

R&D INSIGHTS

How Systems Engineering in Automotive R&D significantly increases customer value, launch maturity and efficiency

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Introduction

With our 3DSE Insights, we share our latest findings and experiences about the implementation of Systems Engineering (SE) and Functional Orientation in the automotive industry. The insights are especially relevant for OEMs as well as Tier 1 suppliers. We start by defining Systems Engineering in the automotive industry. Afterwards, we give an overview of the current challenges of the industry and explain which six levers can be used to overcome these challenges. We summarize the significant benefits of SE and describe our approach to realize the potentials.

SE in automotive industries: Master the successful realization of customer function oriented and profitable mobility solutions, considering the entire product lifecycle. This also includes leveraging interdisciplinary teamwork, systematic problem-solving processes, holistic thinking and model-based engineering approaches.

Our contribution: We advise and help our customers in transforming Automotive R&D units into high performance SE organizations, considering products, technologies, processes, organization and culture.

Current Challenges for Automotive R&D

The automotive industry is undergoing a major transformation. The top drivers challenging today's state-of-the-art vehicle development are a result of trends like autonomous driving, electrification and connectivity as well as already present drivers like globalization and geopolitical changes. Based on our experience, current challenges can be divided into the areas technologies, requirements and cost pressure as well as culture and collaboration.

Complex & New Technologies – including new and immature technologies with little routines available resulting in high integration and testing efforts.

Demanding Requirements & Cost Pressure – including strict regulative requirements (environmental, safety/security), high cost pressure from competition and the economic situation and high customer demand for lifecycle updates/upgrades.

Culture & Collaboration Clash – including culture clash between software, mechatronics and hardware development, organizational boundaries and cross-functional collaboration, new co-development setups with partners/suppliers.



Six crucial Levers to tackle future Challenges

In order to address the growing complexity and challenges, we recommend the implementation of SE not only as a structured approach but also as a philosophy and way of thinking. Within our projects, we have identified six crucial levers that focus on a pragmatic and solution-oriented implementation. In the following, these levers will be explained.

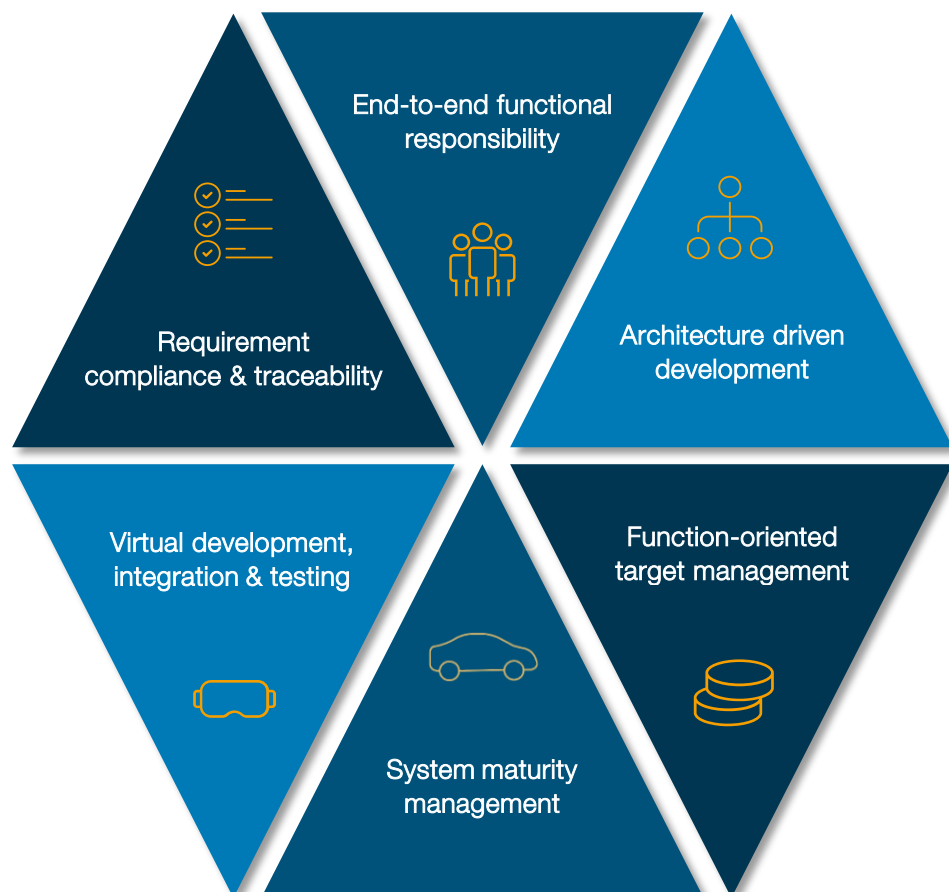


Figure 1: Overview of the six SE levers of Automotive R&D.

- **End-to-end functional responsibility** – including responsibility for customer functions, from design to approval to updates. This includes a cross-departmental and cross-domain role with a clear organizational allocation, mandate and a strong veto power for the customer.



- **Architecture driven development** – including architecture design considering scalability, re-use, flexibility, robustness, decoupling and balancing between Electric/Electronic (EE) vs Software (SW) vs Hardware (HW). There is a higher focus on architecture considering the overall system value, e.g. power system, SW stack.
- **Function-oriented target management** – including top down target system based on complete vehicle and customer value, R&D budgeting and steering from the customer and a product functional view.
- **System maturity management** – maturity planning, agreement, monitoring for functions and properties from a complete vehicle view including interfaces for purchasing and production. The identification of system and integration conflicts in early development phases.
- **Virtual development, integration & testing** – inspection and early validation of maturity in virtual prototypes, systematic simulation & model development. Re-use is considered, and cross R&D models and data are integrated. A consistent integration platform / integration layer and team are set up.
- **Requirement compliance & traceability** – focus traceability on regulatory & compliance critical requirements. There is a clear organizational allocation and cascading of specification and approval responsibility from complete vehicle level down to components considering the make-or-buy scope as well as Hardware, Software and Electric/Electronic components.

Significant Benefits

The focused implementation of SE leads to the realization of significant benefits regarding three dimensions: efficiency, launch maturity and customer value. Based on our project experience, the following values can be achieved if the six levers are implemented in the organization with discipline.

Up to **18%** reduction in the development effort – *reduce waste, deliver lean*
Efficiency benefits realized through the re-use of function modules and system specifications, reduction of non-testable prototypes, reduced use of hardware, reduction of effort for error and root cause analyses.



Up to **35%** reduction of cost of poor-quality – *launch it right the first time*

Launch maturity benefits realized through reaching early product maturity, reduction of late changes, reduction of rework in the plant, reduction of warranty claims and reduction of task force effort

Up to **20%** additional revenue through features over product lifecycle – *offer additional & unexpected values*

Customer value benefits realized through stronger customer journey consideration and focus on use cases, increased customer excitement beyond satisfaction. There is a better cost-value ratio from the internal and the customer perspective.

3DSE Approach and Capabilities for successful SE Implementation

“We transform Automotive R&D units into high performance SE organizations, considering products, technologies, processes, organization and culture” – Therefore, 3DSE Management Consultants offers a customized, pragmatic and automotive-proven SE implementation approach following four iterative steps: engage, shape, apply and anchoring of proven practices, mechanisms & structures.

Within these four steps, different aspects and artifacts were developed in cooperation with our customers based on company specific needs. This ensures a tailor-made solution and at the same time strengthens the drive for change within the organization.

- **Engage** – creating a comprehensive understanding and the will to change among stakeholders. This is achieved by creating clarity about the current situation, understanding of the value, benefit, strategic fit and value contribution of SE. This builds a strong leadership coalition to start a consistent communication into the organization.
- **Shape** – shaping specific SE solution elements including 3DSE best practice injection and benchmarks, deciding on implementation steps (e.g. Entry, Target, Vision). We start by selecting appropriate / impact-oriented projects and create clear guidelines and role clarity. At the same time, we analyze the organizational and procedural requirements, resources and consequences of the implementation.



- **Apply** – enabling the organization to adopt SE Artifacts. This includes appropriate key role qualification, pragmatic operationalization and application. Our experts support the employees on the job in their specific projects. To pave the way for anchoring SE, effectiveness control and adaptation are carried out in parallel. SE multipliers in the organization are activated
- **Anchor** – enable further growth and broad application of SE in the organization. Therefore, SE is institutionalized, structurally allocated and target / control / steering mechanisms are anchored. To further ensure the long-term benefits of SE, the transfer to a line organization is carried out.

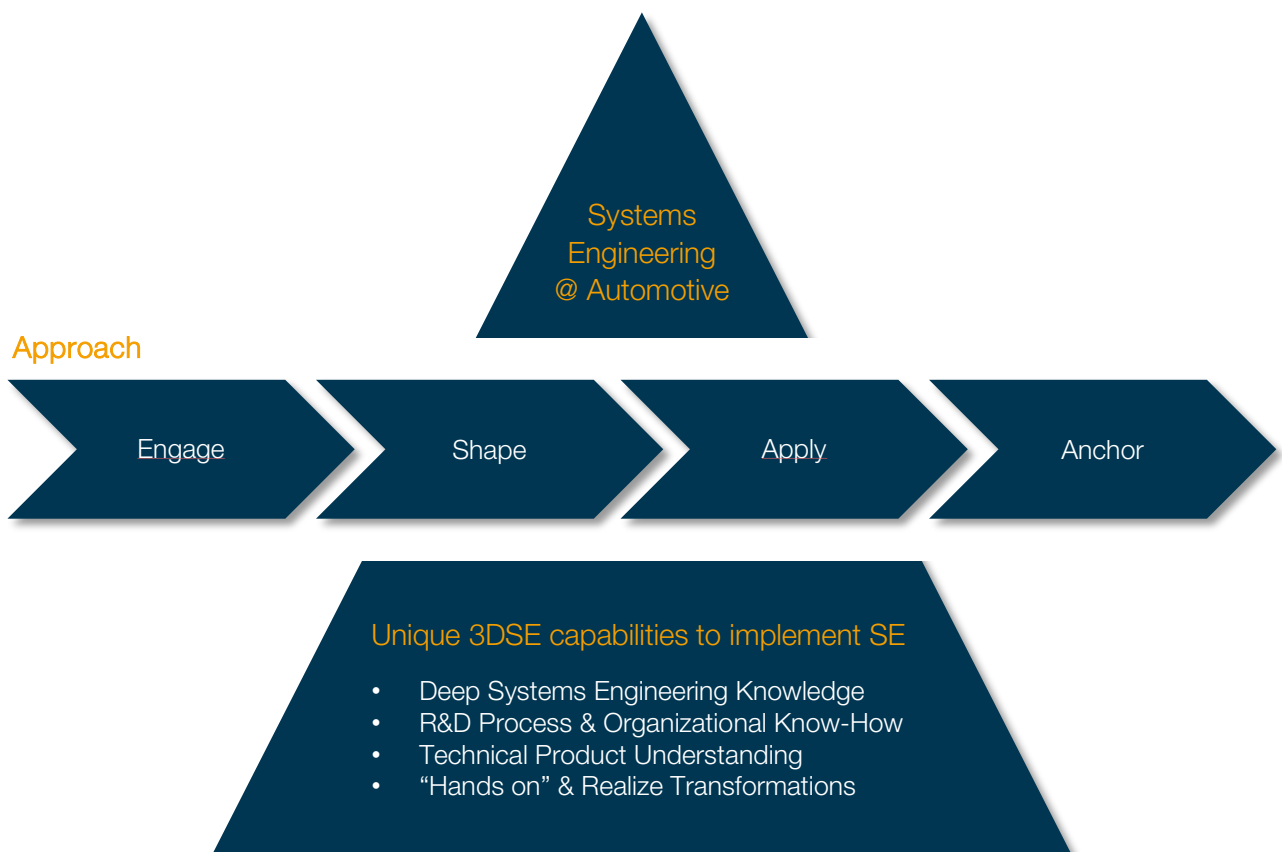


Figure 2: Overview of the implementation approach and unique 3DSE capabilities



SE Experience @ 3DSE

3DSE has more than two decades of SE experience in a variety of industries. As a R&D consulting firm, 3DSE offers a proven approach for SE in the automotive industry as well as unique capabilities for a sustainable implementation. We offer **deep SE knowledge** regarding methodology, best practice and standards as well as **technical product understanding** including the ability to speak the language of engineers. We also offer a profound **R&D process & organizational know-how including in-depth know-how** on development processes and organizational structures, project and program management and R&D best practices. We are **“hands on” and realize transformations** including leading large transformations, sustainable implementation and management as well as employee engagement, enablement and communication competence. With this set of USPs, we ensure that R&D organizations become high-performance Systems Engineering organizations.

Interested? Get in touch!



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Dr. Tim Sturm is a Partner at 3DSE Management Consultants GmbH. He has more than 12 years of extensive R&D consulting experience with focus on Automotive, but also Industrial, Aerospace & Defense as well as Chemicals in national and international consulting projects. His core competencies lie in the design, initialization and implementation of large-scale change programs on product, process and organizational levels. These programs were focusing on Agile Transformations, Systems Engineering Implementations and R&D Re-Organizations. He also participated in several events as host, speaker and expert in the field of product development.

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