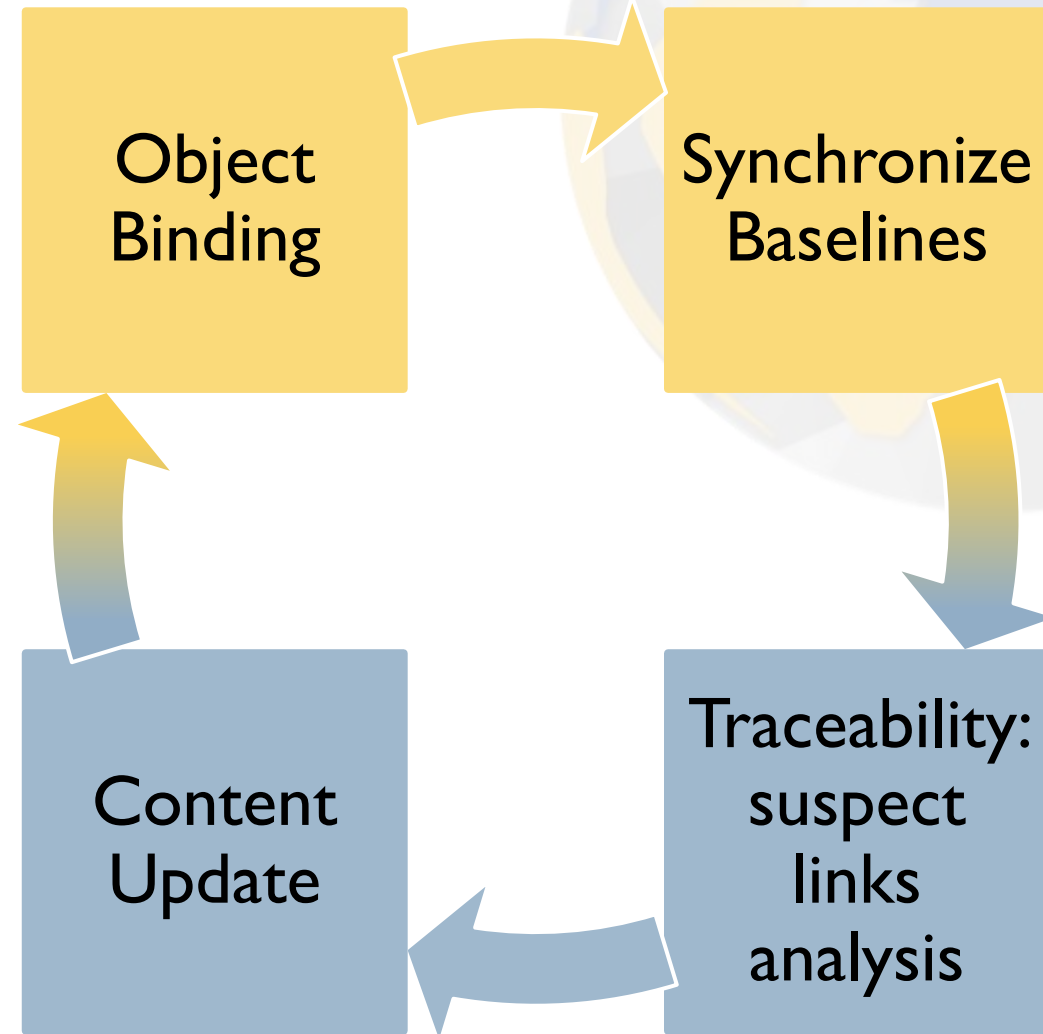


FIGURE 3.5 Iteration and recursion. Reprinted with permission from Garry Roedler. All other rights reserved.

- Interoperability
- Traceability

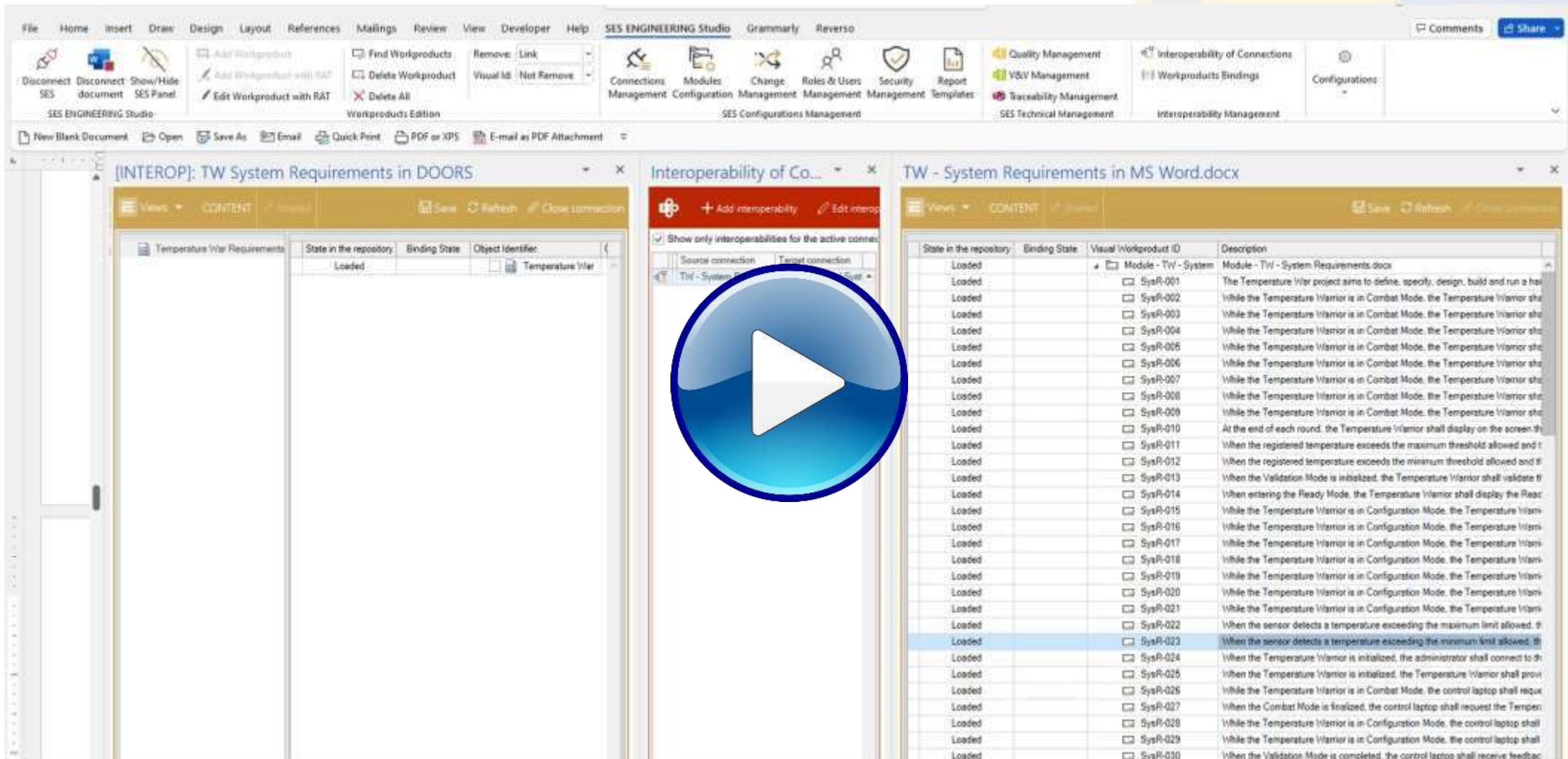




Live Demo

Interoperability

> #1: Data Exchange between tools (synchronization)



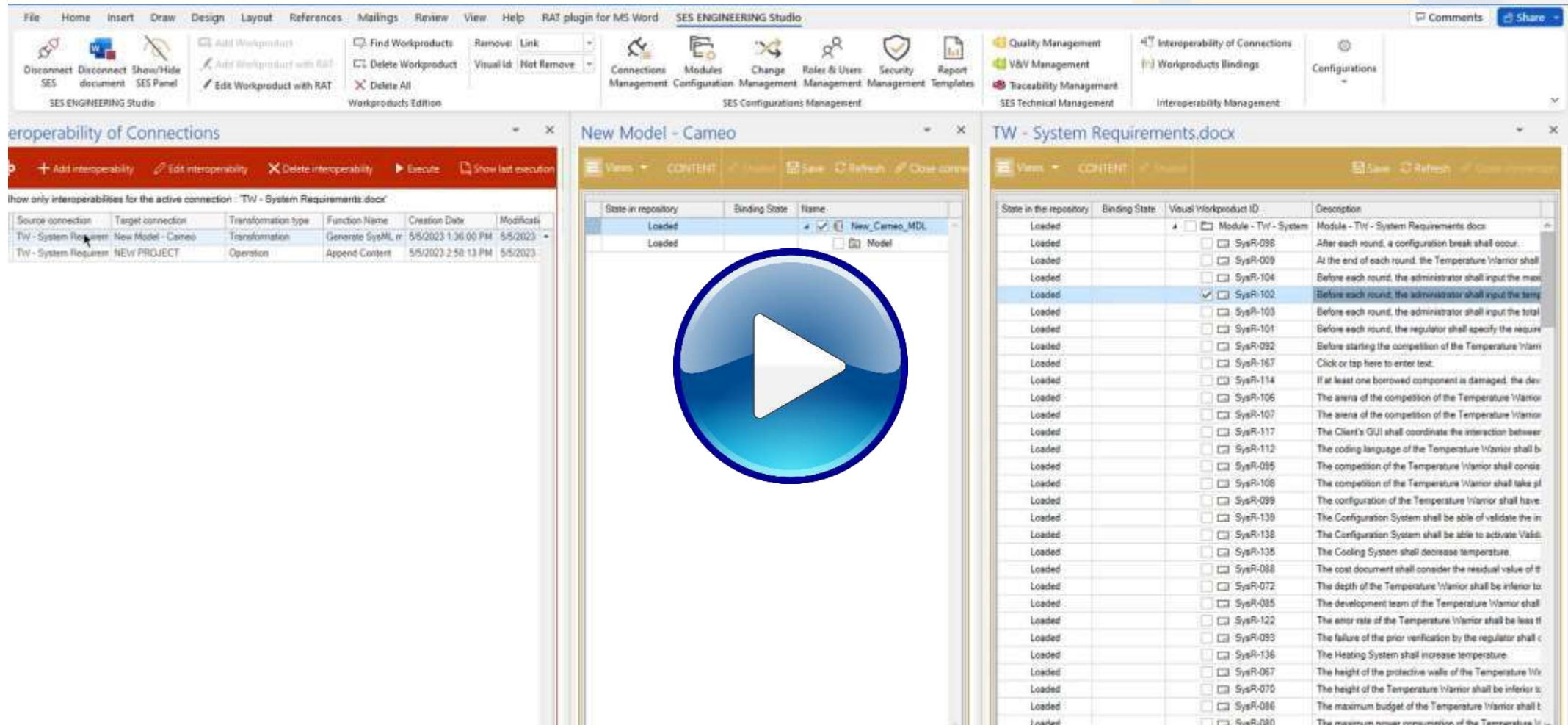
The screenshot displays the SES ENGINEERING Studio interface with three main windows open:

- [INTEROP]: TW System Requirements in DOORS**: Shows a table with columns for State in the repository, Binding State, and Object Identifier.
- Interoperability of Co...**: A central window with a red header and a play button icon, used for managing interoperabilities between connections.
- TW - System Requirements in MS Word.docx**: Shows a table with columns for State in the repository, Binding State, Visual Workproduct ID, and Description.

The MS Word window table contains the following data:

State in the repository	Binding State	Visual Workproduct ID	Description
Loaded		Module - TW - System	Module - TW - System Requirements.docx
Loaded		SysR-001	The Temperature War project aims to define, specify, design, build and run a ha
Loaded		SysR-002	While the Temperature Warrior is in Combat Mode, the Temperature Warrior sho
Loaded		SysR-003	While the Temperature Warrior is in Combat Mode, the Temperature Warrior sho
Loaded		SysR-004	While the Temperature Warrior is in Combat Mode, the Temperature Warrior sho
Loaded		SysR-005	While the Temperature Warrior is in Combat Mode, the Temperature Warrior sho
Loaded		SysR-006	While the Temperature Warrior is in Combat Mode, the Temperature Warrior sho
Loaded		SysR-007	While the Temperature Warrior is in Combat Mode, the Temperature Warrior sho
Loaded		SysR-008	While the Temperature Warrior is in Combat Mode, the Temperature Warrior sho
Loaded		SysR-009	While the Temperature Warrior is in Combat Mode, the Temperature Warrior sho
Loaded		SysR-010	At the end of each round, the Temperature Warrior shall display on the screen th
Loaded		SysR-011	When the registered temperature exceeds the maximum threshold allowed and t
Loaded		SysR-012	When the registered temperature exceeds the minimum threshold allowed and th
Loaded		SysR-013	When the Validation Mode is initialized, the Temperature Warrior shall validate th
Loaded		SysR-014	When entering the Ready Mode, the Temperature Warrior shall display the Reac
Loaded		SysR-015	While the Temperature Warrior is in Configuration Mode, the Temperature Warri
Loaded		SysR-016	While the Temperature Warrior is in Configuration Mode, the Temperature Warri
Loaded		SysR-017	While the Temperature Warrior is in Configuration Mode, the Temperature Warri
Loaded		SysR-018	While the Temperature Warrior is in Configuration Mode, the Temperature Warri
Loaded		SysR-019	While the Temperature Warrior is in Configuration Mode, the Temperature Warri
Loaded		SysR-020	While the Temperature Warrior is in Configuration Mode, the Temperature Warri
Loaded		SysR-021	While the Temperature Warrior is in Configuration Mode, the Temperature Warri
Loaded		SysR-022	When the sensor detects a temperature exceeding the maximum limit allowed, th
Loaded		SysR-023	When the sensor detects a temperature exceeding the minimum limit allowed, th
Loaded		SysR-024	When the Temperature Warrior is initialized, the administrator shall connect to th
Loaded		SysR-025	When the Temperature Warrior is initialized, the Temperature Warrior shall provi
Loaded		SysR-026	While the Temperature Warrior is in Combat Mode, the control laptop shall requ
Loaded		SysR-027	When the Combat Mode is finalized, the control laptop shall request the Temper
Loaded		SysR-028	While the Temperature Warrior is in Configuration Mode, the control laptop shall
Loaded		SysR-029	While the Temperature Warrior is in Configuration Mode, the control laptop shall
Loaded		SysR-030	When the Validation Mode is completed, the control laptop shall receive feedbac

#2: Transformation between tool languages (model conversion)



The screenshot displays the SES ENGINEERING Studio interface. The top menu bar includes File, Home, Insert, Draw, Design, Layout, References, Mailings, Review, View, Help, and a RAT plugin for MS Word. The main workspace is divided into three panes:

- Interoperability of Connections:** Shows a table of connections between 'TW - System Requirements.docx' and 'New Model - Cameo'.
- New Model - Cameo:** Displays a tree view of workproducts, including 'New_Cameo_MDL' and 'Model'.
- TW - System Requirements.docx:** Shows a list of system requirements (SysR-098 to SysR-080) with their descriptions.

A large blue play button icon is overlaid on the 'New Model - Cameo' pane, indicating the execution of a transformation process.

Source connection	Target connection	Transformation type	Function Name	Creation Date	Modification Date
TW - System Requirements.docx	New Model - Cameo	Transformation	Generate SysML tr	5/5/2023 1:36:00 PM	5/5/2023
TW - System Requirements.docx	NEW PROJECT	Operation	Append Content	5/5/2023 2:58:13 PM	5/5/2023

State in the repository	Binding State	Visual Workproduct ID	Description
Loaded		Module - TW - System	Module - TW - System Requirements.docx
Loaded		SysR-098	After each round, a configuration break shall occur.
Loaded		SysR-099	At the end of each round, the Temperature Warrior shall
Loaded		SysR-104	Before each round, the administrator shall input the max
Loaded		SysR-102	Before each round, the administrator shall input the temp
Loaded		SysR-103	Before each round, the administrator shall input the total
Loaded		SysR-101	Before each round, the regulator shall specify the require
Loaded		SysR-092	Before starting the competition of the Temperature Warri
Loaded		SysR-167	Click or tap here to enter text.
Loaded		SysR-114	If at least one borrowed component is damaged, the dev
Loaded		SysR-106	The arena of the competition of the Temperature Warri
Loaded		SysR-107	The arena of the competition of the Temperature Warri
Loaded		SysR-117	The Client's GUI shall coordinate the interaction betwee
Loaded		SysR-112	The coding language of the Temperature Warrior shall b
Loaded		SysR-095	The competition of the Temperature Warrior shall consist
Loaded		SysR-108	The competition of the Temperature Warrior shall take pl
Loaded		SysR-099	The configuration of the Temperature Warrior shall have:
Loaded		SysR-139	The Configuration System shall be able to validate the in
Loaded		SysR-138	The Configuration System shall be able to activate Valid
Loaded		SysR-135	The Cooling System shall decrease temperature.
Loaded		SysR-088	The cost document shall consider the residual value of t
Loaded		SysR-072	The depth of the Temperature Warrior shall be inferior to
Loaded		SysR-085	The development team of the Temperature Warrior shall
Loaded		SysR-122	The error rate of the Temperature Warrior shall be less t
Loaded		SysR-093	The failure of the prior verification by the regulator shall
Loaded		SysR-136	The Heating System shall increase temperature.
Loaded		SysR-067	The height of the protective walls of the Temperature Wa
Loaded		SysR-070	The height of the Temperature Warrior shall be inferior t
Loaded		SysR-086	The maximum budget of the Temperature Warrior shall b
Loaded		SysR-080	The maximum power consumption of the Temperature V

#3: Traced Objects binding & roundtrip editing

The screenshot displays a software interface with two main panels. The left panel shows a tree view of system components under 'TW - Cameo Model'. The right panel shows a table of requirements under 'TW - System Requirements Interoperability'.

State in repository	Binding State	Name
Updated		Temperature_War
Updated		Model
Loaded		2. System Analysis
Loaded		1. Operational Analysis
Loaded		TW Profile
Updated		3. Logical Architecture
Loaded		Relations
Loaded		Root System Functions
Loaded		Control System Requirements Requirements Requirer
Loaded		Temperature Warrior Requirements
Loaded		Temperature Warrior
Loaded		Temperature Registration System
Loaded		Configuration System
Loaded		Power System
Loaded		Management System
Loaded		Cooling System
Loaded		Temperature Actuation System
Updated		Management System
Loaded		Information Visualization System
Loaded		Temperature Controller
Loaded		Sensor
Loaded		Heating System
Loaded		Power Source
Loaded		Functions Allocation in PBS
Loaded		FBS
Loaded		PBS
Loaded		4. Physical Architecture
Loaded		Control System Requirements Requirements Requirements Requirer

State in repository	Binding State	Code	Description
Updated		CSyR	CSyR
Loaded		CSyR1	The weight of the Control System shall be 4 kg
Updated		CSyR2	The Management System shall be a Nesturno 2 Plus.
Updated		CSyR3	The Management System shall contain the temperature regulation software.
Updated		CSyR4	The Management System shall send and receive electric signals to control the activity of I
Updated		CSyR5	The Management System shall be physically connected to the Temperature Actuation Sy
Updated		CSyR6	The Management System shall be physically connected to the Management System.
Updated		CSyR7	The Management System shall be physically connected to the Temperature Registration
Updated		CSyR8	The Management System shall be physically connected to the Power System.
Updated		CSyR9	The Management System shall store the system configuration parameters during the rou
Updated		CSyR10	When the minimum temperature threshold is exceeded, the Management System shall be
Updated		CSyR11	When the Management System is in Configuration mode and the input configuration para
Updated		CSyR12	When the Administrator inputs the configuration parameters and selects the Finish optio
Updated		CSyR13	When the maximum or minimum temperature threshold is exceeded, the Management Sy
Updated		CSyR14	When the minimum temperature threshold is exceeded, the Management System shall be
Updated		CSyR15	When the Management System is in Validation mode and the input configuration paramet
Updated		CSyR16	When the Management System is in Validation mode and the input configuration paramet
Updated		CSyR19	The Management System power consumption shall be 5 W.
Updated		CSyR20	The Management System shall be compliant with The Electricity at Work Regulations 198
Updated		CSyR23	While the Temperature Warrior is in Combat Mode, the Management System shall comm
Updated		CSyR24	While the Temperature Warrior is in Combat Mode, the Management System shall comm
Updated		CSyR28	While the Temperature Warrior is in Combat Mode, the Management System shall comm
Loaded		MSysR	MSysR
Loaded		PSysR	PSysR
Loaded		TASysR	TASysR
Loaded		TRSysR	TRSysR
Loaded		TWSysR	TWSysR





Learn about the V&V Management Capabilities within SES ENGINEERING Studio

- *Digitalize and monitor your V&V activities in compliance with ISO-15288 standard*
- *Centralize the V&V actions of your system development life cycle using the connectivity of SES ENGINEERING Studio (interoperability hub).*
- *Produce V&V reports and dashboards*
- **Dates: February 13 & 15, 2024**

Link to register : <https://www.reusecompany.com/webinars/digital-verification-and-validation-according-to-iso-15288-across-the-v-model>





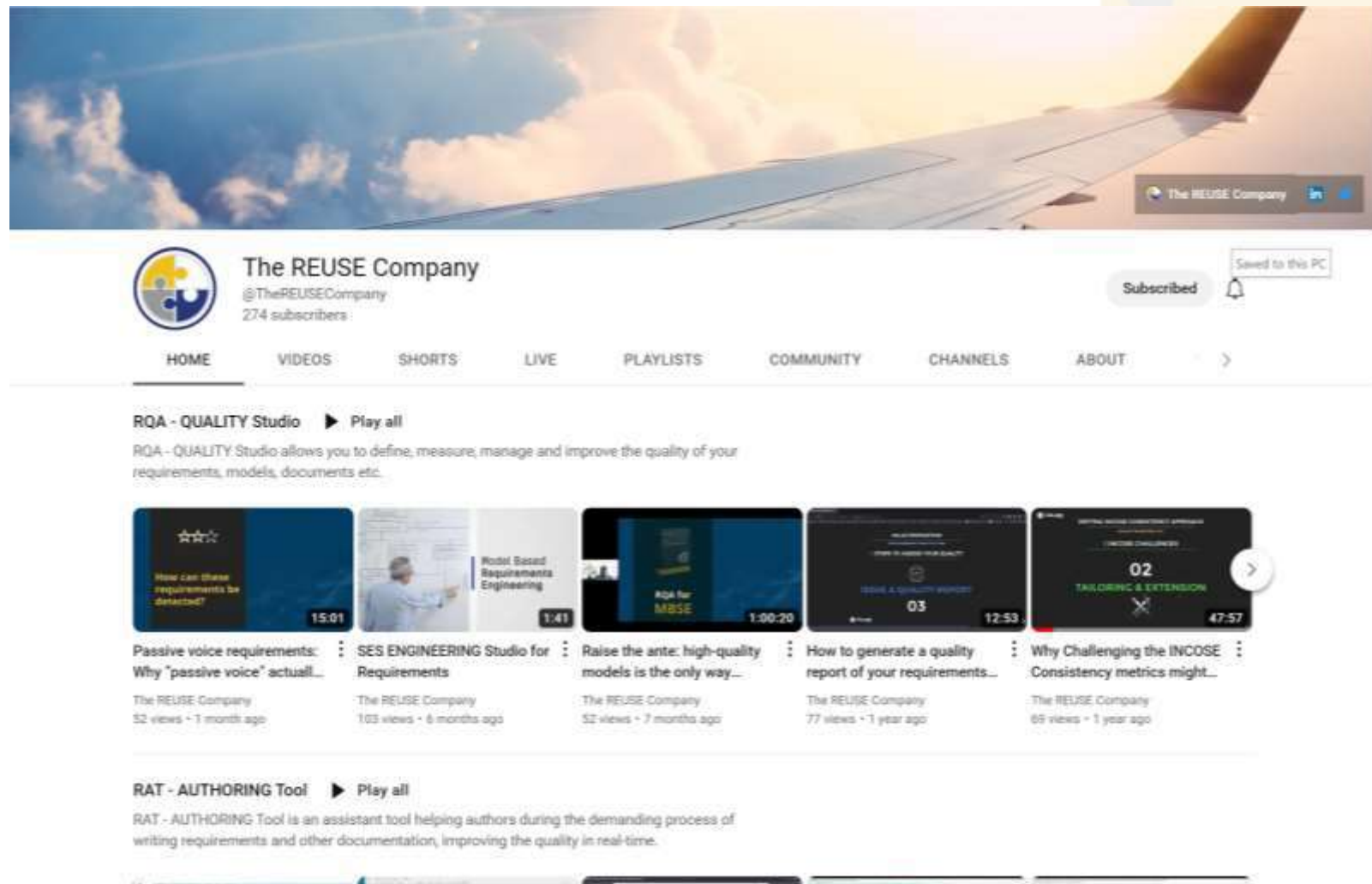
- > www.reusecompany.com
- > Information about the Systems Engineering Suite
- > Resources (Webinars, handbooks)
- > Request for demo
- > Support Forum

The screenshot shows the 'Resources' page of the REUSE website. The page title is 'Enabling SMART Systems Engineering'. The navigation menu includes 'Products', 'Services', 'Resources', 'TRC Forum', 'Support', 'Company', and 'Contact'. The main content area displays a grid of 12 resource cards, each with a thumbnail image and a title:

- Requirements management through AIIG Contracts
- Connecting the Dots: Interoperability between your favourite Systems Engineering tools
- Semantic traceability: how to keep the digital thread all along the SE lifecycle
- The MBSE Podcast: MBSE around the world: Spain with Juan Llorens
- Passive voice requirements: Why "passive voice" actually can become a nightmare
- (In Spanish) Invitados al podcast 'Sistemistas': V&V ¿Qué es qué?
- Connecting textual requirements and Capella models (Invited presenters)
- Requirements Management: Managing data over entire life cycles
- How to kick off your KM – KNOWLEDGE Management project
- Taming the System Engineering Life cycle using Connectivity and Interoperability: the SES ENGINEERING Studio
- Raise the ante: high-quality models is the only way forward after high-quality requirements
- Digitalizing the V&V process on both sides of the V-Model

➤ Subscribe to our Youtube channel to follow our latest content!

<https://www.youtube.com/user/TheREUSECompany>





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