

**Automotive
Electronics**

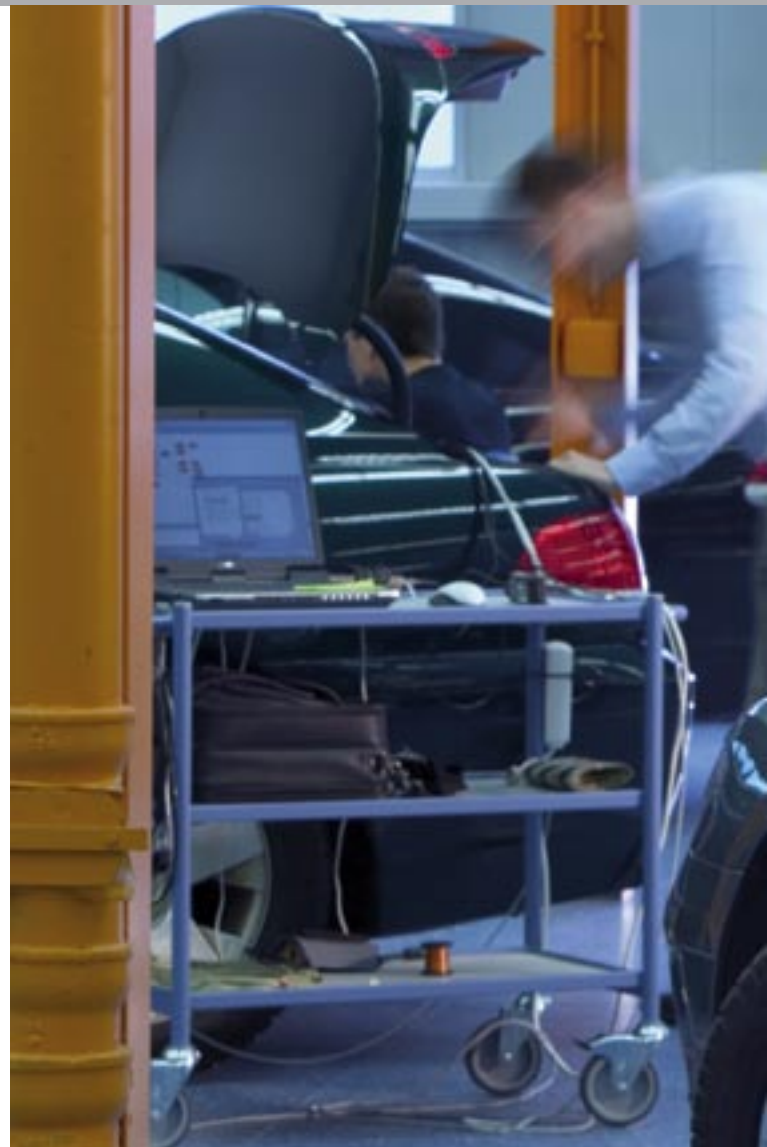


ESG – Partnership – System Competence – Progress

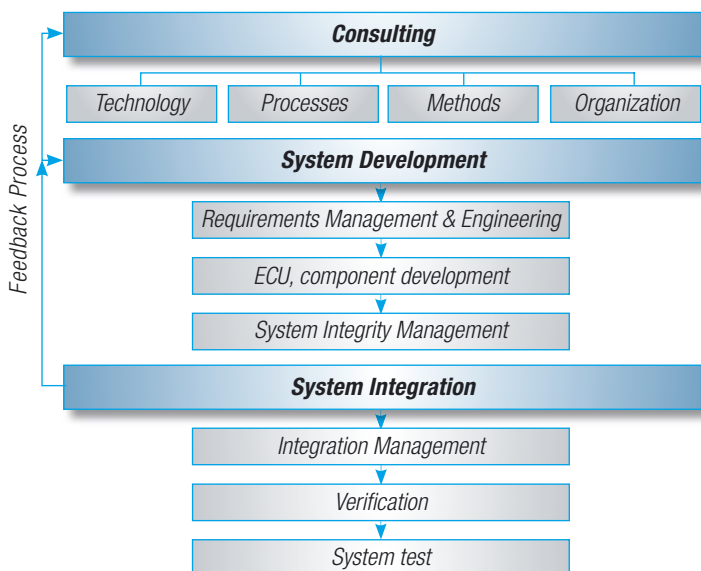
For over forty years ESG has been one of the leading German companies active in the development, integration and operation of electronic and IT systems. As an independent technology and process partner we provide system development, logistics, training and consultancy services. We provide fully qualified services in the areas of aircraft, land-based vehicles and ships, IT and communication, logistics, telecommunications, transportation and traffic as well as consumer goods, capital goods and automobiles.

ESG has been active in electronic systems engineering for more than 40 years. What sets us apart is the way we bring together knowledge and experience of various procedural and process models from the military, aviation and automotive industries as well as extensive experience of the processes in the automotive industry.

We support our customers in designing efficient processes and utilizing methods and technology in a need-oriented manner. In terms of diagnostics, we together with our subsidiary, ServiceXpert, provide 100% coverage for the demands of the diagnostic process chain. Our expertise in training sets standards for employee qualification.



ELECTRONICS SYSTEM DEVELOPMENT – BUSINESS ACTIVITIES



CONSULTING

ESG consulting in electronics system development has its place above and beyond that of classic management consulting. Our strength lies in developing innovative and individual solutions that are heavily weighted towards implementation and the ability for them to be integrated. As such, we orient ourselves towards current and future market standards.

Our active cooperation in various committees such as FlexRay or ASAM and our status as “First Silicon User” with various industrial partners gives us access to current and ground-breaking technologies and methods.

We cover the entire development cycle throughout the lifecycle process model (V-model). We examine the effects of individual development steps on production, logistics and after-sales as part of a holistic observational approach, and integrate the appropriate solutions in each particular case.



INFORMATION SYSTEMS & TOOLS

Information systems combine individual development steps and make it possible to achieve high levels of data and process transparency. Our experts are masters of current market tools and utilize them professionally. However, special tasks frequently require special solutions that are developed for a particular challenge.

For example, many of our customers plan automotive on-board electrical systems using the **MSC Tool Chain**. With this, development engineers specify and test Message Sequence Charts, etc. and can evaluate how the electronic components in a vehicle communicate with one another.

DiaMon, a tool chain from our subsidiary ServiceXpert, is used for diagnostic management. It creates diagnostic applications.

SIM Tool is a tool that is used in both development and production as well as service. The compatibility of the entire system is ensured as part of system integrity management (SIM).

TRAINING

Efficient development is closely linked with employees' knowledge of new technologies, methods and standards as well as how they should be applied. For more than 20 years, we have been a partner to the automotive industry in training and we know how training can be structured efficiently. Our expertise in terms of methods and technology enables us to offer both training courses and workshops in various disciplines:

- ▶ Process models (CMM(I) ...)
- ▶ Bus systems (CAN, LIN, MOST, FlexRay)
- ▶ Standards (ASAM-ODX ...)
- ▶ Requirements Engineering & Management
- ▶ Diagnostics
- ▶ Driver workload management

Furthermore, as a full-service provider, ESG possesses extensive experience in designing and implementing training concepts as well as training and coaching topics that are closely attuned to market requirements.

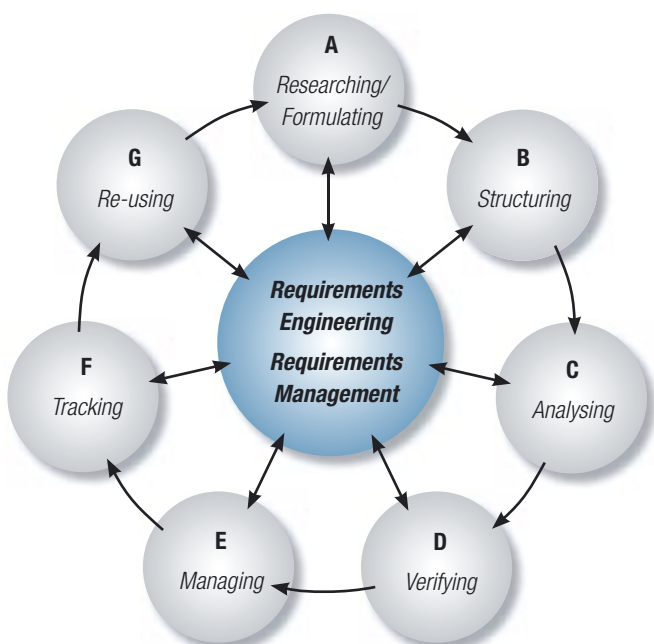


REQUIREMENTS ENGINEERING & MANAGEMENT

Systems engineering demands a structured, function-oriented, consolidated system and process description that results in specifications capable of being used for calls for tenders – from the component through to the vehicle. Specifications are worked out in an iterative process involving departments, stakeholders and suppliers, amongst others. The subsequent process of producing test specifications from the specification is one of our activities.

Our strength lies in creating the specifications, introducing methods of requirements engineering, selecting a tool that is suitable for the requirements, verifying and documenting the results as well as process training and taking over the entire change management process.

Requirements management continues the development of processes that are under way throughout the entire product lifecycle. New or modified technical requirements are integrated into the overall system of the “vehicle”.





We have pushed ahead with the development of the V-model and have adapted our customers' processes accordingly. We cover all the tasks in electronics systems development – for OEMs and suppliers – throughout the lifecycle process model.

The most important precondition for smoothly functioning internal and external processes is to ensure that all data throughout the product lifecycle of a vehicle is up-to-date and compatible. This is also a driver for achieving a faster time-to-market. ESG introduces methods, controls and optimises development processes and, indeed, itself forms part of these processes as a service provider.

Innovation Partners

We see ourselves as a creative “blue-skies” thinker for technological and method-driven issues. To live up to this claim, we are investing in in-house research projects, cooperating with universities and institutes as well as taking part in Europe-wide research projects.

ECU/COMPONENT DEVELOPMENT

We perform the following activities relating to the development of electronic control units and components:

- ▶ Project management to support development
- ▶ Creating and optimizing specifications
- ▶ Deriving the test specification
- ▶ Rapid prototyping and modelling
- ▶ Code generation, coding, diagnostics
- ▶ Verification/validation, automation
- ▶ Fault detection, management and rectification
- ▶ Versions and variant management
- ▶ Change management (from analysis to evaluation)
- ▶ Technical coordination of suppliers

SYSTEM INTEGRITY

Ensuring system integrity is made more difficult nowadays due to various general conditions. These include, for example, the increasing number of control units, functions and vehicle variants as well as the fact that it is no longer possible nowadays to safeguard or cover all electronic control unit configurations and variants for test purposes.

The objectives of system integrity stand in contrast to this: The overall system as well as the system variants and individual configurations derived from it must remain stable and functionally reliable in the long term throughout the entire product lifecycle.

We bring our many years of experience to bear in the form of concepts and methods for safeguarding system compatibility right from the early development phases. We create specifications on the basis of models which are formal descriptions of functions and their interfaces. In addition, we evaluate various process alternatives, handle the data and take over responsibility for the obsolescence management.

These ESG methods ensure process security and improve product quality in the long term.

System integration is a significant component of the overall process: This is where the theoretical concept and the implemented functions are harmonized with one another.

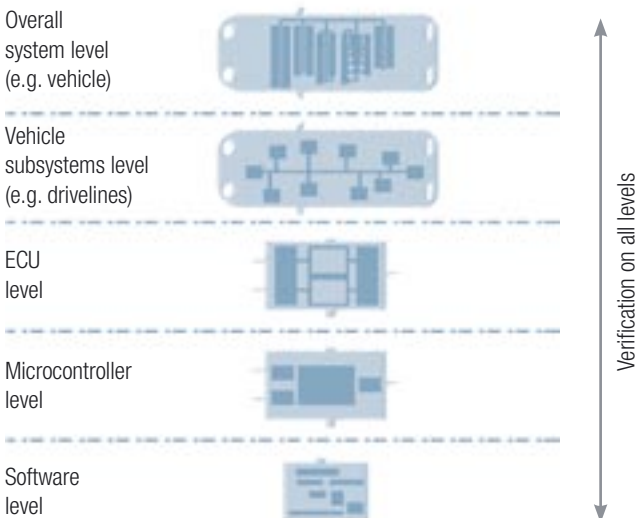
ESG has made a name for itself in the field of verification of components, sub-systems and the overall system. The company now has in-house test centers equipped with the latest measuring and test systems.

An active exchange of information and close coordination between development and test departments as well as individual suppliers are important criteria for overall process optimization.

The tools and information systems developed by ESG throughout the product lifecycle provide long-term support for these processes.



VERIFICATION LEVELS



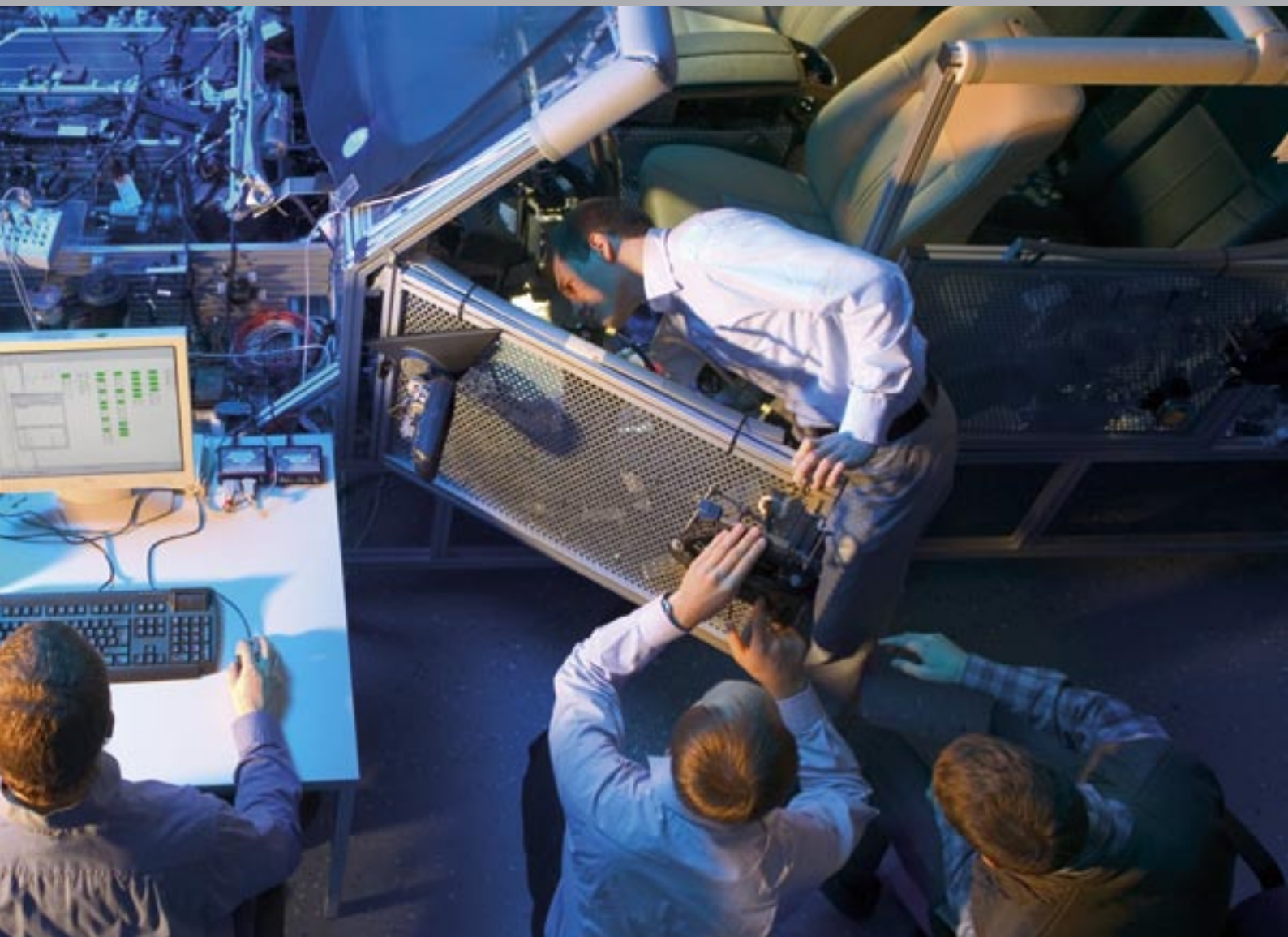
VERIFICATION

Each verification must be based on a corresponding test strategy and introducing automatic test sequences with the objective of safeguarding the decisive variants and extrapolating the results achieved to other variants. ESG does not just perform test procedures, we also create concepts for corresponding test set-ups and then build them.

The scope of the system and tests is defined together with the customers. On the basis of these results, ESG verifies the electrical system properties as part of the system trial.

For example, in the context of gearbox development, we undertake tasks in the area of functional integration for electronic gearbox control units as well as responsibility for the control units in series production.

Both in-house and directly on the customer's premises, we also verify the function of the system for our customers. This includes testing the control units as well as testing them in the overall system context.



SYSTEM TEST

We perform static and dynamic system tests on all system levels in the laboratory, on laboratory vehicles, on prototypes as well as on the actual vehicle. The scope of services includes:

- ▶ Creating test cases, test scenarios
- ▶ Checking system/customer functions
- ▶ Bus communication, network management (automatic cycle time monitoring, stress and interference conditions)
- ▶ Procedures relevant to diagnostics (verification of the coding/parameter setting, verification of the end-of-line check)
- ▶ Energy studies, current/voltage characteristic, closed-circuit current behaviour (fail-safe circuit, verification of the stand-by behaviour, energy balance monitoring)

Furthermore, we provide support to the departments, for example in troubleshooting or with feedback from the plants or workshops. In addition, we work closely with suppliers during the integration of new components. Also, we are skilled in using the conventional tools and develop application-specific tools if necessary.

INTEGRATION MANAGEMENT

Dynamic changes in product development – both on the supplier's and the manufacturer's side – continue after the start of production. Components, modules and systems must be developed further and adapted during the lifecycle. This applies just as much to vehicle derivatives as to the full range of systems in the supplier area.

In these cases, we are always responsible for the entire process, especially the programme and project management, as well as all development activities relating to the entire scope of electronics.

Our main areas of expertise:

- ▶ Functional integration
- ▶ System integration
- ▶ Production-related integration
- ▶ Service-related integration

Our outstanding performance is based on many years of experience and the expertise of our employees.

