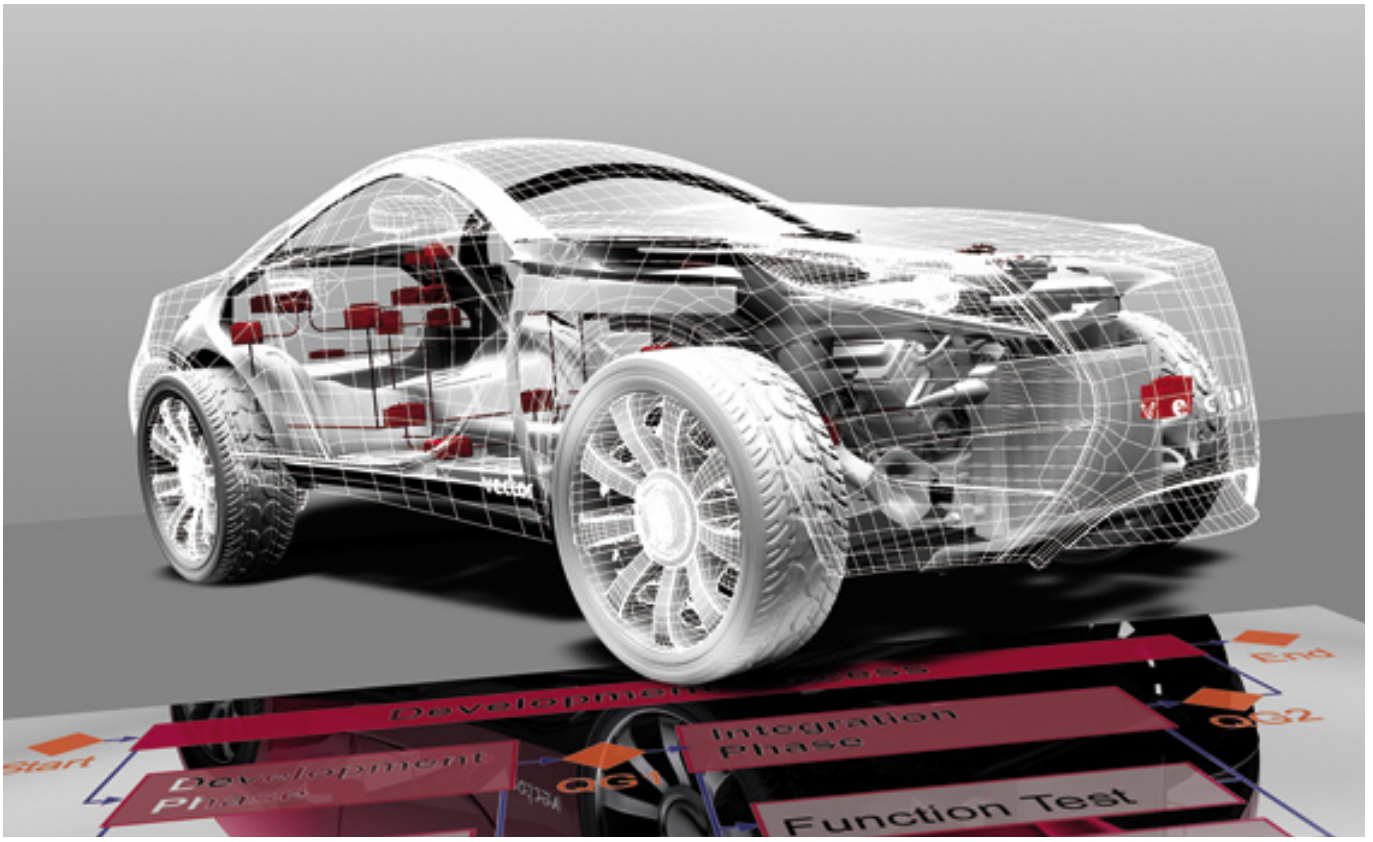
Tool for Developing Complex Architectures

Good Tool – Good Results!



Individual automobiles require customized electric/electronic architectures. Delphi uses a special software tool suite to design power distribution and data networks and all necessary components precisely to customer wishes.

Increasing individualization of vehicles and growth in the range of their features has significantly changed the way E/E architectures are developed. In turn, the scope of specifications and requirements for an E/E architecture has grown immensely in recent years **(Figure 1)**. Such an architecture needs to be structured modularly to satisfy the many different demands for features by car drivers, but at the same time its technical design must be universal to simplify production.

New vehicle concepts such as low cost cars, hybrid and electric vehicles also require completely new E/E approaches. Last but not least, a supplier needs to consider the sometimes very different structures, processes and development goals of its European customers' product development departments.

Delphi has developed a tool suite named Velocity, which supports the entire process - from specification to the finished product. Its special aspect: It represents a combination of commercially available software tools, special advanced development commercial tools and some solutions developed in-house at Delphi. The individual tools retain their technical data in the Global Data Backbone, a database in which a company's entire data inventory for components and production processes is stored.

Selecting widely used tools creates universality and a broad database. In addition, automatic exchange of model data results in the lowest loss of information and reduces the risk of errors that can originate from manual interventions.

Data Management

The Tool Suite and its shared database also make it possible for development engineers to collaborate between distributed work sites. Changes are loaded into the system in real time, and they are immediately available to others participating in the development process. The Velocity Tool Suite is not an insular market-unfriendly solution. Delphi handles its Requirements Management with the widely used DOORS tool, and its standardized specifications are in electronic form.

For architecture development and optimization, Delphi has adapted the PREEvision tool from aquintos. This tool is

now becoming a quasi-standard for the automotive industry. Two programs developed internally at Delphi handle analysis of the electronics (eScout). A universal data management system that does not require tedious data maintenance or reconfiguration of data parameters is a high priority at Delphi. This is the only way to rapidly implement development processes to satisfy the continually shorter time demands of customers and the high degree of detailing. At the beginning of a project, Delphi validates basic data from the customer and then converts this data to internal data formats for further use. The development process for an E/E architecture runs through six steps at Delphi:

- First, a complete requirements inventory is generated together with the customer, which mainly consists of customer data. Delphi fills in any data gaps based on its wealth of experience and data contents from the Global Data Backbone.
- Afterwards, meaningful E/E architecture concepts are created emi-automatically with eScout, or manually if design limitations are more stringent.
- Delphi automatically evaluates these alternative concepts with analysis metrics. Afterwards, the best alternatives and their evaluation are reviewed with the customer in a final evaluation.
- The selected E/E architecture is then technically validated with Delphi Simulations tools.
- This established E/E architecture serves as the foundation for technical departments to create their product descriptions.
- In developing wire harnesses, up to 80 percent of work can be performed using existing data of the specification.
  Only special wire harness products, such as special wire covers and add-on parts, still need to be added completely. Usually, the final mechanical data is not available until this project phase. The tool suite especially helps to accelerate processes in the definition phase and early development phases of a vehicle project. Today, only about three to six months are required instead of one year previously. The results yield a solid foundation for material and production cost estimates, because of the significantly higher level of detailing.

Universal yet Detailed

The PREEvision concept development tool plays a key role in the Delphi Tool Suite. The tool unifies all basic data from the customer as well as the Global Data Backbone and is the optimal environment for a detailed analysis and evaluation of different architectural draft designs. After the requirements level has been defined or imported, the next step is to describe functions and their relationships abstractly before distributing them to the network level. ECUs, networks with their various bus systems and sometimes very complex power supply systems are described here **(Figure 2)**. On the subsequent schematic level, the level of detail is further refined with electrical circuit diagrams **(Figure 3)**. A core competency of Delphi is the physical level. Here, the interplay of power distribution modules, body controllers, sensors and actuators is developed into a complete network with the help of pins, connectors, in-line connectors and seals. Finally, the vehicle topology defines the locations of the sectioning points and the layout of the wire harness and possible assembly. The results are iteratively optimized and checked with simulation tools. It is possible to study the entire wire harness, for example, to determine the potential effects of changes in wire gages or conductor materials on fuses or the total

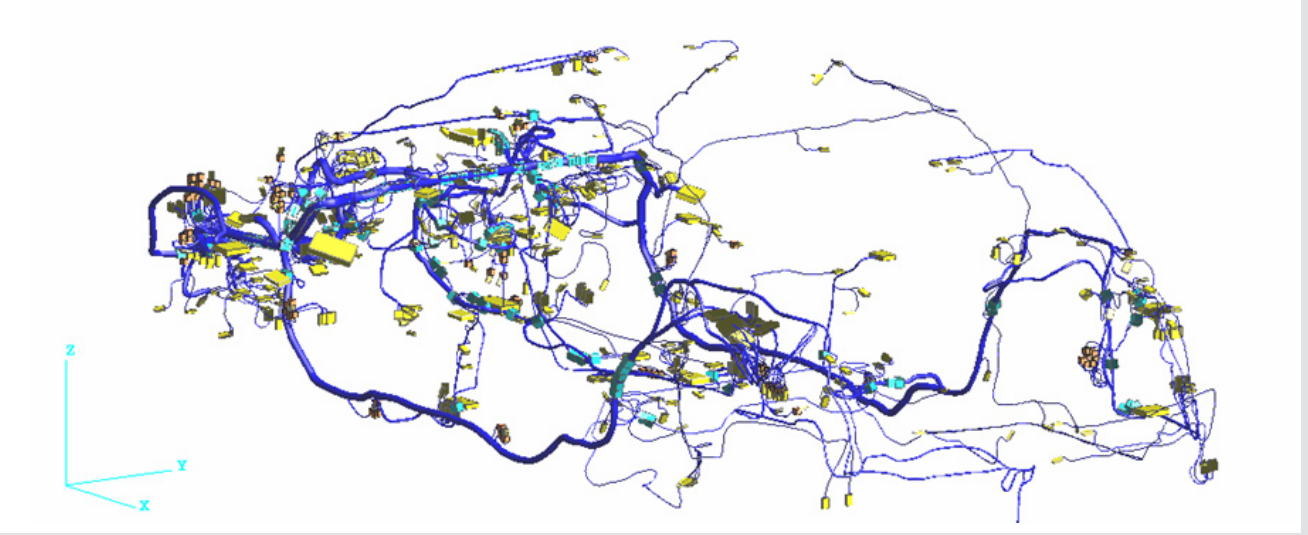


Figure 1: During the last years The complexity of the specification has terrifically grown.

weight of the electrical system. It is also very easy to compare the effects of complex parameter changes.

Standardized reports then provide basic information for the development of assemblies and wire sets. Afterwards, the architecture is transformed to a two-dimensional system with the help of other Delphi tools (Delight); production documentation is created based on this system data.

Graphic visualization in preparing the data lets developers clearly structure even complex E/E architecture concepts. In addition, basic components such as chassis or convenience functions may be shown or hidden to focus attention to specific aspects of the electrical system.

On the analytic level, color coding helps in laying out a topological model. For special problems, schematic views of power distribution, wiring details or communication behavior of the networks can all be called up practically at the press of a button.

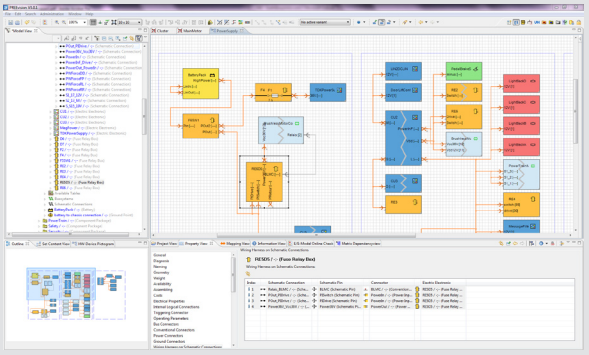


Figure 2: The single architecture levels are stuctured clearly with PREEvision

Summary

The Tool Suite creates transparency, networks the data, supports creative work in concept development and at the same time enables simulation. This increases the efficiency of the development process and soundly embeds it within a global corporate network. The Tool Suite concept demonstrates that the approach of using commercially available programs as the core or starting point can be very successful in intelligent "refinement and integration," and it also quickly gains acceptance and recognition among customers.

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works in the E/E system development in Delphi as the manager of tool development.

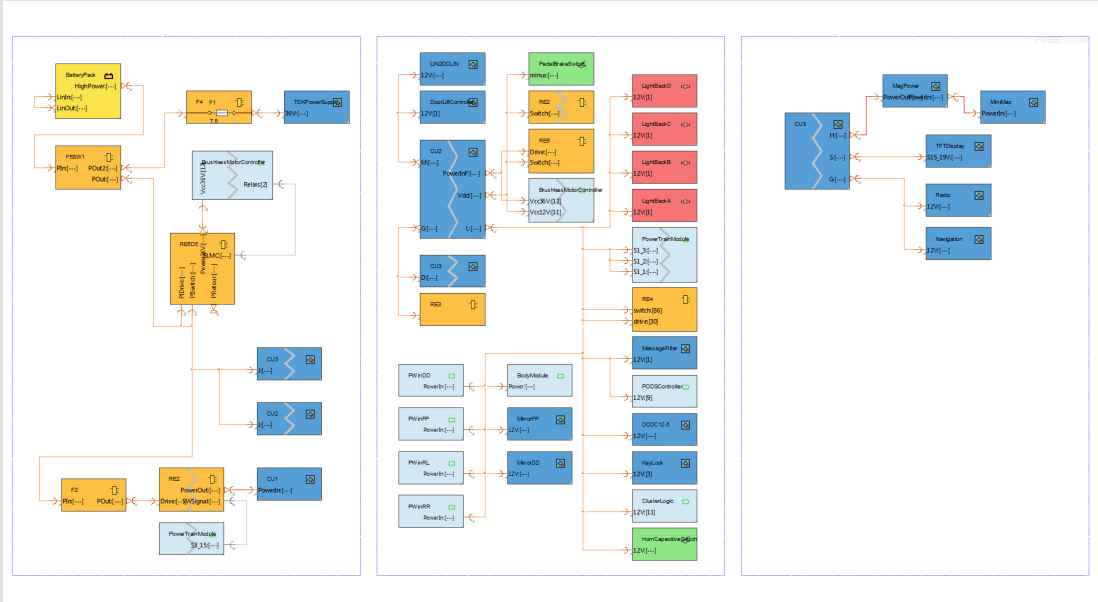

Figure 3: schematic overview of the electric power distrubutions