

# **Model Based approach applied on complex system representation: R&AE Electrical Powertrain project**

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It is a fact that mechatronic systems are more and more complex and integrated. If we consider electrical vehicles, innovation and complexity do not only concern the system and its subsystems but also its interaction with the energy grid and with societal and environmental trends so the scope of the system is itself an issue.

Engineers also face a proliferation of written information. Because everybody is involved in transverse projects, it's also more and more difficult to keep in touch with colleagues, partners, suppliers, with different cultures in different locations despite the emergence of various emailing, chat, and web conference support.

So more and more in the design activity, each actor needs to access easily the right information (sound, reliable, small and simple) at the right moment. It's also needed to capitalize new knowledge, develop expertise and technology awareness and put them efficiently at the service of various projects to enable innovation. But how to achieve these needs in a context where organizations and products complexity increase ?

We think "system visualization" is the main lever to this challenge. The key idea is that a hierarchical system (or product) representation capturing "how the system works" at all levels of details can be the reference for all actors involved in a product development. Such a system representation would include interaction of product with context systems, interfaces between subsystems and components, requirements and constraints and their allocation to components, and would be the result of a Model Based Systems Engineering approach (MBSE).

MBSE has a high cultural impact, and since people are reluctant to change, tools used for the representation have to be easily adapted to support the company's own processes by offering an integrated customizable workflow.

This program has been implemented by the Renault DREAM division with the arKItect environment from Knowledge Inside on Research and Advanced Engineering Electrical Powertrain projects. In itself, the Electrical Powertrain is a complex system, that can be divided in subsystems, each available in many variants. Consequently, many actors have to work together for design, optimization, justification, and capitalization, including system architects, software architects, and design agents for each sub-system and component. A system representation has then been formalized and maintained for complete system, as well as for its subsystems. And still, this electrical powertrain system is just a sub-system of a vehicle system imposing its own requirements and constraints, within the even wider infrastructure system. In the paper we address the quantitative and qualitative feedback of these projects.