# Binding and synchronizing your Models & Requirements: **RAT – AUTHORING Tools** for Capella MBSE



Ilyes Yousfi Key Account Manager The REUSE Company *ilyes.yousfi@reusecompany.com* 





#### About The REUSE Company





Ilyes Yousfi

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Ilyes Yousfi got his Master's degree from the University of Montreal (Canada) and the IMT Atlantique School of Engineering (France). Ilyes has 5 years of experience in sales, technical background in energy and mechanical engineering and was involved in a research project around the environmental impacts of end-of-life management of aircrafts. Passionate about international projects and learning languages, Ilyes speaks 4 languages fluently: English, French, German and Spanish.

**Current position:** Key Account Manager at The **REUSE Company** 



#### Contents





# Complexity of Systems Engineering



"It's hard to **imagine a world without text**. A picture may well be worth a thousand words, but it's likely a **different** thousand words for each of us. Text gives our ideas a precision that we can rarely approach with images alone."

#### MBSE

helps formalize and consolidate customer and system requirements "Our brain is hard-wired to process the world in a **visual form**. It's part of our 'native OS'. For at least 40,000 years, humans have been **transferring information** from one person to another with the help of **images**, **pictograms** and **graphic symbols**."



Textual requirements (Natural Language)

are at the center of the current engineering practices



#### System Architecture

helps validate feasibility, elicit/justify new requirements for the system/subsystems





#### Why matching text with models?





#### The need for recursive engineering

### **Source:** INCOSE Systems Engineering Handbook, Ed. 4



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



#### The need for recursive engineering: Team communication





# The

# Capella MBSE Tool



#### What is Capella ?

- Open-Source solution for Model-based Systems Engineering ARCADIA Method
  - Extensions and add-ons to enhance the scope & tool capabilities
- Comprehensive, extensible and field-proven MBSE tool and method to successfully design systems architecture
- > Main characteristics:
  - Understand the customer need
  - Define and share the solution
  - Ensure engineering-wide collaboration
  - Early evaluate and justify architectural choices
  - Prepare and master V&V
- +info: <u>https://www.eclipse.org/capella/</u>





#### **Binding Textual requirements and model elements**

**MBSE** Models **add rigor** to need expression / solution description helps formalize and consolidate Models enable automated processing **System** customer needs Architecture and system requirements A model requirement can formalize a textual requirement and **explicit** its effects and ramifications Some expectations (environmental, regulations, etc.) Textual requirements Natural Languag 255 are easier to express with textual descriptions are at the heart of current engineerin practices Textual requirements (Natural Language) Some expectations on a model element at a given engineering level **do not require a formal** modeling (which is left to subsystem design) Textual form of needs and requirements are not only useful, they are **absolutely necessary** 

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# Main capabilities of

# RAT for Capella



#### The Systems Engineering Suite



## **Traceability**

Support the integration among assets through semantic interoperability to discover and keep the traces among related elements

## Authoring

Definition of requirements and other textual engineering assets based on real-time analysis (NLP), writing assistance, data extraction..





# Quality Management

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



#### The Systems Engineering Suite



### Authoring

Definition of requirements and other textual engineering assets based on real-time analysis (NLP), writing assistance, data extraction..





# Quality Management

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





Requirements grid S Reqs module overview S Import requirements by pasting text or using MS Excel

S Export to MS Excel

#### Requirements Editing

 In line writing assistance
 Pattern based for correct and complete requirements syntax

S Customized window setting

Knowledge Based Subset uses an Ontology (KM) SMART quality rules for Correctness, Completeness and Consistency checking. Subset uses the model elements and the textual requirements

#### Data management

S Provide a complete round-trip between textual requirements in Requirement Management Systems and models

S Enables synchronization of different data sources



#### Synthetic view : RAT Grid



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#### Real-time quality analysis: dictionaries





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#### Real-time quality analysis: dictionaries









#### Real-time quality analysis: **Patterns**







### CCC – Correctness, Consistency and Completeness







#### Metrics based on information coming from the RMS:

- > Ex : Attributes, Links
- Metrics based on lists of terms:
  - Ex: Forbidden terms -> ambiguous, pronouns...

#### Metrics based on linguistic algorithms:

> Text length, misspelling, readability....

#### > Metrics based on the conformance with models:

- Concepts from Logical Structures, Function Breakdowns...
- Metrics based on patterns:
  - **Specific** structures within the requirements







#### Real-time quality analysis: **Completeness**



The Temperature Warrior shall have a Control System.
The weight of the Temperature Warrior shall be less than 50 kg.
The Temperature Warrior shall have a Power System.
The Temperature Warrior shall have a Management System.
The Management System shall a Configuration System.



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#### Real-time quality analysis: **Completeness**



When the Temperature Warrior is loaded and operating, the Temperature Warrior shall enter the Authentication Mode.

While the Temperature Warrior is in the **Post-Combat Mode** (and when the Administrator selects the New Combat command), the Control System shall activate the **Configuration Mode**.

When the **Validation Mode** is initialized, the Temperature Warrior shall **validate the input parameters,** according to the displayed instructions on the Client's GUI.

While the Temperature Warrior is in **Combat Mode**, the Temperature Warrior **shall display the temperature of the environment**.





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#### Real-time quality analysis: **Consistency**



When the Temperature Warrior is loaded and operating, the Temperature Warrior shall enter the Authentication Mode.

When the Temperature Warrior is in the **Post-Combat Mode** (and the Administrator selects the New Combat command), the Control System shall activate the **Validation Mode**.

When the **Validation Mode** is initialized, the Temperature Warrior shall **validate the input parameters,** according to the displayed instructions ( the Client's Gui.

While the Temperature Warrior is in **Combat Mode**, the Temperature Warrior shall activate the engine thrusters.













# RAT for Capella

Demo





#### Tool Demo: RAT for CAPELLA

## USE CASE #I – Write a new requirement in Capella using RAT

- Sequence:
  - I. Write a new requirement in Capella (Reqs Viewpoint)
  - 2. Create requirement links **manually**.
  - 3. Open RAT. Edit and save the requirement **updating requirement the link.**
  - 4. Write a new requirement with RAT using a pattern.





[3:05 min]



Tool Demo: RAT for CAPELLA

- USE CASE #2 Use the RAT Grid to edit requirements
- Sequence:
  - I. Open the RAT Grid
  - 2. View all requirements in a sequence. Do some editing.
  - 3. Find suspect **similar requirements**.
    - Overlapping?
    - Inconsistent?
  - 4. Save and view in Capella.



[2:53 min]



- USE CASE #3 Detecting wrong state transition
- Sequence:
  - I. Author **creates a new** requirement with RAT.
  - 2. RAT quality window **detects** that the **wrong state transition** has been written.
  - 3. The author adds that state transition to the state chart.
  - 4. The **ontology** is reloaded.
  - 5. No issue found, the requirement is correct!





#### Tool Demo: RAT for CAPELLA

#### USE CASE #4 –

Synchronise requirements between Capella and Doors

#### Sequence:

- I. Start the synchronization module of **RAT**
- 2. Select the **Capella** module and the **DOORS** project to synchronize
- 3. Select requirements to be input into Capella.
- Edit a requirement and synchronize it from Capella back to DOORS.





[4:09 min]











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https://www.linkedin.com/in/ilyesyousfi/en





