FOR VICE OR VIRTUE

- DIGITAL VERIFICATION AND VALIDATION ACCORDING TO ISO-15288 -

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THE REUSE COMPANY

INTRO TO PRESENTER

- INCOSE ASEP
- MAIN CONTRIBUTOR TO THE INCOSE GUIDE TO WRITING REQUIREMENTS
- SALES & CONSULTING REPRESENTATIVE UNDER CSEP & ESEP
- FIRST AUTHOR OF THE *"APPLYING THE KNOWLEDGE CENTRIC SYSTEMS ENGINEERING METHODOLOGY TO A PRACTICAL CASE"*

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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 life cycle.

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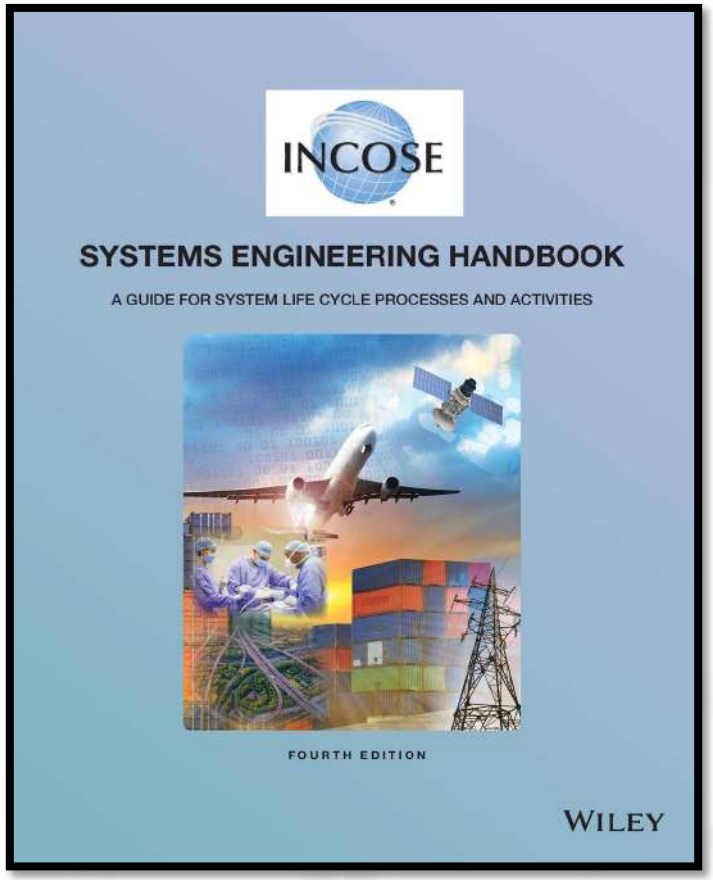
CHAPTER 00

INTRO TO V&V

VERIFICATION AND VALIDATION PROCESSES WITHIN THE ISO 15288



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KEY CONCEPTS: LIFE CYCLE PROCESSES

TECHNICAL PROCESSES	
Business or mission analysis process	*Integration process*
Stakeholder needs and requirements definition process	*Verification process*
System requirements definition process	*Transition process*
Architecture definition process	*Validation process*
Design definition process	*Operation process*
System analysis process	*Maintenance process*
Implementation process	*Disposal process*

ORGANIZATIONAL PROJECT-ENABLING PROCESSES
Life cycle model management process
Infrastructure management process
Portfolio management process
Human resource management process
Quality management process
Knowledge management process

AGREEMENT PROCESSES
Acquisition Process
Supply Process

TECHNICAL MANAGEMENT PROCESSES
Project planning process
Project assessment and control process
Decision management process
Risk management process
Configuration management process
Information management process
Measurement process
Quality assurance process

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ISO 15288: INPUTS, PROCESSES & OUTPUTS

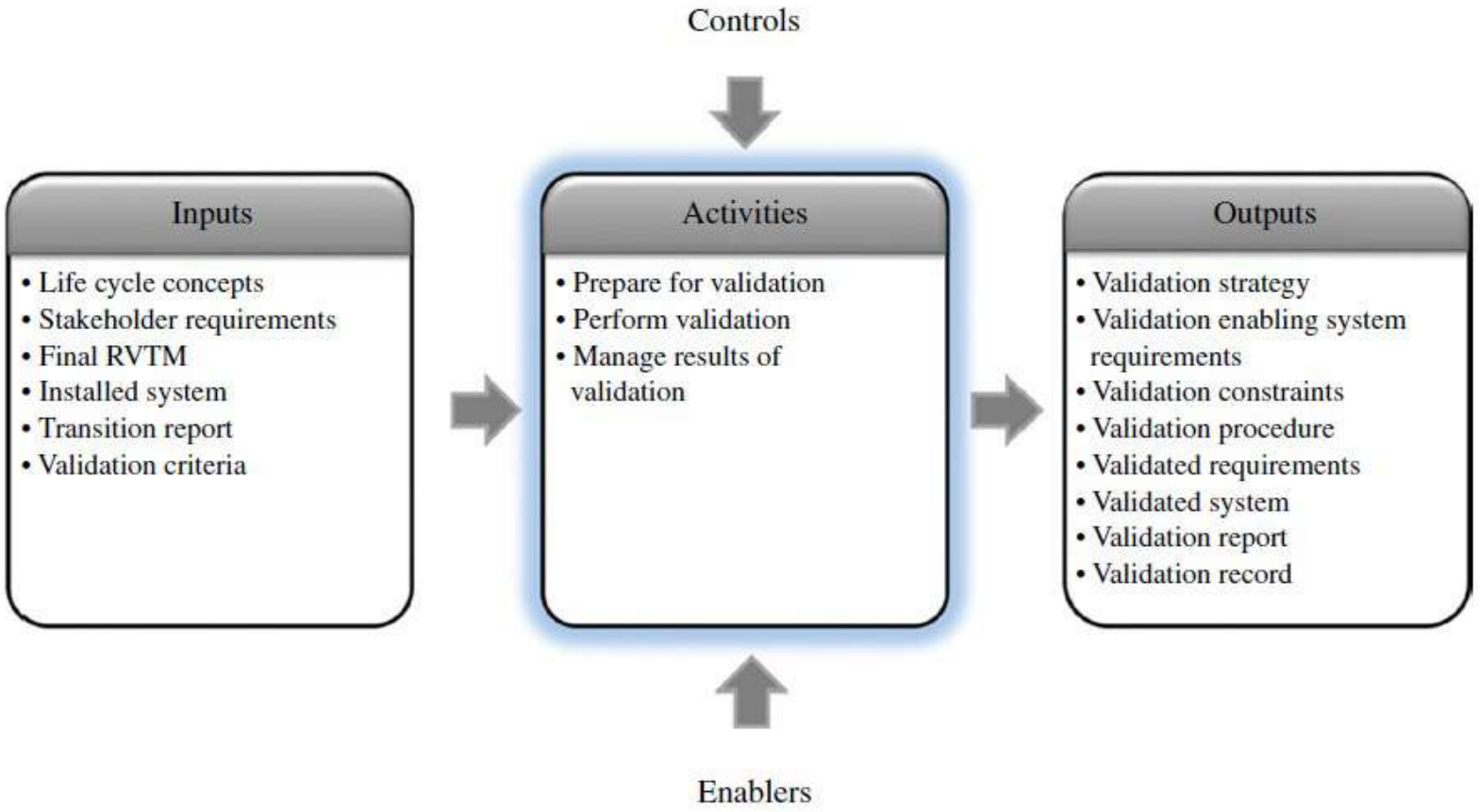

FIGURE 4.17 IPO diagram for the validation process. INCOSE SEH original figure created by Shortell and Walden. Usage per the INCOSE Notices page. All other rights reserved.

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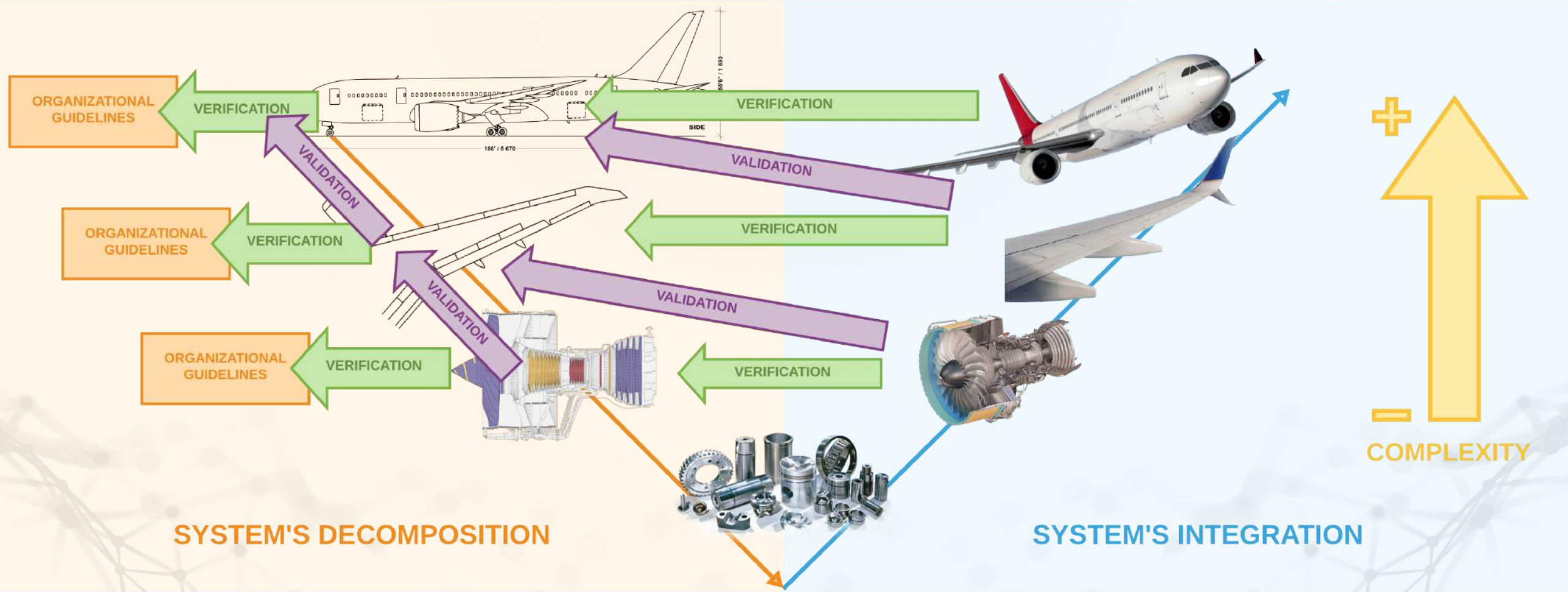
THE V-MODEL



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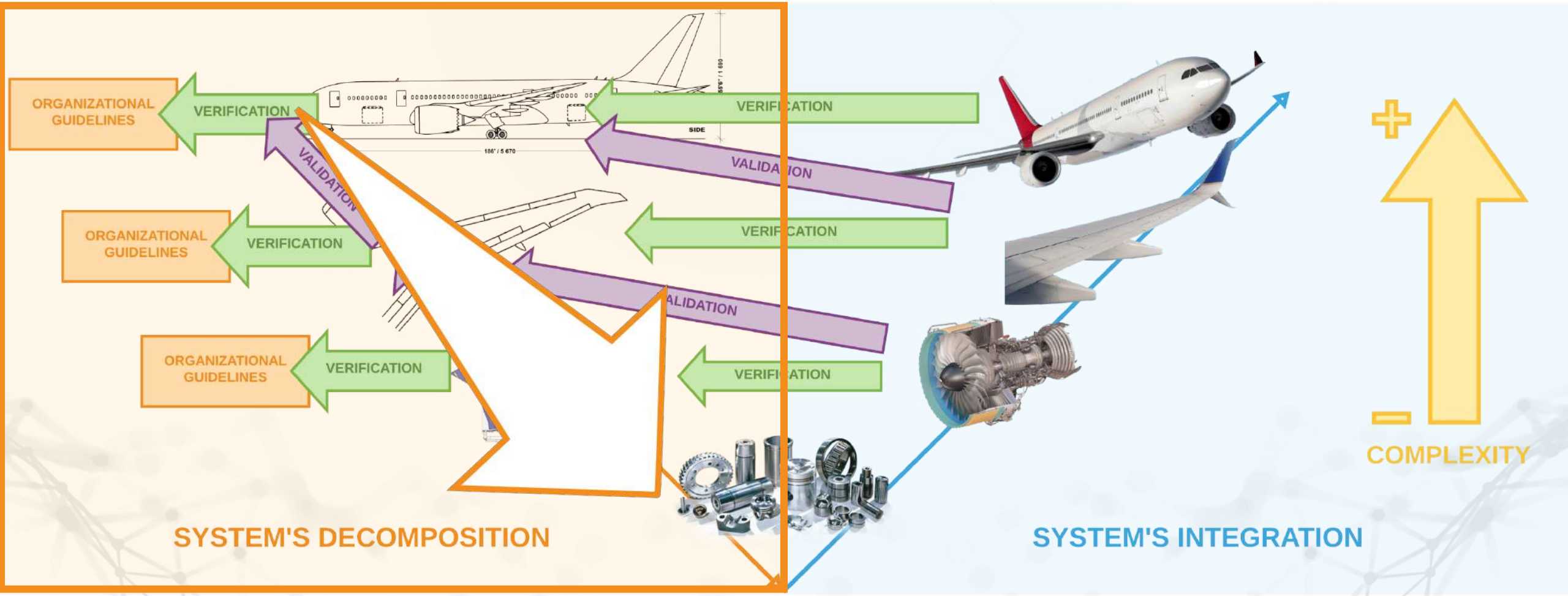
SYSTEM DECOMPOSITION



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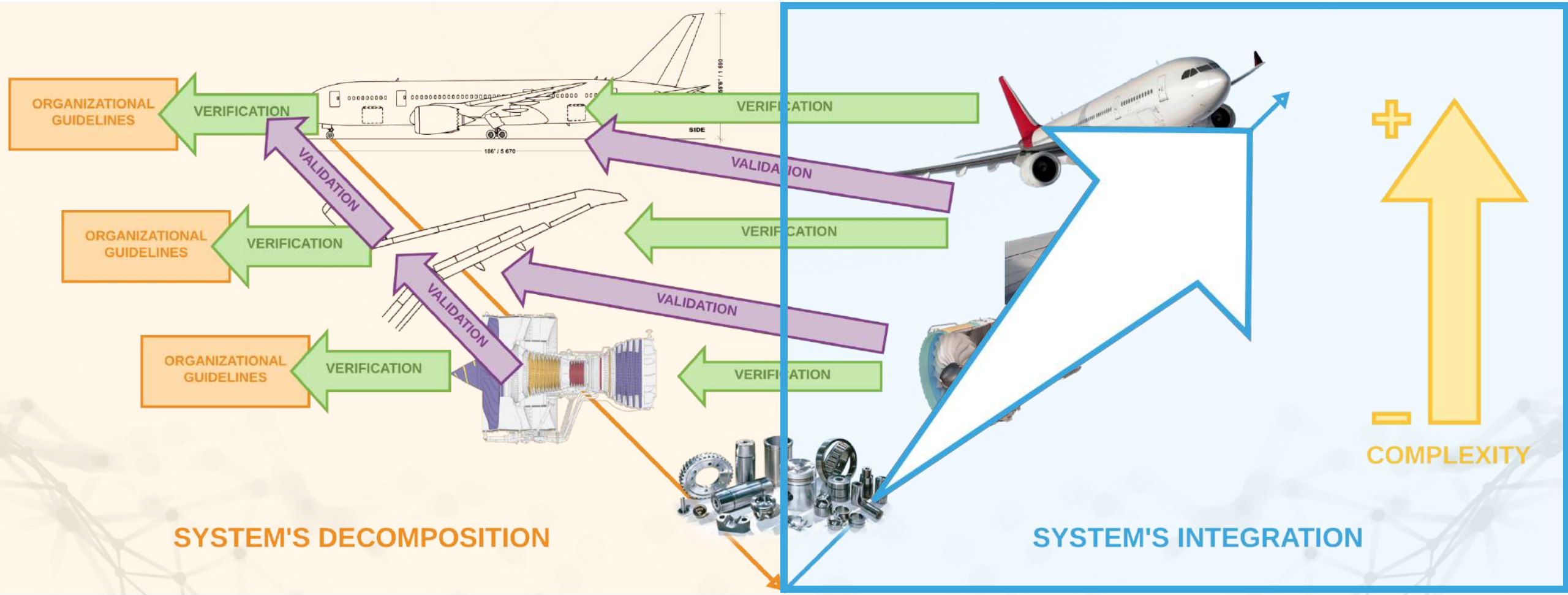
SYSTEM INTEGRATION



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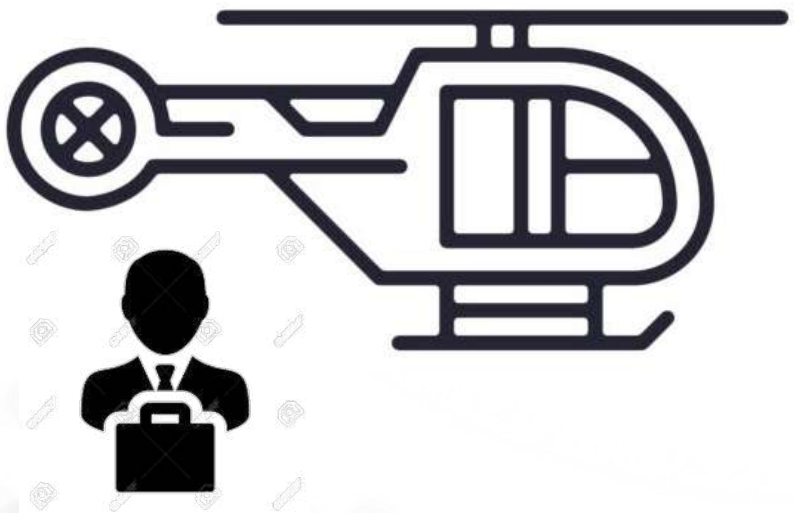
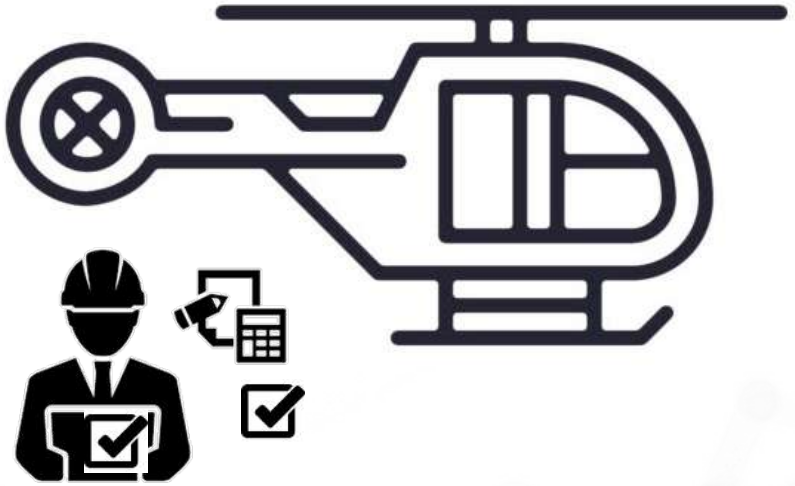
VERIFICATION VS VALIDATION





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VERIFICATION VS VALIDATION

- *"The purpose of the **Verification Process** is to provide OBJECTIVE EVIDENCE that a system or system element FULFILLS its SPECIFIED REQUIREMENTS AND CHARACTERISTICS."* *(SEHb p.83)*
  - The purpose of the verification process is to provide EVIDENCE that NO ERROR/DEFECT/FAULT has been introduced at the time of any transformation of inputs into outputs; it is used to confirm that this TRANSFORMATION has been made according to the requirements and selected methods, techniques, standards, or rules.

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- *"The purpose of the **Validation Process** is to provide OBJECTIVE EVIDENCE that the system, when in use, FULFILLS its BUSINESS OR MISSION OBJECTIVES AND STAKEHOLDER REQUIREMENTS, achieving its intended use in its intended operational environment".* *(SEHb p.89)*

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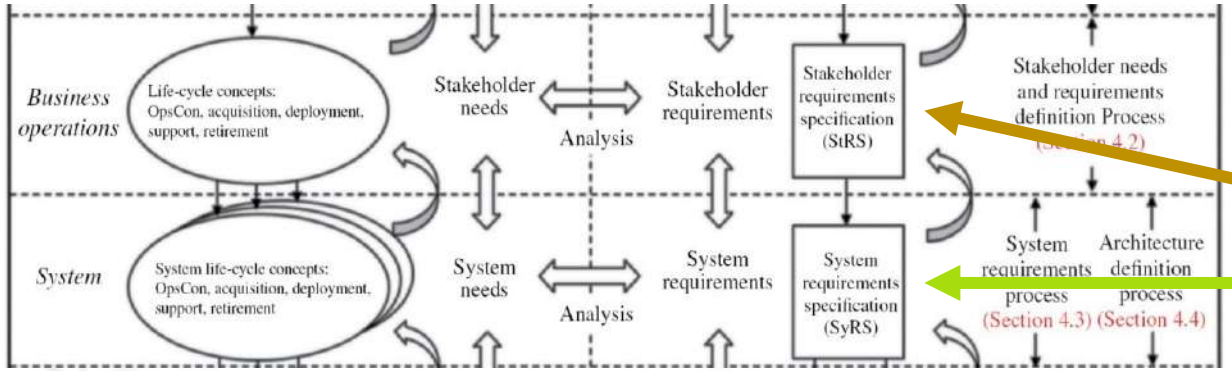

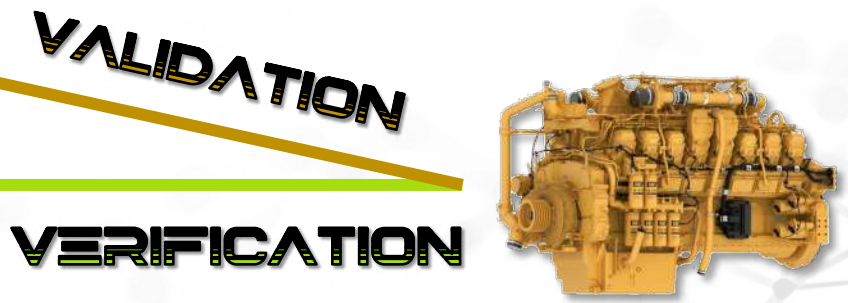

Source: Mike Ryan - SE Handbook V4

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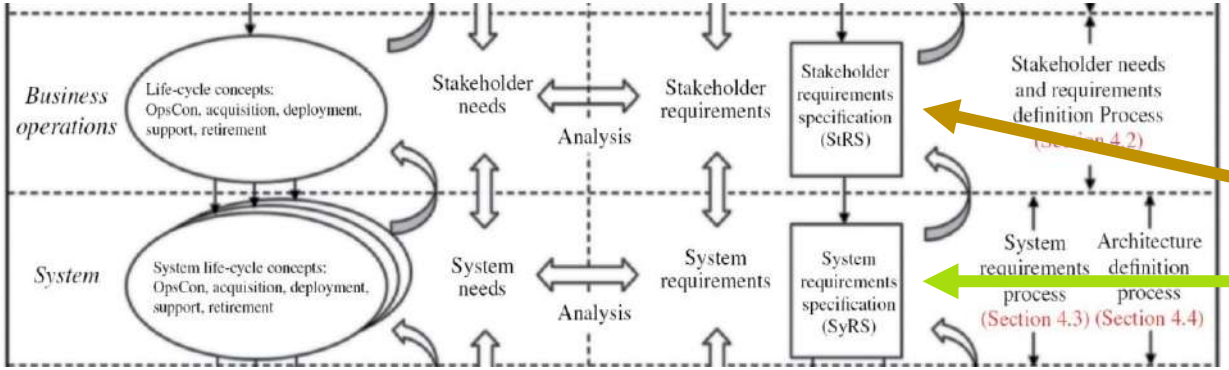
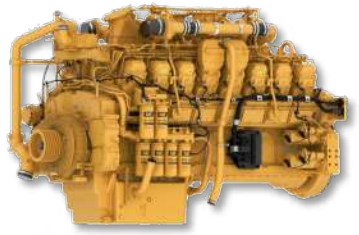
VERIFICATION VS VALIDATION



Source: Mike Ryan - SE Handbook V4

VALIDATION

VERIFICATION



VALIDATION

"Build the RIGHT THING"

VERIFICATION

"Build the THING RIGHT"

Different CONTEXT

Divergent SCOPE

...

But SAME METHODS and TOOLS

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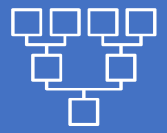
V&V CORE ACTIVITIES

V&V Preparation



- **Selecting Items** to Verify/Validate.
- Define a **V&V Action Template**.
- Specify **Resources**, **Constraints**, **Enabling Systems**, etc.
- Define a **V&V Technique**.

V&V Execution

- **Execute** the **V&V Action** for each Verifiable Item.
- Software applies the **OK / KO** decision process based on the **standard guidelines**.
- **Engineer** defines the **final state** of the Verification process.

V&V Results Management

- **Manage and record** discovered **anomalies** and **evidences**.
- Track the **Verification Process** and **manage Configuration**.
- Build and maintain the **RTVM**.
- Provide **proper reports**.

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CHAPTER 01

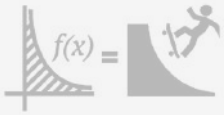
PREPARE

V&V PREPARATION

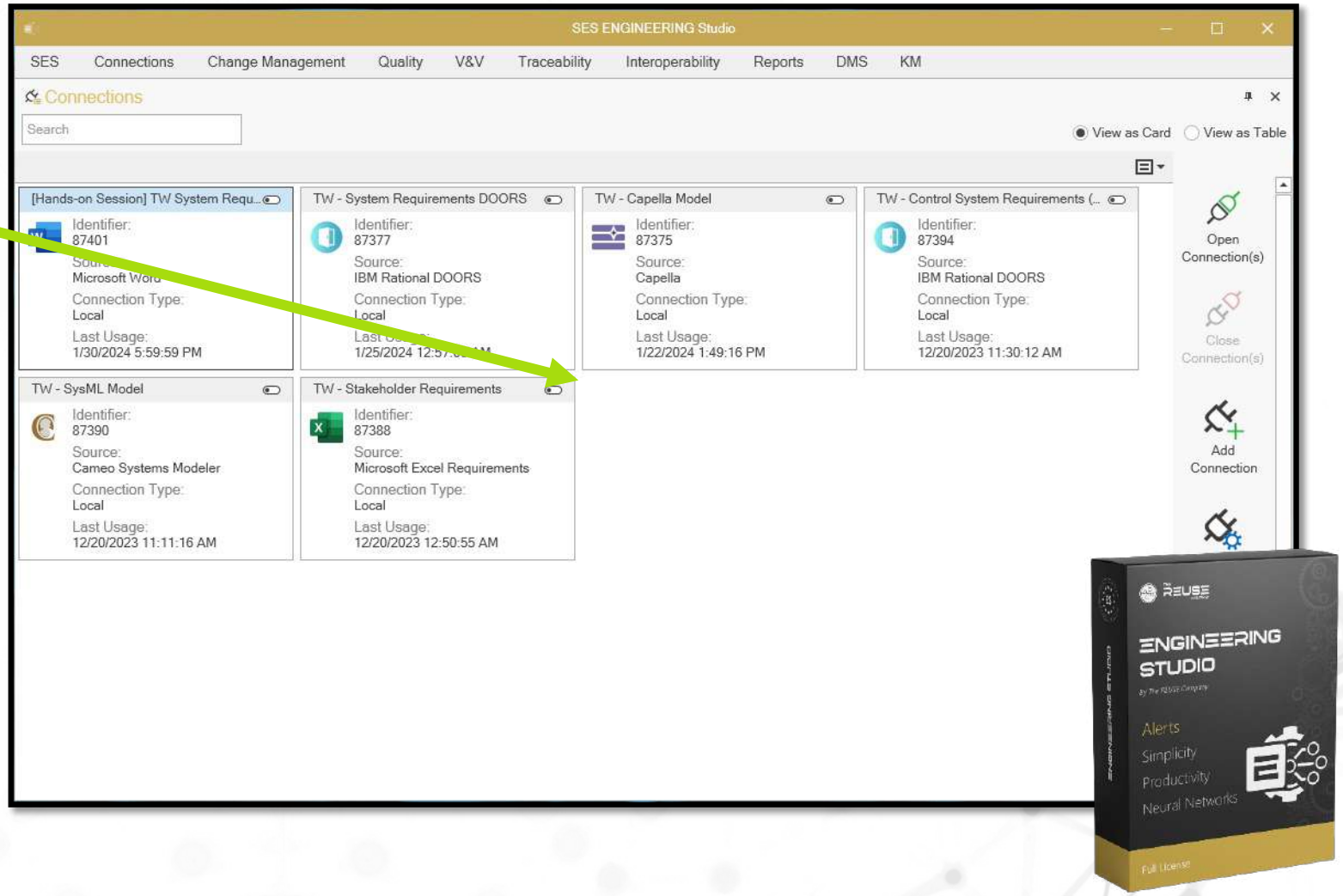
Access the Items to be Verified

Define a Verification Action for each Verifiable Item

Prepare Resources of all types, Identify constraints, Enabling Systems, etc.



Define a Verification Technique for each Verifiable Item



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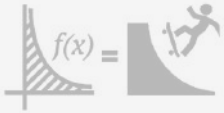
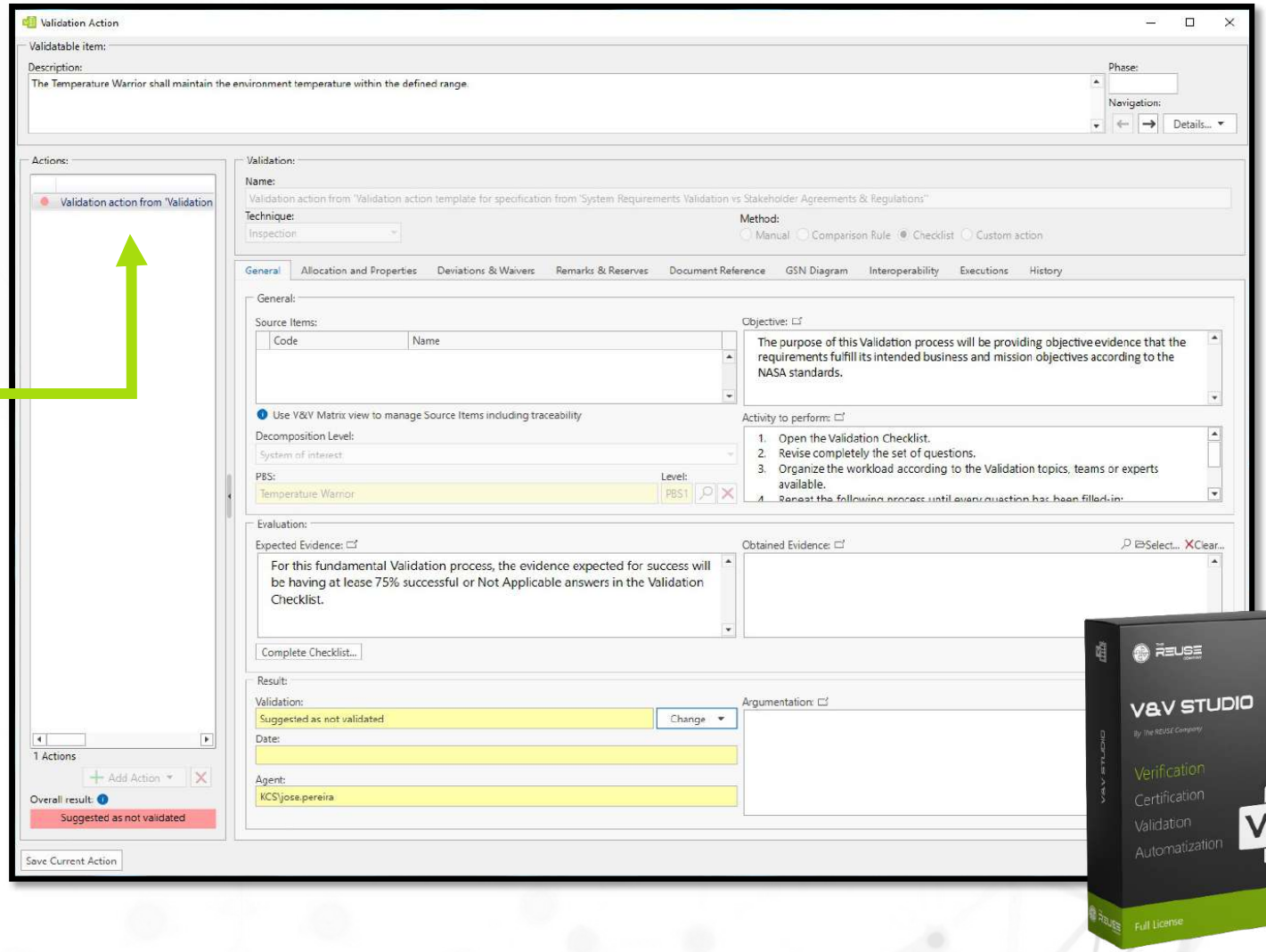


Define a Verification Technique for each Verifiable Item



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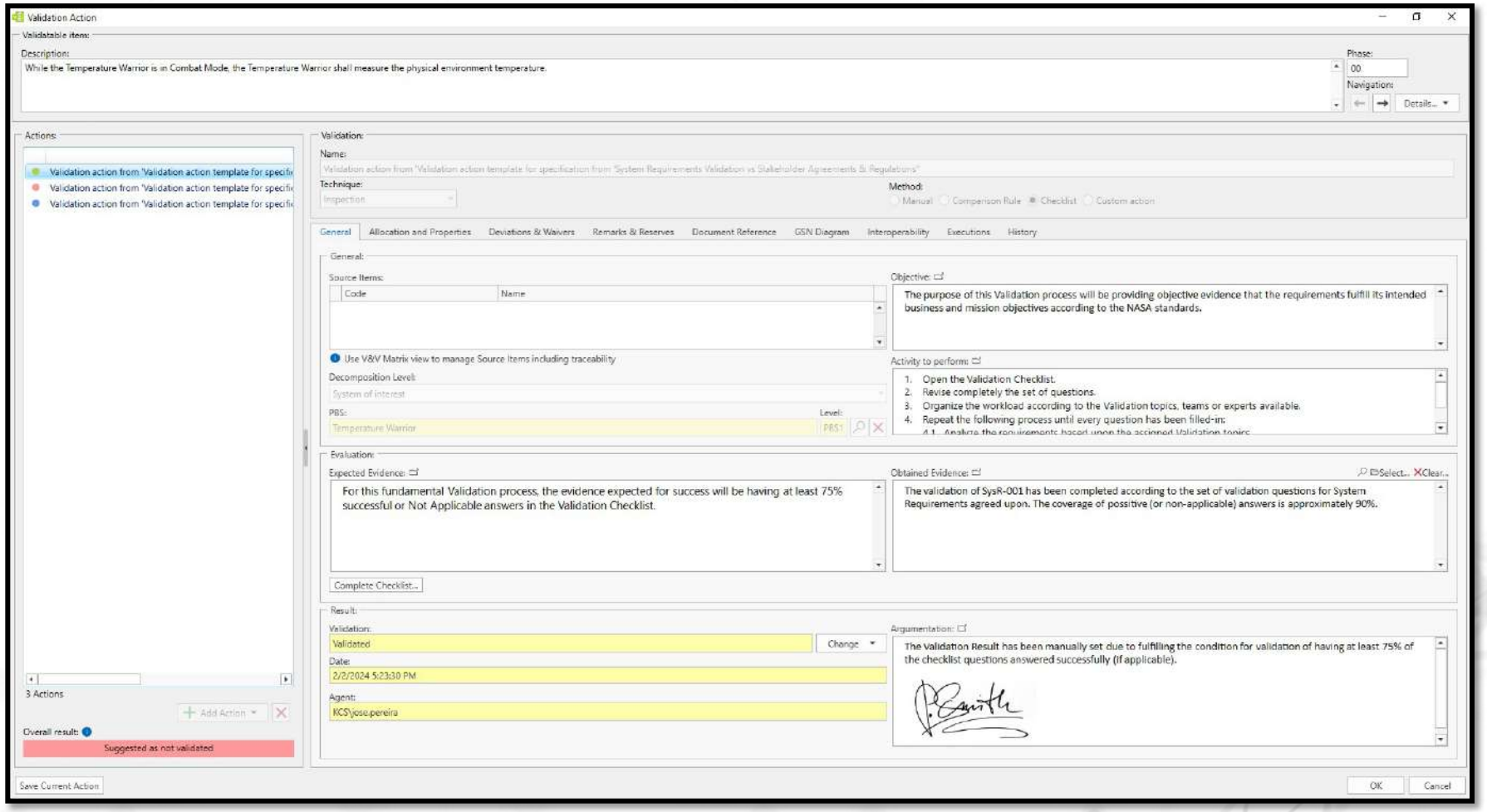
VERIFICATION ACTIONS INSIDE SES ENGINEERING STUDIO

- Record of fields **DIGITALLY** managed and stored in a **DATABASE**.
- Assigned to **EVERY VERIFIABLE ITEM**.
- **RESPONSIBLE ENGINEER** fills it with relevant information.
- **STORE** information for the Verifiable Item to be considered verified.
- **N:N RELATIONSHIP** between *Validatable Items* and *Validation Actions*.



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V&V PREPARATION

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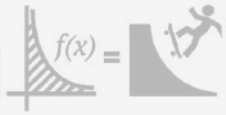
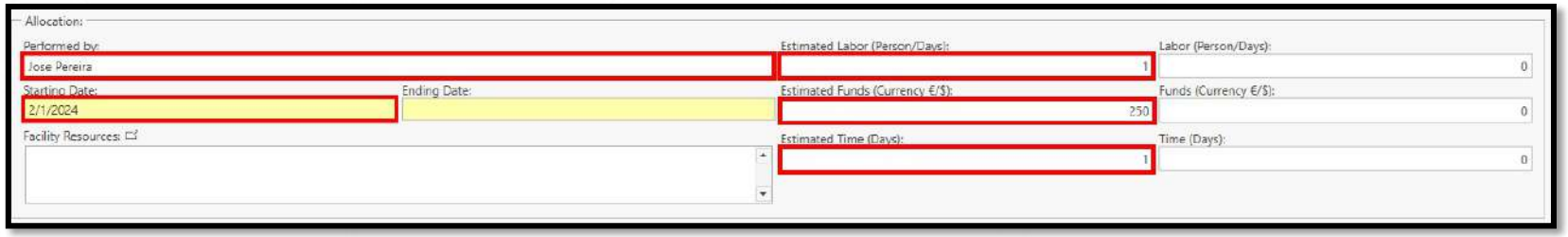


Define a Verification Technique
for each Verifiable Item



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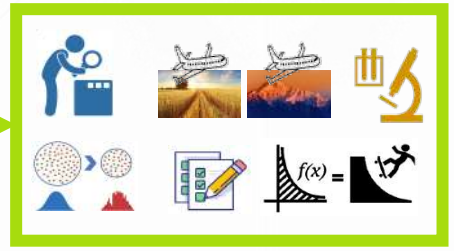
V&V PREPARATION

Access the Items to be Verified

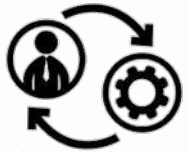
Define a Verification Action for each Verifiable Item

Prepare Resources of all types, Identify constraints, Enabling Systems, etc.

Define a Verification Technique for each Verifiable Item



Select one **Verification Technique** or define your own one.



Define if the obtained results will be gathered <u>manually or automatically</u>.

- Manually: (A human engineer fills data in the VA by hand).

Defining customizable Check-lists.

Defining values to be expected.

- Automatically: A **Calculation Function** generates the resulting data.




Connecting to other tools.

Calculating the Quality of Verifiable Item using RQA Tool.

Defining your own Calculation Function.

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CHAPTER 02

EXECUTE

V&V ACTIVITIES EXECUTION

Execute the Verification Action for each Verifiable Item.

Computer applies the OK / KO decision process based on the standard guidelines.

Engineer defines the final state of the Verification process

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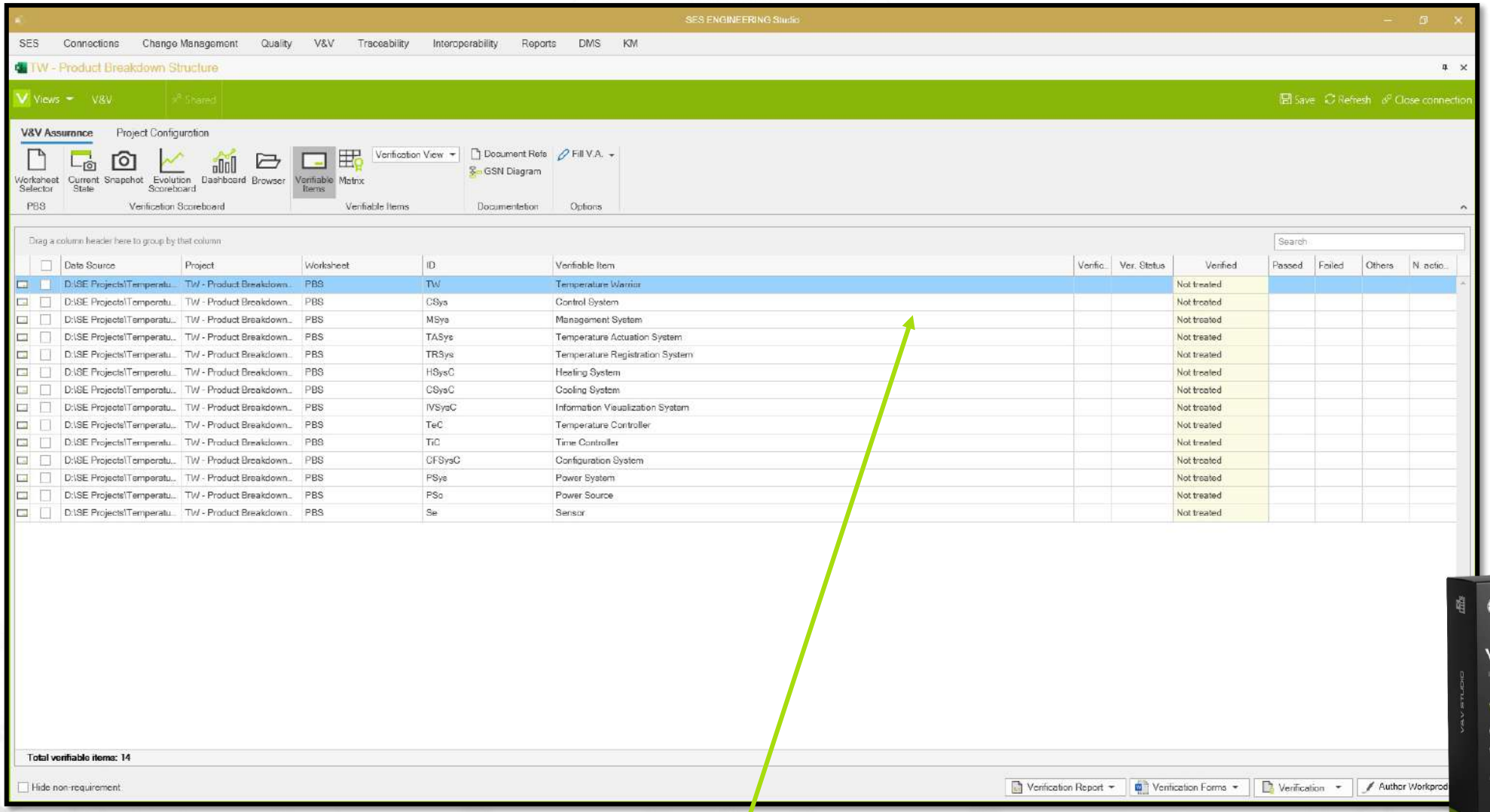

Connect to the **Source**
to collect the *Validatable Items*

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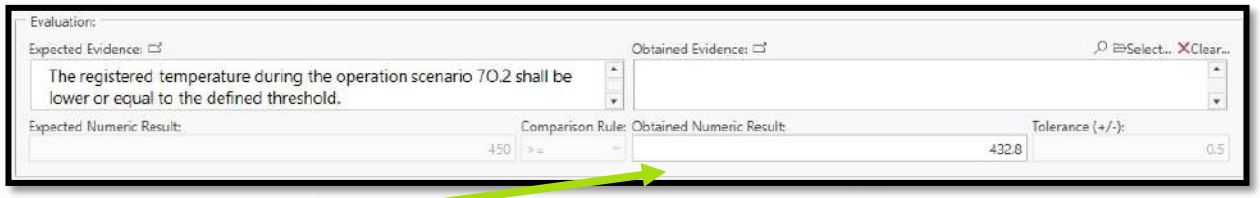
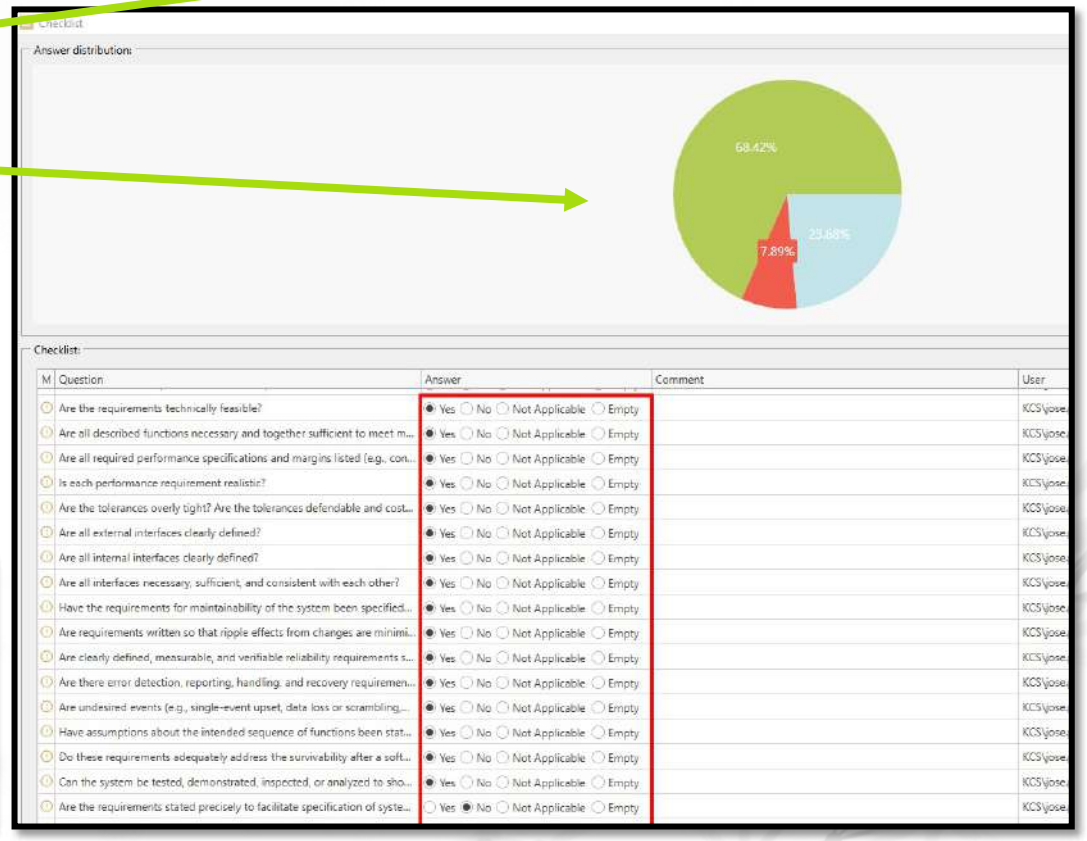
HOW TO VERIFY & VALIDATE?

1. AUTOMATIC ASSESSMENT:

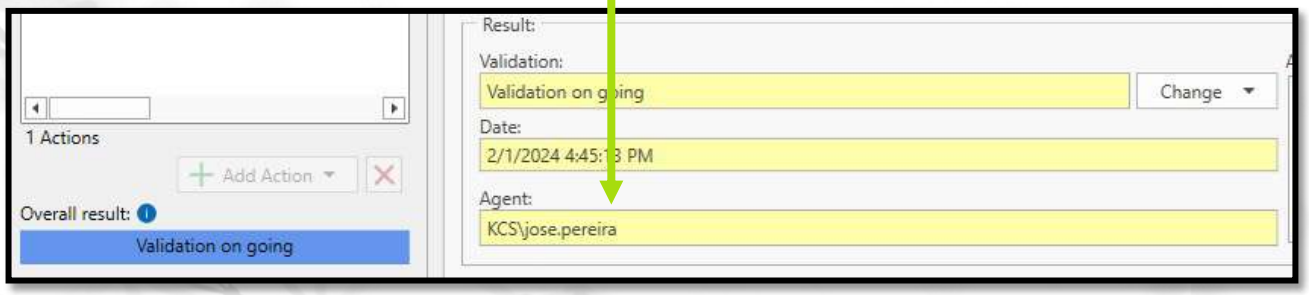
A human fills information and a computer evaluates a comparison operation.

- ✓ Numeric Comparison: Expected Result vs Obtained Result.
- ✓ Check List results evaluation: (e.g., All values YES ➔ VA OK).
- ✓ Based on the comparison result, the VA gets automatically a *State*.





2. MANUAL EVALUATION: A human decides if OK or KO.



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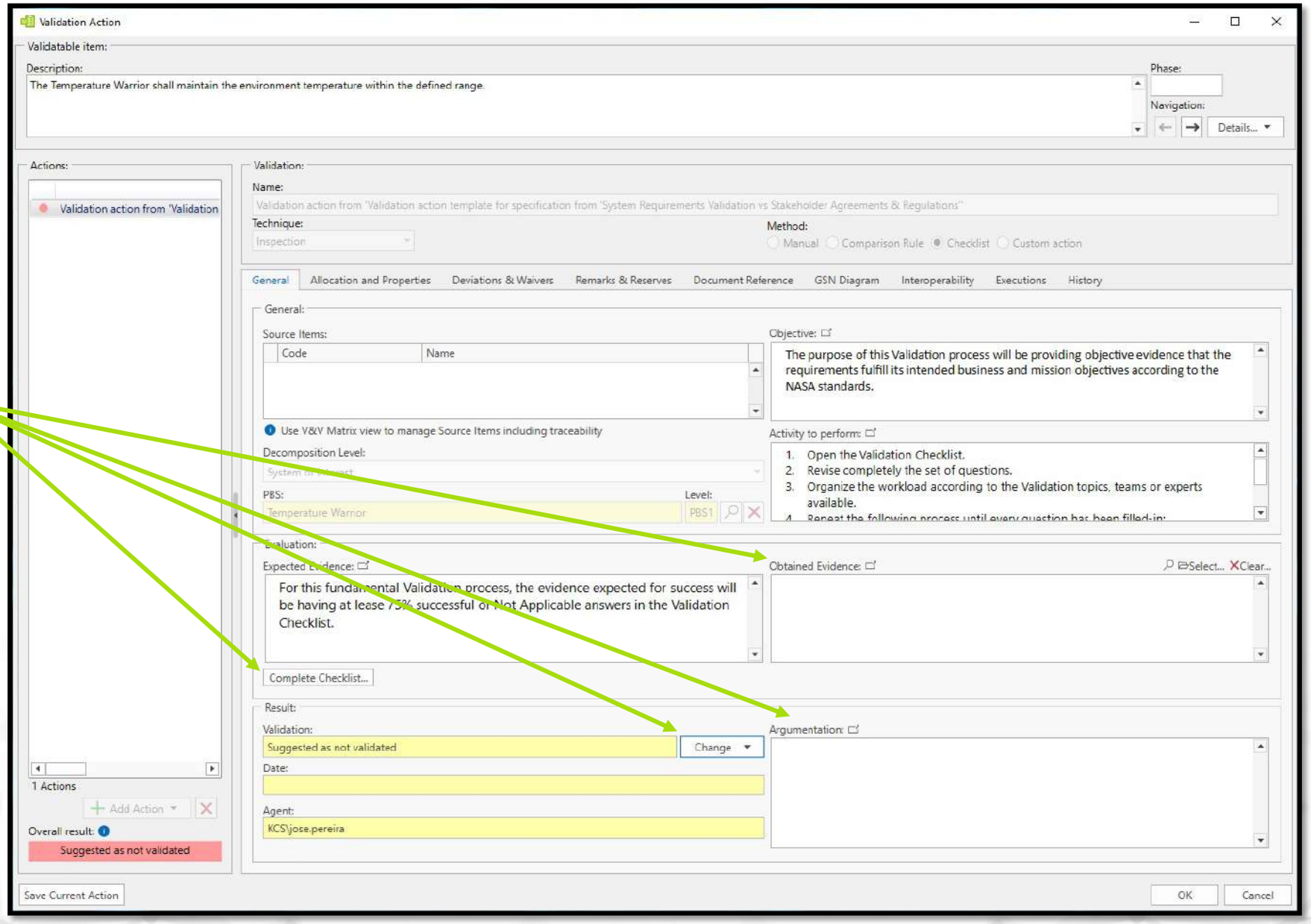
Filled in by **Validation Agents**



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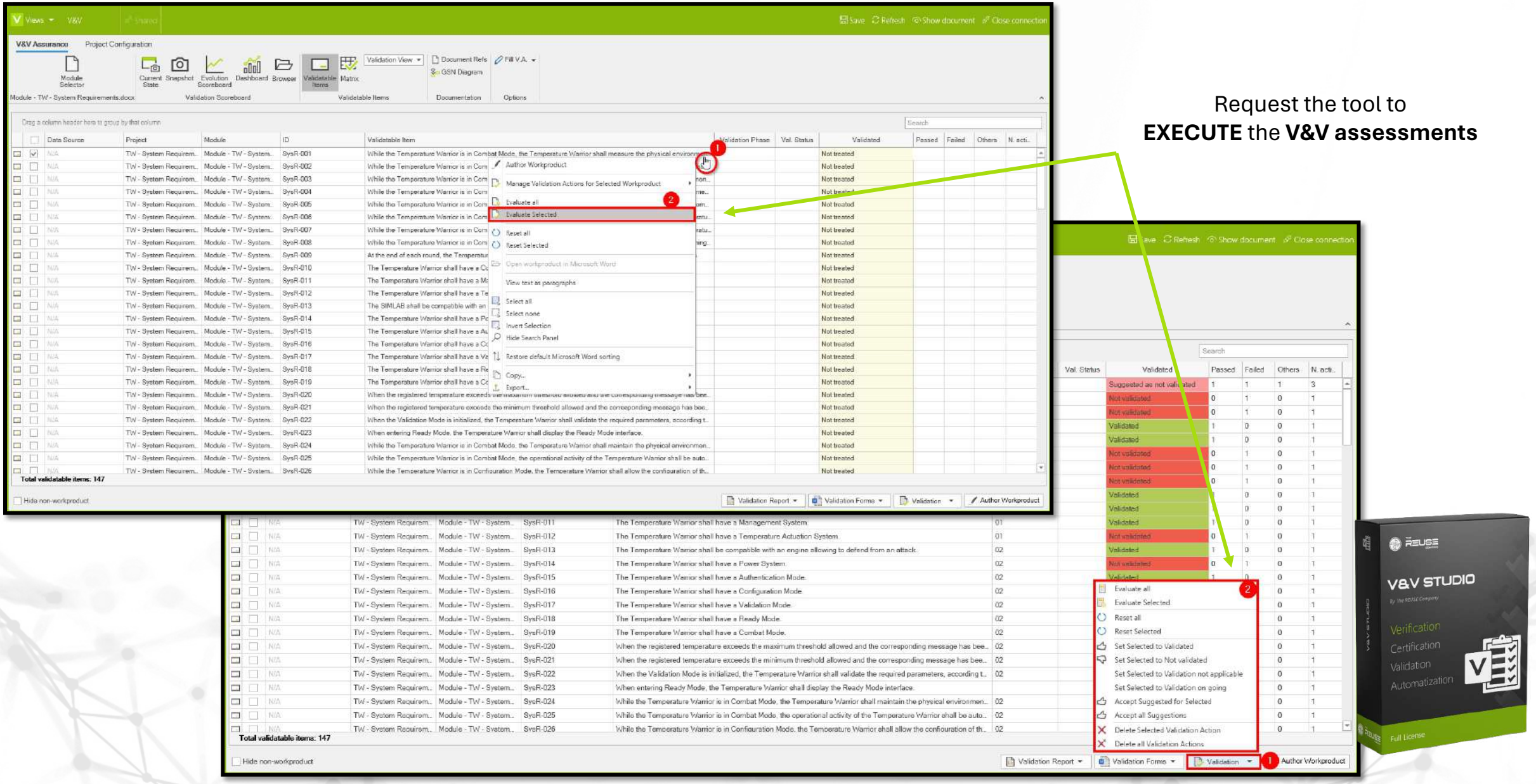
Request the tool to
EXECUTE the **V&V assessments**



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V&V ACTIVITIES EXECUTION

Execute the Verification Action for each Verifiable Item.

Computer applies the OK / KO decision process based on the standard guidelines.

Engineer defines the final state of the Verification process

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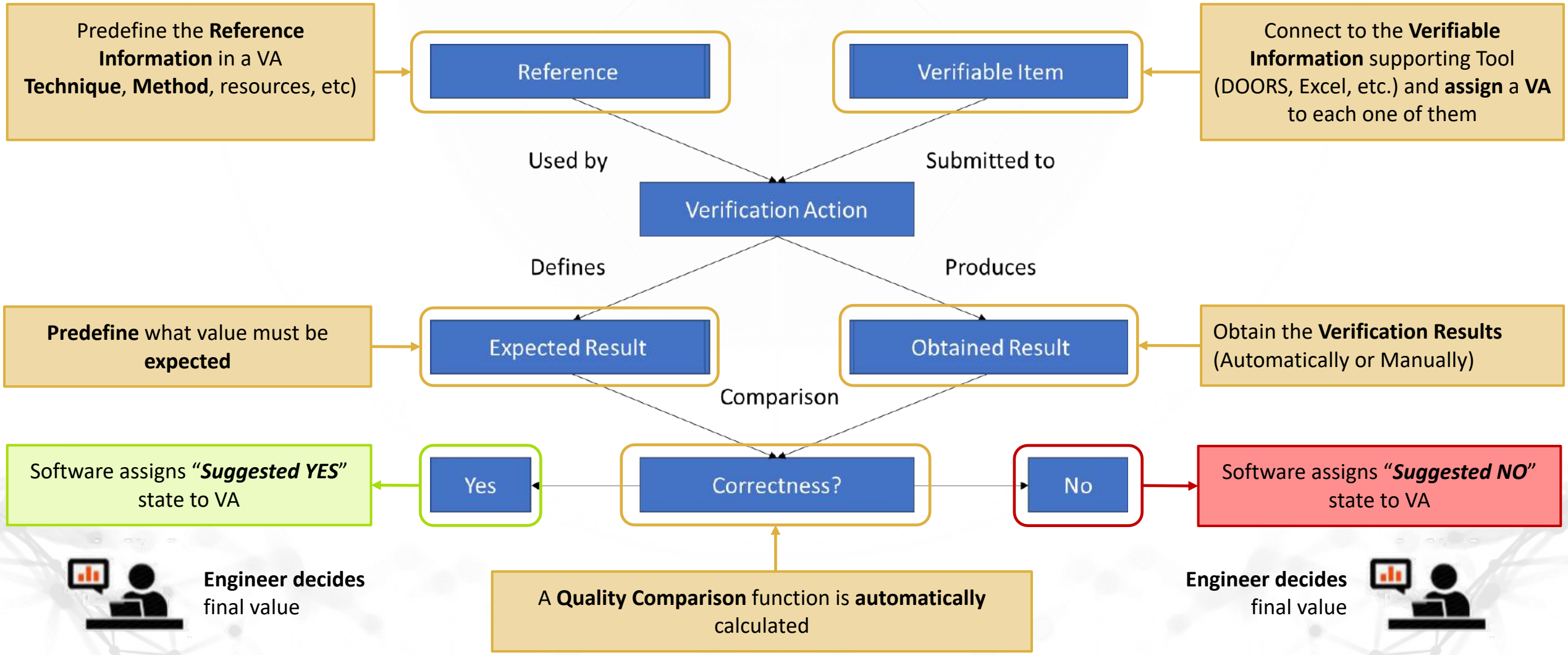

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V&V ACTIVITIES EXECUTION

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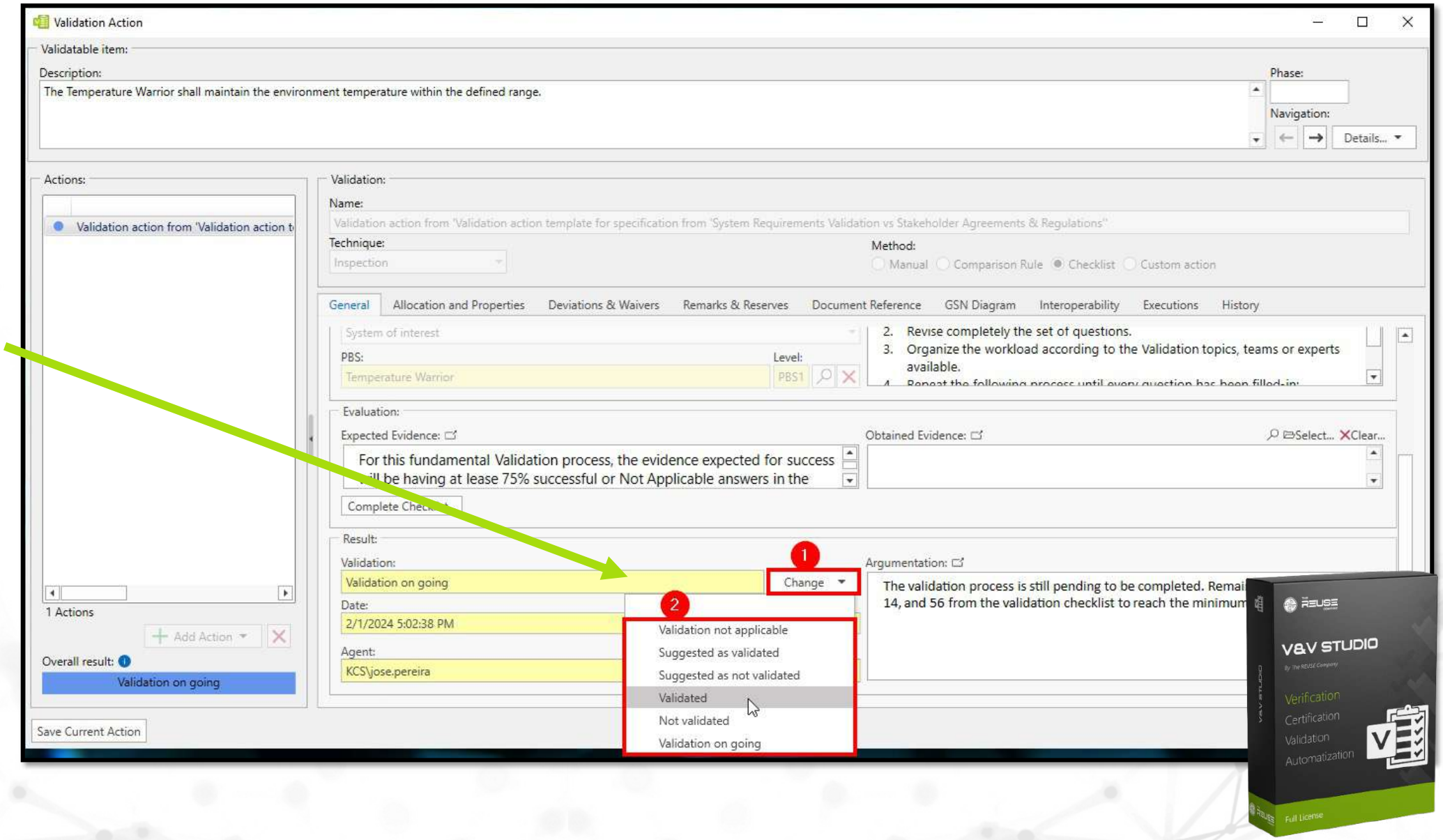
The **engineer** provides the **final state** for the **V&V Action** (and cannot be altered by the tool).



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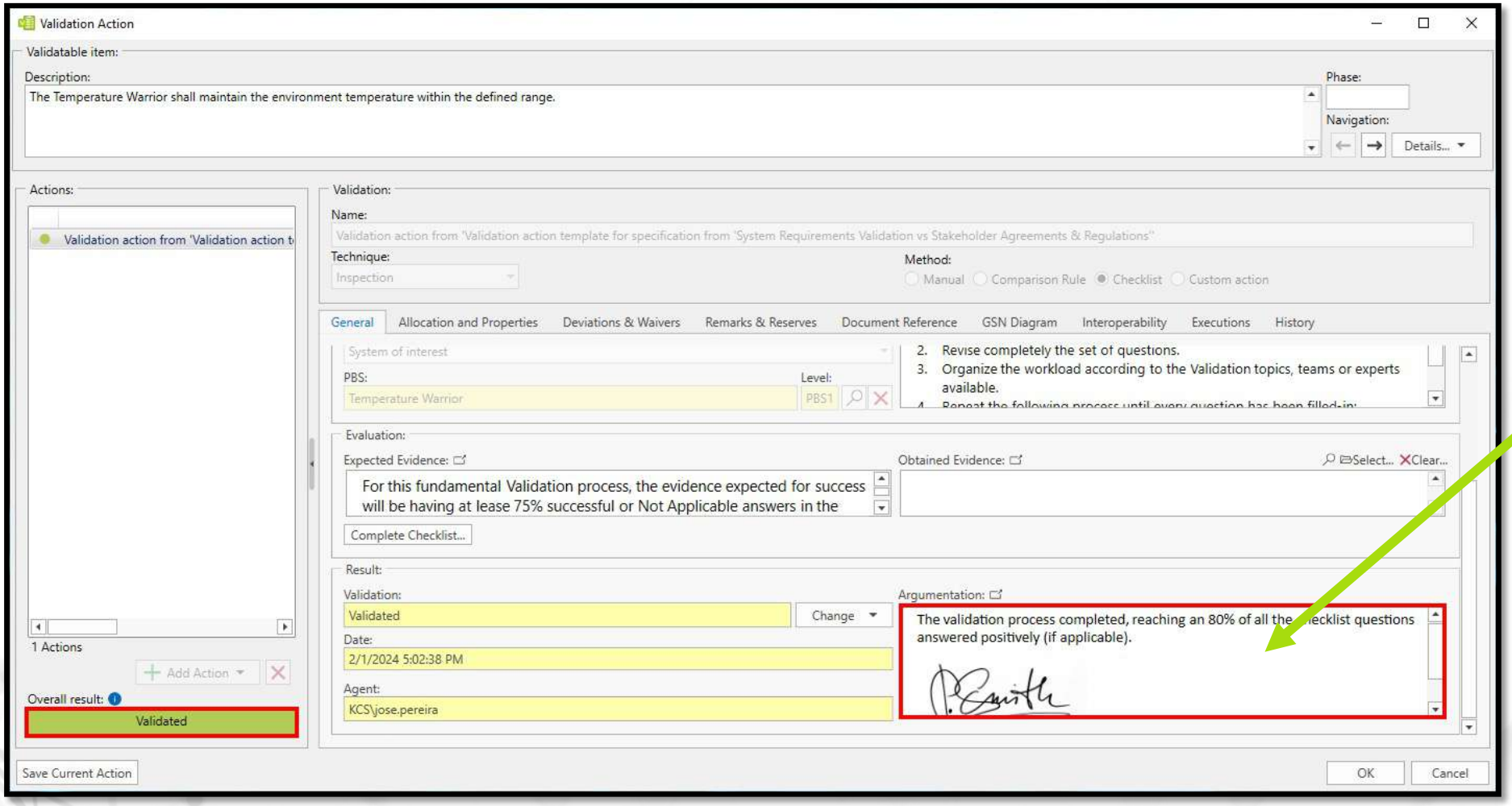

Then provides the **argumentation**, and the **new status** is registered.

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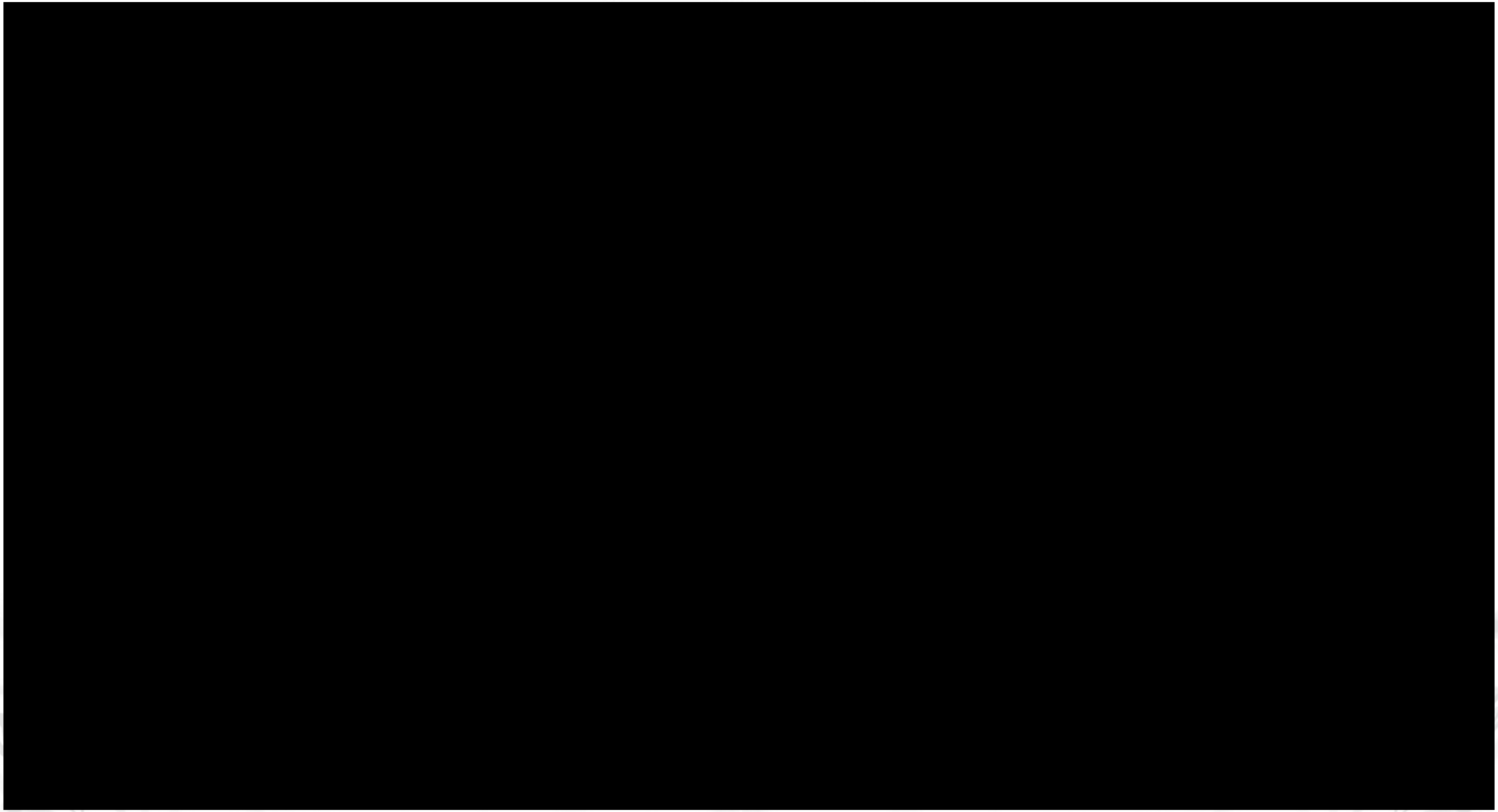
CHAPTER 03

RESULTS MANAGEMENT



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QUESTIONS, COMMENTS!

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