

## Streamline development processes through a holistic, standardized automotive architecture framework

As modern vehicles continue to grow in complexity, the automotive industry faces the challenge of finding more efficient development practices. There is a growing consensus that the introduction of an architecture paradigm could reduce this complexity and streamline the development processes. IBM, in conjunction with the Technical University of Munich, laid out the foundations for an architectural framework specific to the automotive industry. The study demonstrates how this framework could support future vehicle development together with the IBM solutions available for managing the product life cycle.

### **The advent of “smart” vehicles**

Vehicle complexity has increased dramatically since the first prototype rolled off the factory assembly line. New “smarter” vehicles are evolving with intelligent, built-in safety and comfort functions, connected systems linking occupants to the outside world, and “green” technologies such as hybrid, electric and fuel cell. But these trends have led to the use of more electronic content and embedded software. It is estimated that today’s luxury cars contain approximately 100 million lines of code running on several dozens Electronic Control Units (ECUs). This complexity leads to higher costs in the form of longer development times and a greater risk of development failure.

As a result, original equipment manufacturers (OEMs) are trying to reduce the number of ECUs needed by integrating more powerful processors, such as multi-core. ECU consolidation will require advanced systems engineering and architecture management to enable OEMs to make the best decisions.

With the goal of helping clients turn complexity into innovation, IBM and the Technical University of Munich conducted a systematic study on automotive architecture and laid out foundational concepts for the development of an automotive architecture framework (AAF).

### **A complex, interdependent ecosystem**

The automotive industry is made up of a multifaceted network of highly interdependent organizations which must collaborate in all phases of the vehicle lifecycle. This requires all members of this ecosystem, whether OEMs, suppliers, tool vendors or research institutes, to agree on a somewhat common way for structuring and describing a vehicle in order to increase overall efficiency within the ecosystem.

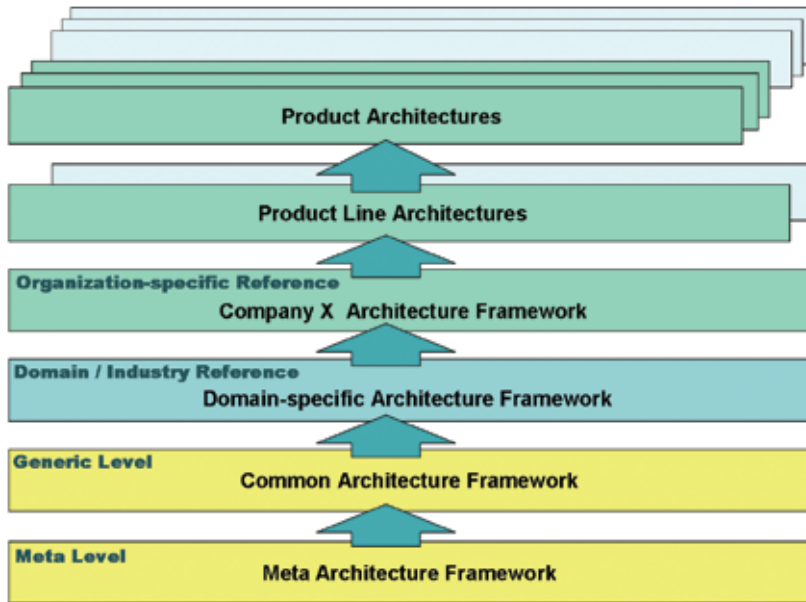


Figure 1

An architecture framework provides a consistent way to structure, decompose and describe a system across a specific industry or value net. Naturally some of the methods of structuring and decomposing are more generic and others are very specific to the modeled system.

For example, a system can be described in a generic manner by its user functions (black box view) as well as by its implementing components (white box view). On the other hand, decomposing a system into body, interior, chassis and engine is very specific to the automotive industry.

Figure 1 presents levels of architecture frameworks ordered by generality, beginning with the most concrete one.

On the generic Level, on the common architecture framework, general concepts are laid out such as the distinction between the functional, the logical and the technical architecture, as seen in figure 2.

These will then be applied for the development of more detailed architectures such as the domain-specific architecture framework.

The automotive architecture framework, as suggested in the joint study, is the automotive-specific instantiation of the domain-specific architecture framework.

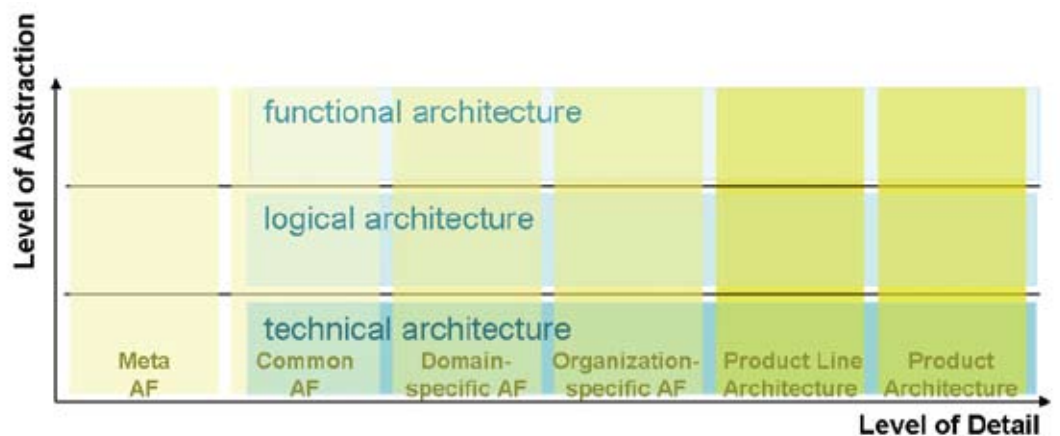


Figure 2

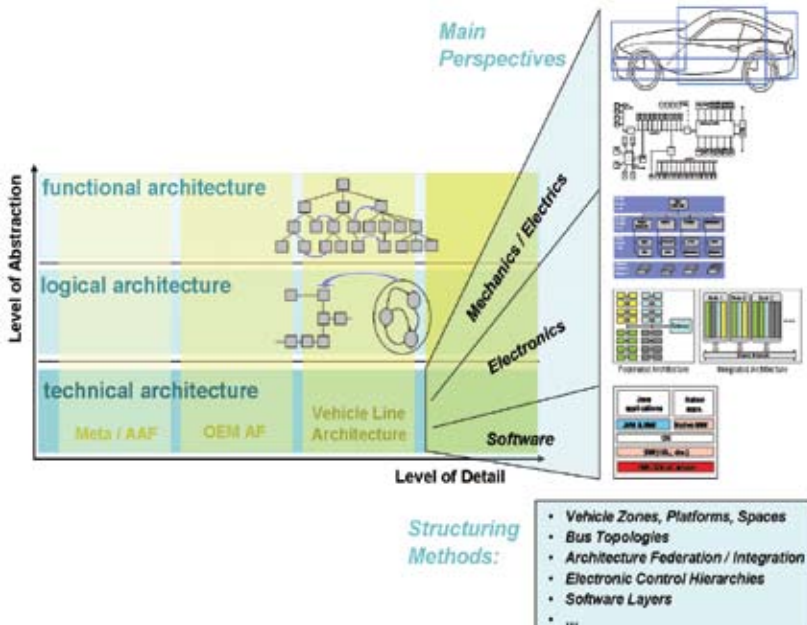


Figure 3

The joint study depicts proposed elements of an AAF by describing various viewpoints. Unlike AUTOSAR, AAF goes beyond a focus on technology platform and the related methodology, instead spanning a wider range, including the interrelation between mechanic, electric, electronic and software.

An automotive architecture framework can contribute to improvements in all areas of product development, from the first reasoning about a new product, to communication between stakeholders of the value net, down to a more integrated development environment. It helps collaboration by providing guidance and rules for modeling, documenting, developing, understanding, analyzing, using and comparing architectures based on a common denominator across a virtual development organization. An AAF can also:

- Provide insight for external stakeholders into how a specific lead organization develops products.
- Help ensure that descriptions of vehicle architectures can be compared and related across different vehicle programs, development units and organizations.
- Support traceability, increase quality and innovation, and reduce costs while mitigating risk.

The most efficient way to implement the architectural development concept within the relationship space of methodology, process and artifacts, is in an integrated fashion, by an iterative, model-driven approach.

Classical, mostly document-driven, product development has several drawbacks, often decomposing requirements into specifications rather than decomposing systems to subsystems and deriving requirements for each substructure.

Figure 4 shows an outline of the model-driven system development approach in several abstract layers and very similar to the architecture layers. In fact, the various layers of the system decomposition can be supported and fed with components from an architecture framework.

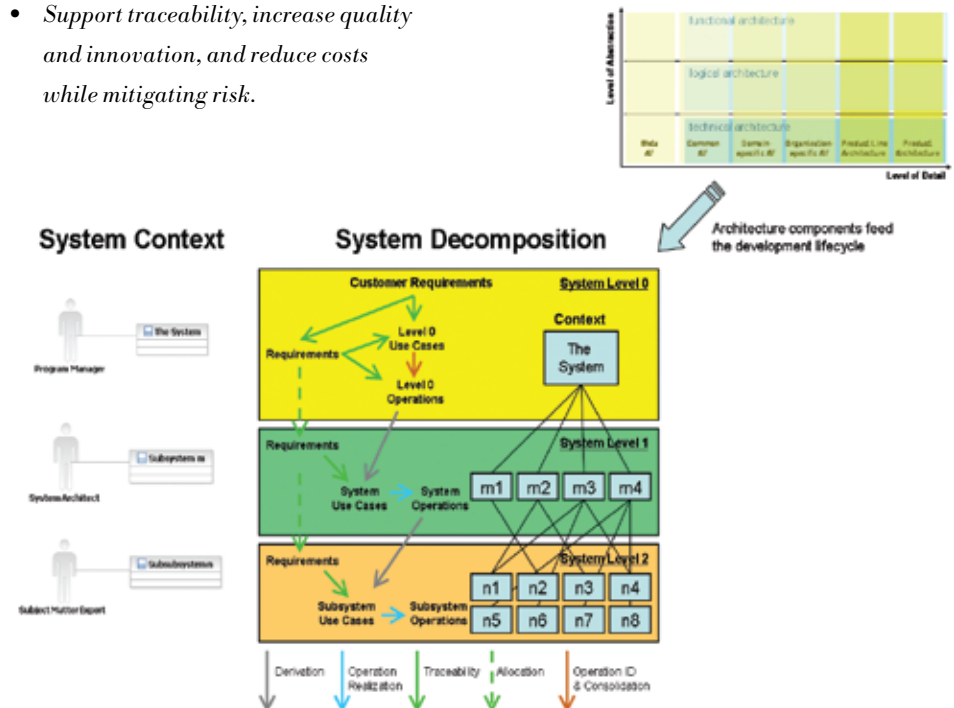


Figure 4

## A technology roadmap—how IBM supports an automotive architecture framework

IBM has a long history of developing and managing architectures for complex electronic systems and embedded software within our own range of IBM products. We also have a track record in providing the means for architecture development and management, including tools, methods, best practices and processes.

Based on this experience we actively work with automotive clients to improve the way they architect their products, whether vehicles, contained electronic control units or embedded software. IBM offerings allow automotive manufacturers to:

- Leverage proven process frameworks: *Support iterative elements within the “automotive-typical” V-model.*
- Manage product portfolios effectively: *Build the right product at the right time for the right market.*
- Manage requirements: *Capture, define, analyze and manage requirements across the supply chain.*
- Develop systems and software: *Visually develop complex systems using a structured approach in a model-driven way.*
- Adapt modern approaches: *Elevate software engineering to a strategic business process.*
- Manage change: *Synchronize changes across different disciplines and across the supply chain.*
- Manage quality: *Make quality management a continuous lifecycle activity from beginning to end.*

The IBM Rational software platform for automotive systems provides the required authoring and data management tools needed to realize these best practices, with integrated systems engineering and embedded software development solutions to help manufacturers build the systems, products and product lines that meet their business’ objectives and their customers’ needs.

When leveraged appropriately, the automotive architecture framework, along with IBM solutions and services, can help the automotive industry manage complexity, manage product lines, maintain a strong competitive edge, and become state-of-the-art innovation leaders as the future brings more advanced electronics and integrated driver interfaces.

### For more information

Read the full text of the study, Automotive Architecture Framework: Towards a Holistic and Standardized System Architecture Description, at the following link:

[ibm.com/software/plm/resources/AAF\\_TUM\\_TRI0915.pdf](http://ibm.com/software/plm/resources/AAF_TUM_TRI0915.pdf)

To learn how IBM is working with the automotive industry to help them cut costs, improve efficiencies and reduce complexity, contact your IBM marketing representative or IBM Business Partner, or visit the following Web sites:

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