ETAS Calibration Consulting
Makes calibration of complex embedded controllers more efficient
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ETAS offers embedded software development, testing and validation, as well as measurement, calibration, and diagnostic tools, along with engineering and consulting services to automakers and suppliers worldwide.

ETAS Calibration Consulting supports the complete calibration process including workflow and data management as well as the setup of experiments with advanced technologies such as automated and model-based calibration (Figure 1).

ETAS is networked with calibration experts worldwide and continuously explores new approaches, methods, and technologies for better managing calibration complexity and improving calibration efficiency.

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**We make your calibration of complex embedded controllers more efficient**

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<th>Dedication</th>
<th>Sustainability</th>
<th>Cutting-edge</th>
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<td>We build up best fitting customized solutions including third-party products.</td>
<td>Our customers achieved sustained success in terms of lower cost, optimized use of resources, and calibration time savings.</td>
<td>We set trends and support the most advanced calibration methods and technologies.</td>
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**Consulting approach**

- **Analysis**: Analysis of processes, methods, and tools in use at the customer
- **Proposal**: Documentation of the optimization potential
- **Evaluation**: Selection of the best fitting solution to leverage the optimization potential
- **Supervision**: Supervision and support of the customer during and after the implementation phase

*Figure 1: Mission of ETAS Calibration Consulting*
In the past fifteen years, innovative new vehicle functions controlled by advanced electronics and embedded software have led to enormous progress with regard to vehicle performance, comfort, safety, and environmental compatibility. Because of the high number of interacting control functions from different vehicle domains, calibration of automotive control systems has become a challenging task. This pushes up calibration effort and expenses for equipment in terms of test vehicles and test benches. On the assumption that there will be no change in calibration methodologies, ETAS predicts a doubling of calibration effort until 2020 (Figure 2).

![Figure 2: Drivers of the increase in calibration effort between now and 2020]
Not long ago, calibration was seen as a part of the validation phase at the end of the development process (V-model) and was mainly facilitated by use of measuring and calibration tools. Errors in software functions found during the calibration phase caused major time delays.

In the future, calibration work will be shifted towards earlier stages of the development ("frontloading"). Requirements will be tested in virtual environments, initial calibration will start during function design, and pre-calibration will be done simultaneously with the integration of a function into a specific system project, for instance by reusing data sets from other projects or experience. New methods such as DoE (Design of Experiments), data-based modeling, and automated calibration will support calibration engineers during their day-to-day work.

Figure 3: Increase of engine-management complexity
ETAS Calibration Consulting will make customers’ calibration of complex embedded controls more efficient. We will guide and support our customers in establishing calibration processes to add long-term value. In close cooperation with our customer, we will:

— Explore potential cost and time savings.
— Find ways to manage calibration complexity and volume, including data handling, variant and requirements management.
— Set up customers’ calibration workflows and processes.
— Implement customized cutting-edge solutions.
— Set up change management.

2.1. The value of consulting for the customer

Customers each have their own individual calibration process. They expect customization of new methods in line with their established calibration approaches. That is why ETAS consultants will consider the current customer situation, including the existing tool environment, as well as internal regulations and targets during their work.

ETAS consultants have built up many years of experience in calibration work with different customers in various fields. They know the trends in calibration and understand the tools available on the market.

The customer’s management no longer has to master increased complexity by deploying additional resources. ETAS consultants will address customers’ specific requirements and propose measures to increase efficiency in order to compensate for the growth in complexity.

One of these measures is to shift calibration work from “Road to Lab to Math” through frontloading measures. Early calibration and simulation steps during system setup will improve the maturity level of the system and speed up its validation. New tools and methods must become accepted by calibration engineers and project leaders. ETAS consultants accompany the change management process at the customer’s site. To elaborate its benefit, we use key performance indicators (KPIs) defined upfront together with the customer.

2.2 The ETAS Calibration Consulting approach

Our approach consists of four steps. The consultant will work together with the customer’s management in order to analyze the current situation by identifying targets, gaps, or existing challenges. A deeper understanding of processes, the methods used, and the tool chain installed will be achieved together with the customer’s experts.

Next, our consultants will investigate proposals for optimizing processes, methods, and tool chains and present their ideas to the customer. Together with the customer, the best approach will be selected. Based on that, the customized solution package will be specified. This includes the identification of KPIs as well as milestone and budget planning.

ETAS consultants feel responsible both for implementation and sustained success once the customer has introduced the solution. As an option, we assist our customers during the change-management phase with training, coaching, and supervision. After the implementation phase, we offer to evaluate the success achieved according to the KPIs.
Combination of simulation, calibration, and early validation

- Calibration against simulation of the controlled system
- Reduced measurement effort by deployment of Design of Experiments (DoE)
- Dynamic calibration by fast ECU access
- Validation and safeguarding of variants
- Supported by expert knowledge and best practices

Figure 4: Calibration effort depends on the calibration environment

Figure 5: Shifting of calibration work from "Road to Lab to Math"
ETAS Calibration Consulting delivers comprehensive consulting services to solve the key challenges of calibrating today’s advanced powertrain systems such as:

- Support of calibration process adjustments
- Effective management of calibration and measurement data
- Intelligent initial precalibration (maturity level of up to 70% possible)
- Variant and version handling, including application software, emission standards, onboard diagnostics, or measurement setups
- Reuse of calibration data and know how
- Evaluating powertrain concepts using simulation
- Precalibration in early development stages by use of control-function models and simulations of the controlled systems
- Seamless calibration of ECU functions in the virtual environment, at the test bench, and in the vehicle
- Automation of standard application tasks including automated configuration and setup of measurement and calibration systems
- Optimized planning of test drives and work packages
- Documentation of measurement and calibration results
- Setup of calibration tool backbones including interfaces to communicate relevant data to experts
- Integrating calibration during function development
- Calibration in ECU network to allow cross-ECU measurement and parameterization
- Provision for quality requirements and standards of automotive software development, e.g. AUTOSAR
- Shortage of skilled professionals such as IT experts or calibration engineers
ETAS Locations Worldwide

Germany
Stuttgart (Headquarter)

Brazil
São Bernardo do Campo

Canada
Kitchener

France
Saint-Ouen

India
Bangalore
Pune

Italy
Turin

Japan
Utsunomiya
Yokohama

Korea
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