9TH INTERNATIONAL DSM CONFERENCE

Managing Complexity in Automotive Engineering

Excerpts from an Empirical Exploration Study

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IN COOPERATION WITH BMW GROUP
CAPITALIZE ON COMPLEXITY

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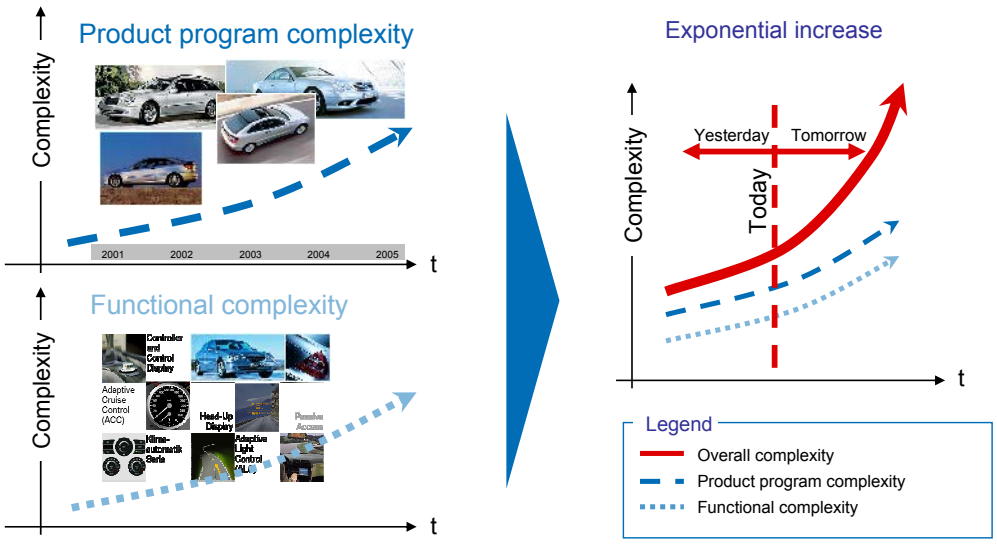
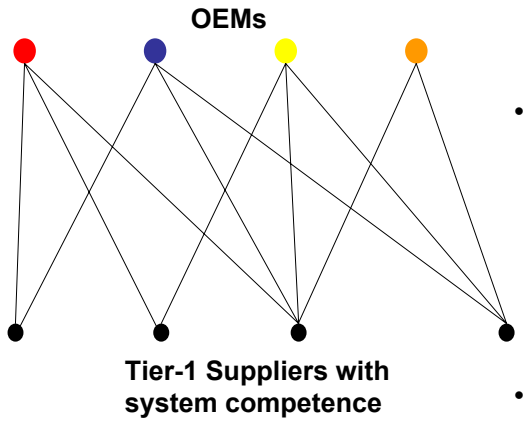
- **Objective and focus of study**
- Positioning of OEMs and systems suppliers
- Conclusions for OEMs and systems suppliers
- Summary

Complexity is increasing



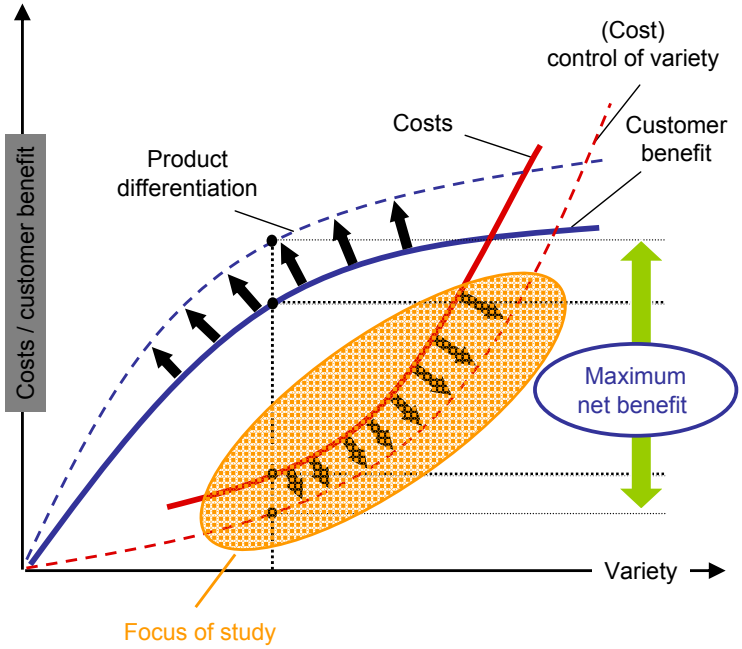
Study focus on OEMs and supplier relationship



Base of survey:

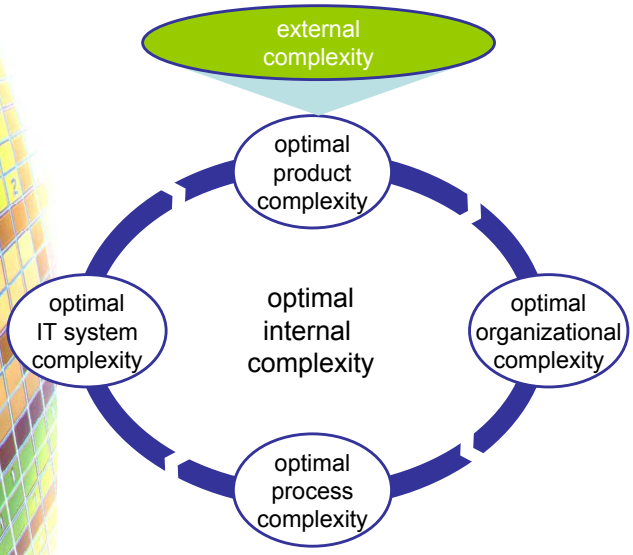
- **Automotive OEMs**
  German volume and premium OEMs with standard mid-size models as a representative comparative basis
- **Suppliers**
  Leading German suppliers
  - for infotainment and
  - brake components
  - with an existing relationship to the participating OEMs (considering the vehicle families)
- **Relationship**
  Analyse specific relationships in the OEMs/supplier network

Starting point: company objective is optimizing net benefit



- With increasing variety the customer benefit increases at a diminishing scale
- However, there is an above-average increase in the variant-dependent costs
- There is a specific variety with an optimum net benefit
- Study focus on cost curve optimization through better management of increasing complexity

Study objective is answering the following questions



- Is product complexity the trigger or consequence of the other complexity drivers?
- To what extent are processes in product development comprehensible and controllable for the participating companies?
- What is the basis for internal and cross-company cooperation between OEMs and suppliers?
- Do the IT system environment support joint processes or is it more of an obstacle, because they lead to product and process complexity?

What is the best mix for future success?

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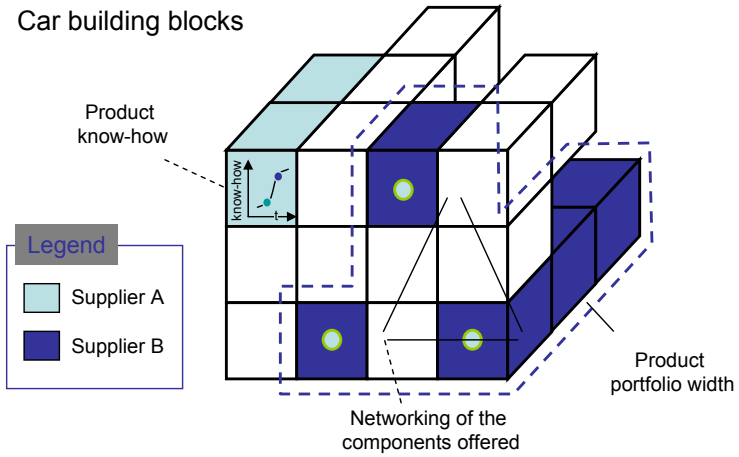
Suppliers and OEMs differ in their respective positionings

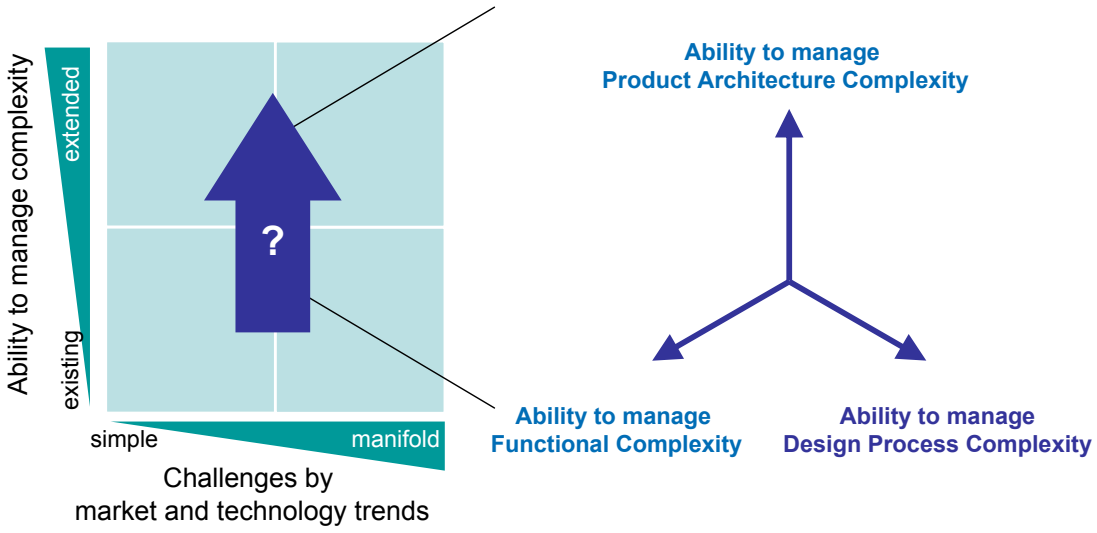
- Suppliers extend their abilities to cope with complexity rapidly, and pick their battles
- OEMs are fiercely driven by external market and technology trends while improving their abilities to manage complexity comparatively slowly

The "power" of the systems suppliers is determined through product know-how, the portfolio width and the networking of the components offered



Innovations are often created through the networked module know-how owners on the supplier side.
OEMs define their competence in the integration of the entire vehicle.

Three performance dimensions improve management of complexity



The performance dimensions support each other both at the OEMs and the suppliers

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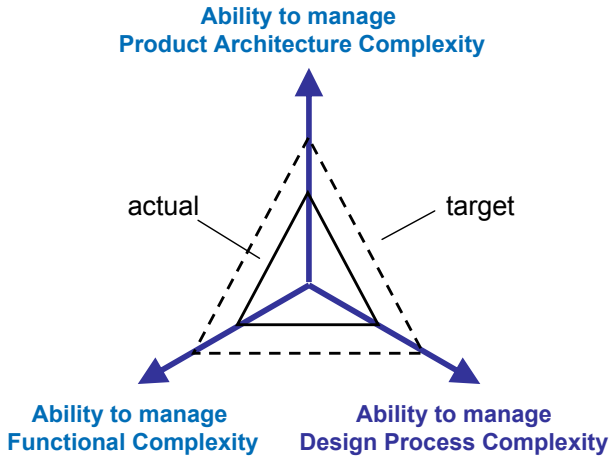
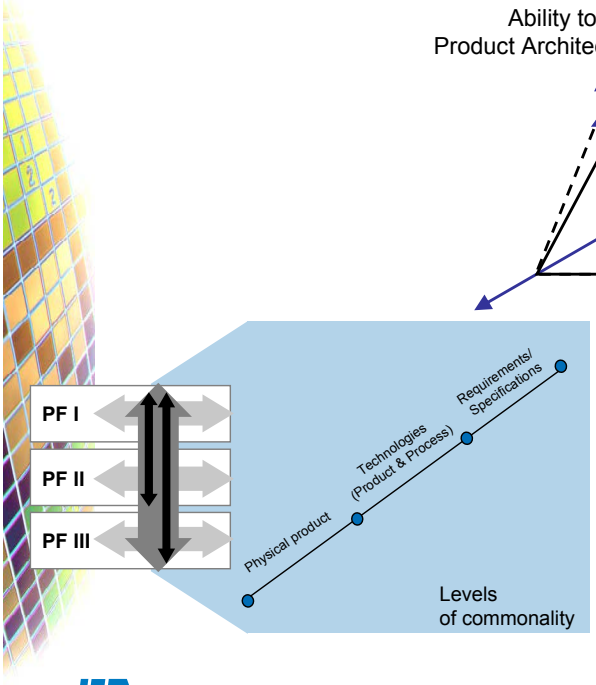
Need to improve along the developed performance dimensions



The status quo of both OEMs and suppliers to manage future complexity offers potential for optimization in all three dimensions

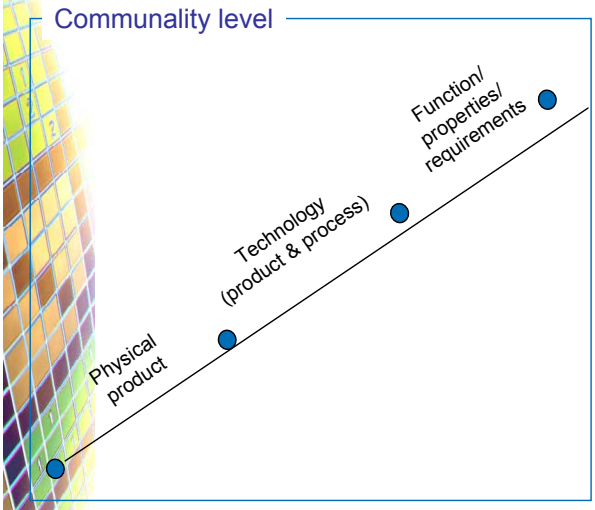
Ability to manage Product Architecture Complexity

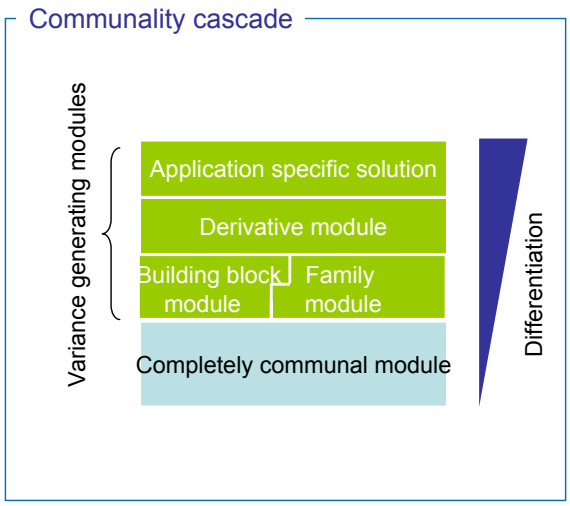


- Building block principle replaces platform principle
- Building block principle has to achieve commonality on several levels
- State-of-the-art configuration management supports the traceability of commonality levels

PF: Product family
Weak implementation of communality
Strong implementation of communality
Meta-building blocks
Platform approach
Building blocks

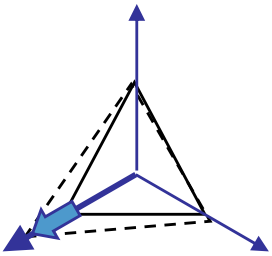
Within the communality levels, communality cascades can be defined



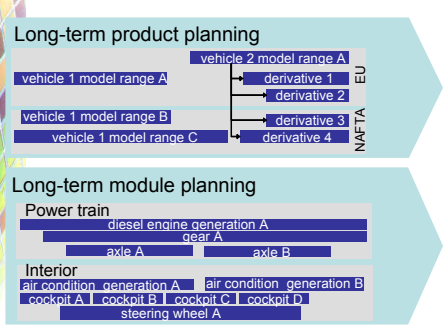


The entire communal cascade can run through each of the different communality levels

Ability to manage Functional Complexity



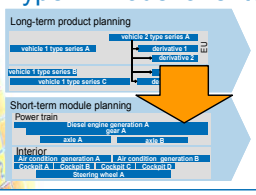
Ability to manage
Functional Complexity



- Building block principles requires a long-term module planning
- Release-engineering is the basis for an effective planning and realization of modules
- The combination of several modules requires a stronger “deductive” system view than an “inductive” module view
- Different approaches to fill building blocks with modules exist (reactive, proactive, lead-car)

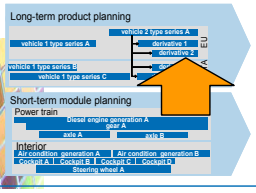
Different OEM approaches to manage modularity

Type 1: model oriented



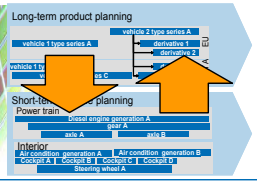
- Model range defines their requirements and control these in the technology/module development
- No/ low budget responsibility of the module development
- Restricted degree of planning/influence

Type 2: module



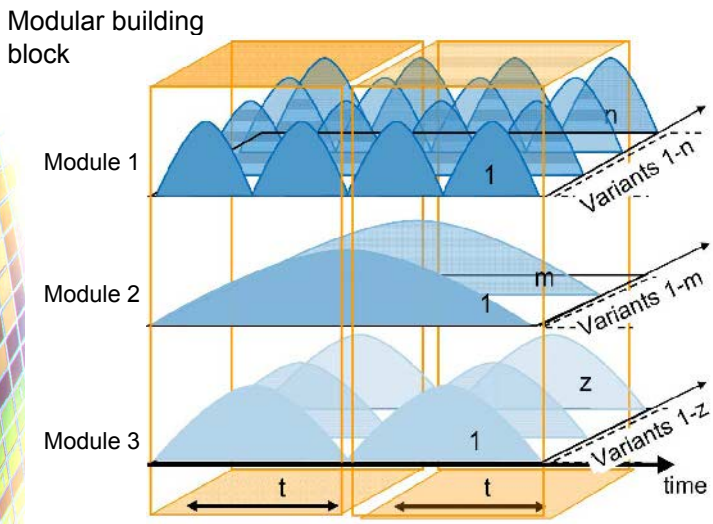
- Module development fills "shelf" and anticipates the requirements of the model ranges
- Budget responsibility assigned to module development
- Limited development expend. / application development for model ranges

Type 3: middle way through lead model



- "First equipping" of the building block via the lead model range
- Lead model range can consist of the maximum requirements of the derivates of a model range

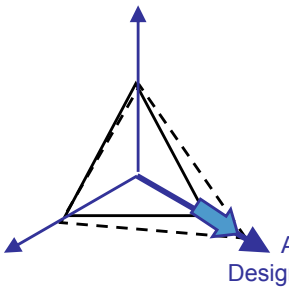
Release engineering is the base for an effective planning and realisation of modules

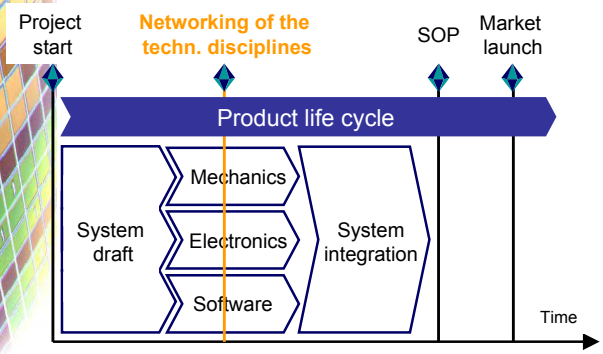


- Modular building blocks require advanced planning and forecasting of release cycles for modules that are to be used in different model ranges
- The different innovation cycles of the various modules and the technology development this is based on have to be synchronized

Decoupled development cycles enable proactive planning of modules and interfaces in the sense of release engineering

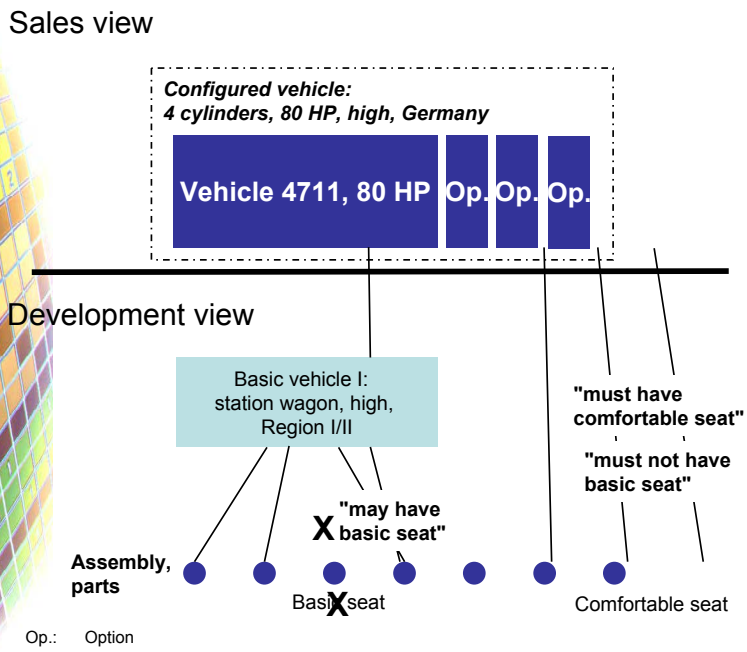
Ability to manage Design Process Complexity





- The integration of the supplier into the development process is depended on the product-know-how
- Development processes must be linked more closely between different technological disciplines
- Interfaces are an effective lever cushioning requirement dynamism in product architectures

Module and configuration management enables benefits along the whole value added chain – example seat configuration



- **User friendly traceability**: Systematically implemented configuration logic leads the user to the relevant assemblies and parts
- Clearly defined rules allow for **transparent visualization and verification**
- **High degrees of change flexibility**: When assemblies or parts are updated the dependencies between product structure elements are retained

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Complexity Management for Product Architecture, Functionality, and Processes impacts cost curve to increase net benefit