

## Software robotics for requirements engineering and modeling & simulation at the conceptual stage

Requirements engineering, problem analysis, early decision support and generation of preliminary models are vital parts in any system, service, and product development process. However, requirements engineering and modeling & simulation are labor-intensive. In the case of problem analysis and early decision support, little help and resources are generally made available —notwithstanding the final impact of those phases. Something must be done.

Dynavio proposes new solutions and a unique combination of software robotics approach to support early development activities. Our innovative software solutions are designed to simplify - the conceptual design and requirements phases of a project -. Our method simplifies the initial problem representation, analysis and synthesis, and initial decision process. Our solutions are user-friendly and do not require sophisticated technical skills to be employed.

What do REA and DACM do?

1) REA (Requirement Extractor and Analyzer) is a software robotics solution for extraction and analyses at the requirements phase.

2) DACM (Dimensional Analysis Conceptual Modeling) is a software solution with partial automation of the most demanding phases of the conceptual modeling phase. DACM supports automatization of early modeling, specification, and simulation and analysis. Its functions are specially designed to cover the conceptual design process.

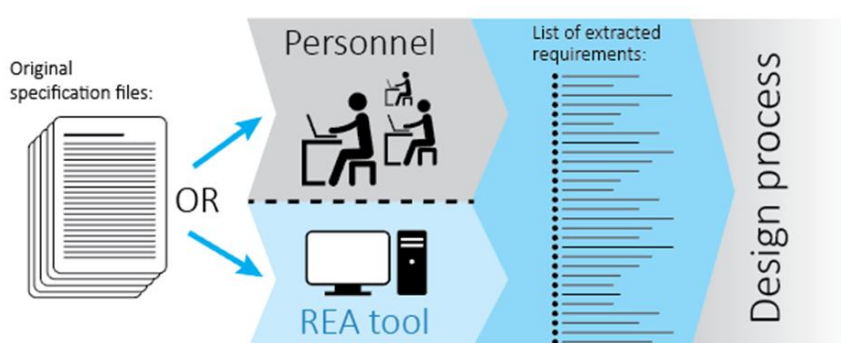
REA and DACM are designed to be used in tandem or individually depending on the nature and configuration of your design process.

How does REA generate value from your body of data?

The REA collects raw requirements from different document sources and processes them to produce a set of validated requirements. REA offers an efficient approach to improve the readability and semantics of individual requirements. Problems in requirements such as ambiguity, incompleteness, redundancies, contradictions are automatically detected by the REA. The REA is also capable of automatically detecting requirement interdependencies and generate requirements taxonomies.

A useful tool for requirement analysis fulfills six distinct functions associated with the requirements engineering process.

Function 1: Extract requirements from different literature sources and standards,



Function 2: Ensure the quality of requirements,

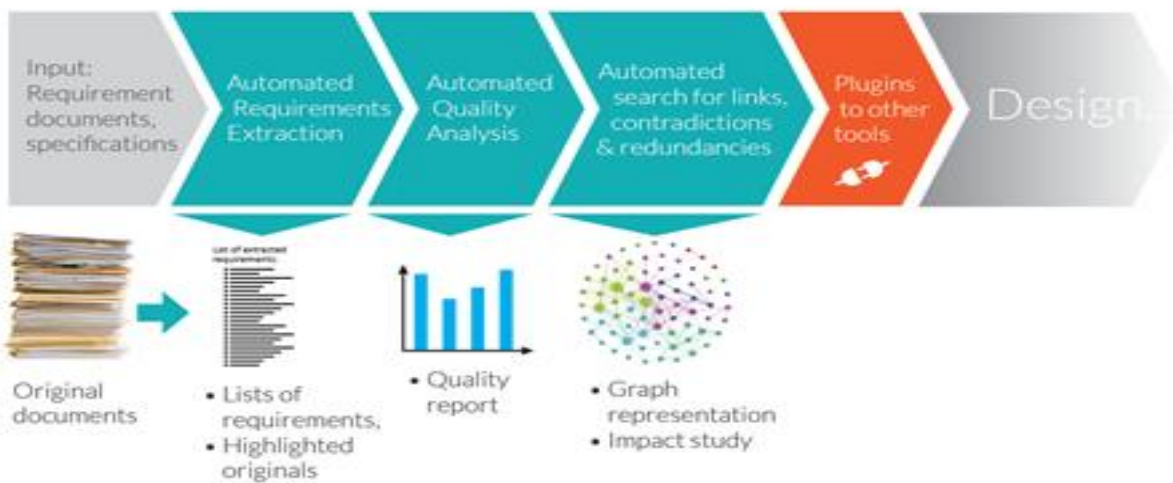
Function 3: Search for potential requirements' interdependencies and clusters of requirements.

Function 4: Search for contradictions and redundancies among requirements.

Function 5: Analyze impact and propagation of requirement changes on design solutions.

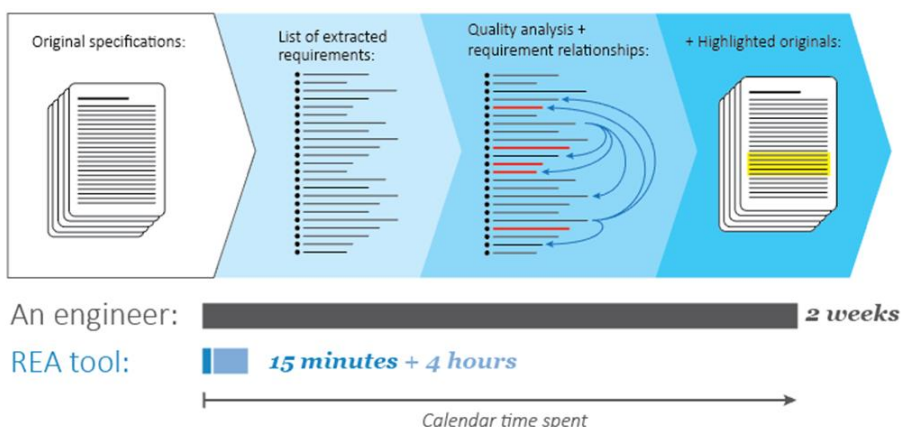
Function 6: Seamlessly integrate requirements set into existing software solutions.

REA is flexible and can be combined with existing tools.



### Expected impacts for users

Tests of the REA in industrial contexts have demonstrated its capabilities. The REA was able to extract requirements from a 250-page safety standard document in only 15 minutes, whereas a highly specialized requirements engineer required two weeks for the same task. In this demonstration, the REA exhibited an accuracy of 80%. In addition, the REA automatically highlighted the parts of the text that were not extracted during the process to facilitate future manual extraction.



Output from the REA can be presented in various formats, including Doors, SysML, Polarion, Visure, Excel, SysML and others.

Once the REA has extracted and formatted requirements the requirements can be employed as inputs to conceptual design activities using the DACM paradigm.

DACM gets you one step further

The DACM is intended as a conceptual modeling mechanism within the engineering development process.

The DACM supports your conceptual design process via an early integration of requirements traditionally considered later in a development process, such as in manufacturing or maintenance. It creates preliminary models that can be readily executed to simulate proposed solutions without additional modeling efforts or skills. The DACM provides both qualitative and quantitative executable models ready for simulation runs. It is particularly instrumental at identifying the most valuable design options and design flaws early in the conceptualization and design process. It also extends the REA to produce more detailed requirement specifications.

The DACM methodology is revolutionary and moves toward automatic generation of simulation models. The DACM framework is a powerful approach for specifying, discovering, validating, and reusing building blocks as well as analyzing systems behavior in the early development stages. The DACM solution is based on a novel combination and implementation of Dimensional Analysis theory, causal graphs and Design Structure Matrices integrated via advanced artificial intelligence methods. The DACM is particularly adept at revealing cause-effect relationships.

The DACM encompasses the following key phases:

Phase 1: Support the extraction of key design variables, constraints and key requirements.

Phase 2: Generate automatically causal graphs representing the key design variables and their interactions.

Phase 3: Supports the classification of system variables in four categories (summarized in the figure below).

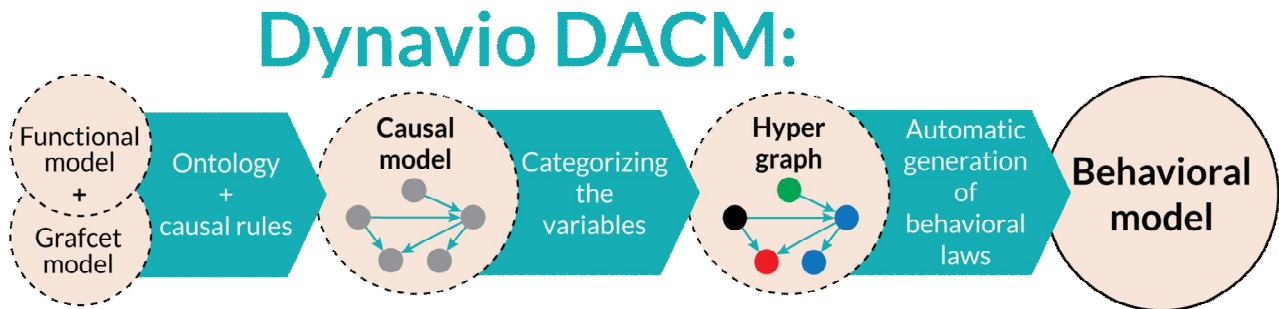
Phase 4: Generates automatically behavioral laws of initial solutions.

Phase 5: Simulates solutions and generate information to:

- discover contradictions between requirements and in the initial design solutions,
- Innovate by removing contradictions,
- Conduct trade-offs among key design variables,
- Conduct analysis of alternatives,

- Analyze the requirements profile of solutions,
- *Other possible utilizations*

The figure below provides a summary of the DACM process.



The DACM framework helps you to anticipate design errors and conflicts. It provides a powerful innovative approach to resolve contradictions and consequently derive valid requirement specification.

Contact information:

Contact Dynavio to learn more about our innovative systems engineering solutions. Dynavio encompasses a team of internationally recognized experts combining substantial and solid disciplinary experiences in industry and academia.

We are available and at your service!

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