The Cyber MagicGrid Methodology

Model-based systems engineering (MBSE) is a relatively young practice for developing complex systems. MBSE is the use of models to support systems engineering to both understand the problem and define an optimal solution to solve it whilst greatly minimizing costly and time consuming engineering changes late in the development cycle. The promise of MBSE is to be able to progressively model and simulate systems behavior in accordance with the needs & scenarios of usage, at any time. This promise is about avoiding the discipline-specific tunnel effect and giving project stakeholders the ability to continuously monitor the evolution of system development. If in Aerospace & Defense MBSE is a standard practice, in other Industries it is a novelty. One of the key success factors of MBSE is to apply best practices based on a sound systems engineering methodology.

Before the Dassault Systemes acquisition of No Magic each company developed its own methodology: Modeling Methodology for Systems© (MMS) and MagicGrid©. Each method addresses a slightly different scope of system engineering processes and is focused on different tools. As the No Magic solution is being integrated onto the 3DEXPERIENCE platform, there is a need to develop a unified methodology to accelerate the efficiency of complex system development; The Cyber MagicGrid methodology is an extension of MagicGrid. Its aim is to cover the overall development of the system and bridge the gap between system architects, product designers and engineers.

The Cyber MagicGrid methodology separates the problem (implementation free) and the solution (technology dependent).

The Cyber MagicGrid framework is applicable for a given system. It can be applied, completely or partially, and recursively to each element of a system breakdown structure.

WE CONSIDER DIFFERENT LAYERS OF ABSTRACTION:

Problem domain

- The operational layer is where the goal is to understand the operational use of the system, (seen as a black box) by all stakeholders.
- The functional layer is where the goal is to transform stakeholder needs into verifiable system requirements by defining system functions, identifying logical interfaces, and specifying measures of effectiveness.

Solution domain

- The solution layer is where the goal is to architect the solution that federates the disciplines: mechanical, electrical, fluid, electronics and software.
- The detail design of the solution is achieved by each of the disciplines, where the goal is to provide a specification for the implementation.

Implementation domain

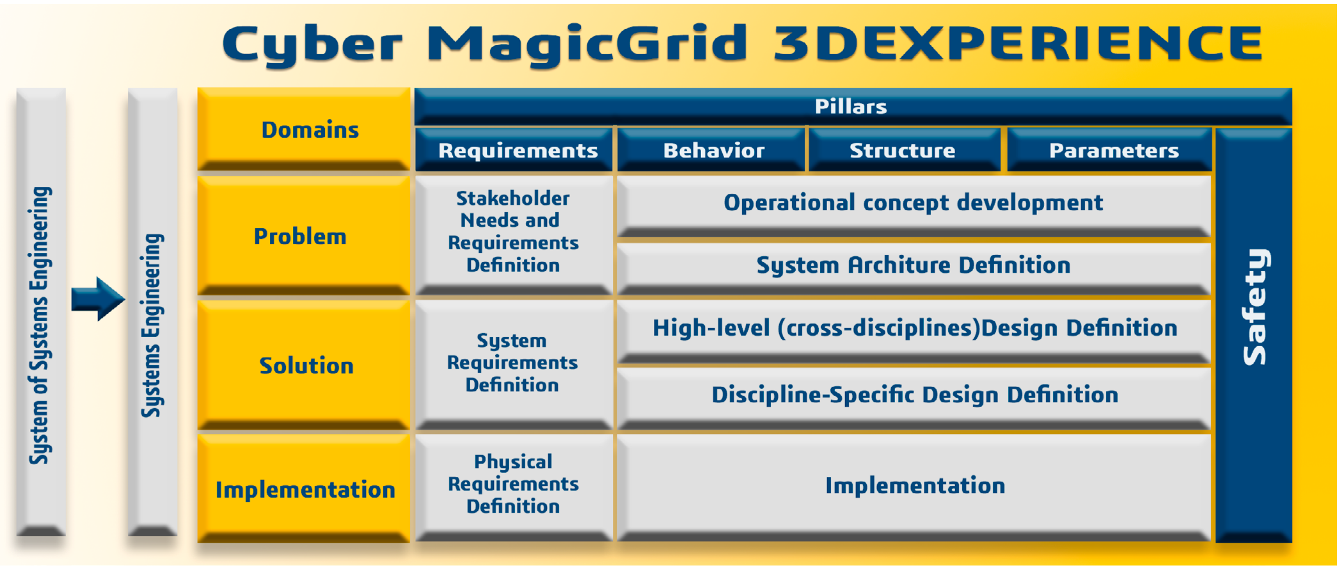
- The implementation layer is where the assets that compose the solution are developed (hardware, software, 3D)

To ensure completeness and consistency of the analysis at each abstraction layer, we consider the following pillars:

- Requirements pillar: the definition of the requirements from stakeholder needs, system requirements and physical requirements.
- Behavior pillar: the definition of the functions and their interfaces, with consideration of both the static and dynamic aspects, from flows to physical interfaces (bus messages & signals, electrical, fluid, mechanical)
- Structure pillar: the decomposition of the system into subsystems upon which functions are allocated, to constitute a system architecture, up to the definition of the solution architecture.
- Parameters pillar: the definition of the measures of effectiveness to the design parameters of the solution to support system analysis and trade-offs.
- Safety pillar: the definition of the undesirable events and their gravity and the analysis of the failure modes, their effects and their probability of occurrence for a safe design.

In the Cyber MagicGrid we consider a modeling, simulation and optimization approach. It starts with the definition of the targets to be achieved from a stakeholder perspective (Measures of Effectiveness), decomposed and quantified (simulation based) at sub-system level (Measures of Performance) and components (design parameters). The solution is progressively defined and assessed thanks to multiple trade-offs of high level design to detail design. The loop is closed with the use of system calibration and reduced order models to virtually verify the expected performance at system level.

At each level, end-to-end, traceability is ensured to check compliance at any time and to assess the impact in the case of a change.



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