



Systems Engineering as an Enabler in the Automotive Industry

The rising complexity in the automotive industry caused by the increasing digitization and connected autonomous driving systems demands the refinement of standardized development processes. A Model-Based Systems Engineering (MBSE) integration from standard textual requirements engineering reduces risks by increasing the quality of customized system development lifecycles. We introduce a concept for a successful integration of MBSE in the automotive development process, rooted in essential functional and technical architecture techniques.

Complex engineering initiatives need to be holistically developed and managed over the full life cycle of a project

Systems Engineering (SE) is an interdisciplinary and systematic approach to enable the development of complex systems that satisfy the stakeholder's needs in an effective and efficient way. The increasing integration of connected and driver assistance systems up to autonomous cars require a shorter time-to-market and a reduction of development cost. This new complexity in the automotive industry needs a "right-first-time" mindset by integrating systems engineering in the development life cycle.

MBSE is a standard practice of SE for a representation of a system to be created or modified and to analyze an existing system for continuous improvements. It views the product with its interrelated parts as a whole system and how the components effectively perform together. SE combined with MBSE increases the system development quality, supports decision making among stakeholders, and reduces development time and costs significantly.

Applying MBSE in product development requires

1. A customized method that considers the specialties of the product and the organization as well as the team culture and the philosophy of the product development
2. A seamless tool platform with implemented methods to support traceability and continuous information sharing between internal and external stakeholders for mutually agreed requirements
3. An integrated stakeholder strategy
4. A migration plan to facilitate the changing process to MBSE

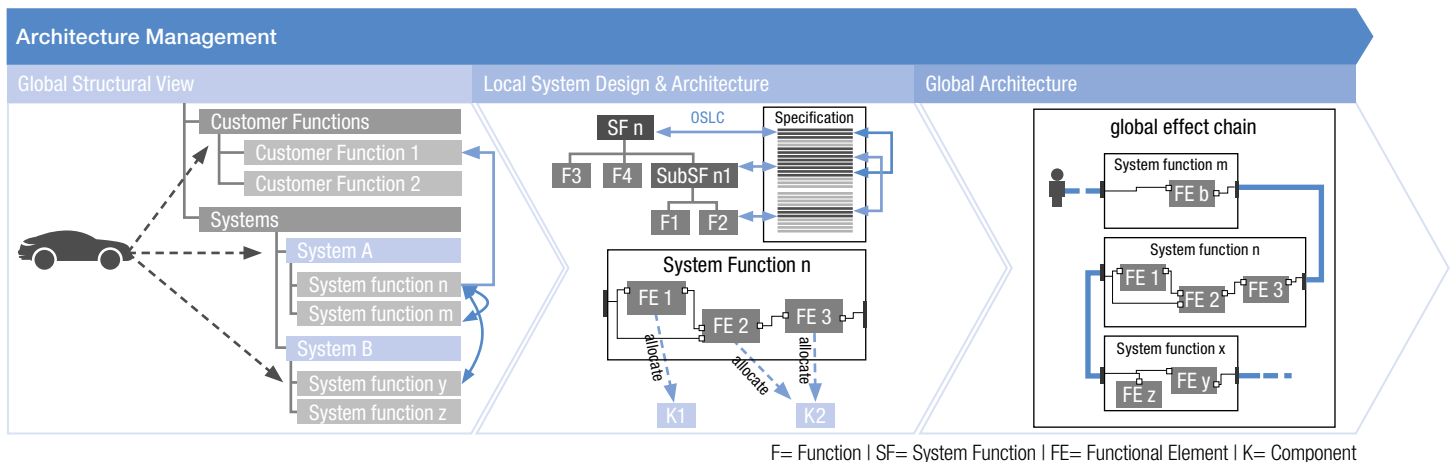
Factors that drive the automotive industry to adapt new interdisciplinary development solutions

1. The need of customer oriented design
2. Rapidly changing technology trends and thereby increasing complexity
3. End-user products getting more IT and service oriented
4. Shorter time-to-market and reducing developing costs



NTT DATA MBSE concept

Our designed system models are built based on an encapsulation concept. This means, each critical modelling element defines its boundary and interacts with another element through a well defined and organized interface.



1. Global Structural View

- Customer needs are realized
- Contributions of each system are considered and their interactions are depicted in an effect chain network
- Functional dependencies are made transparent, and roles of each function are defined

2. Local System Design & Architecture

- Each system has its encapsulated model
- Both domains (model & text) are related and synchronized to provide a full system view
- Functional and technical architecture to depict component relations to systems function

3. Global Architecture

- Integration of the system in a global network

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It focuses on long-term customer relationships: to this end, NTT DATA combines a global presence with local market knowledge, offering first-class, professional services ranging from consultancy and system development through to outsourcing.

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