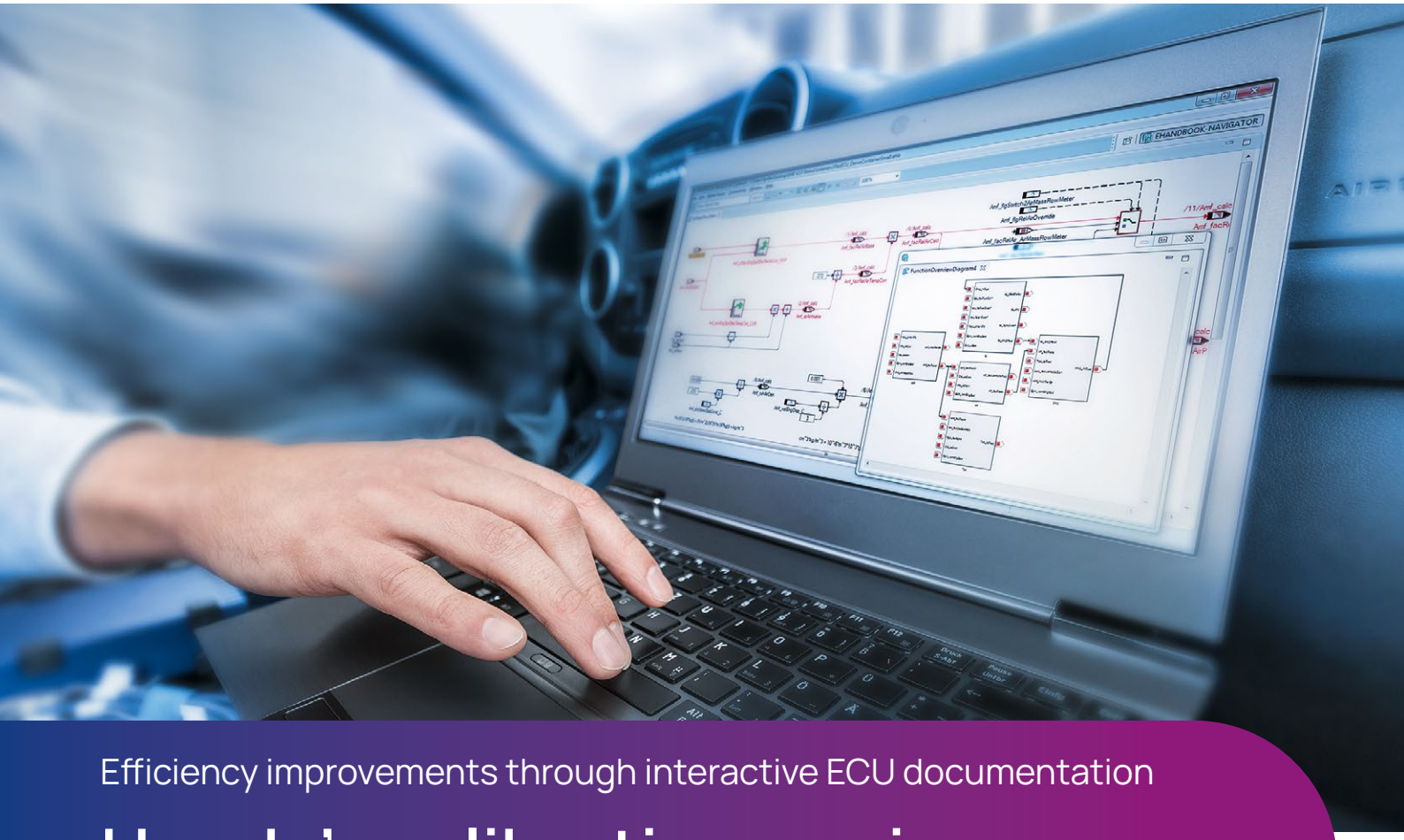
Translated article
"Hondas Applikateure kommen schneller ans Ziel"
Hanser automotive 04/2022



Efficiency improvements through interactive ECU documentation

Honda's calibration engineers get to their goals faster

Honda is driving electrification forward. The increasing diversity of hybrid and electric drives is gaining in complexity and entailing significant additional work in ECU calibration. Until now, calibration experts had to search thousands of diagrams to find their way through the mass of measured variables, signal flows, settings, and dependencies in ECU software. Since Honda began using EHANDBOOK from ETAS, they have been able to put an end to this time-consuming and nerve-wracking process. The interactive documentation allows fast, precise switching between overview and detailed views. Calibration and measurement experts save valuable time and can focus on fine-tuning powertrain control parameters.

It's a natural thing that bugs also occur during the calibration and testing of ECU software. But for the specialists carrying out the tests, this is where the guesswork begins. Usually, they are not familiar with all the details of the software specifications because these were defined at an earlier stage by other function and software development teams, partly internal or external. In fact, they provide them with extensive and detailed documentation. But to find the root cause of errors, calibration and test engineers need to quickly gain an overview of the software specifications.

With documentation written from the software developers' perspective, this is not an easy task. How do the signal flows run? What is the meaning of the measured variables? What is the effect of adjusting parameters? And which functional interferences can be expected? What is already a complex task with fully functional software, becomes time-consuming and nerve-wracking detective work when bugs occur, often under immense time pressure?

Variety of drive concepts increases software scopes

Automobile manufacturers can no longer afford such inefficiencies in view of the rapidly growing scope of ECU software and its specifications. Especially since the increasing variety of drive concepts, automated driving and growing connectivity are drastically expanding the range of functions of central control units – and thus the complexity of calibration.

Honda is no exception. The corporation is systematically pushing ahead with its electrification strategy and has developed more than a dozen hybrids (HEV), plug-in hybrids (PHEV), and zero-emission vehicles (ZEV) in recent years. At the same time, the corporation's proprietary hybrid architecture "e:HEV" has been optimized for efficiency, agility, and driving comfort over three model generations. During the course of this development, the specifications and calibration effort have increased significantly (Fig. 1). Fine-tuning and testing of ECU functions is becoming more complicated from one model generation to the next due to the complex hybrid strategy and the increasing efficiency and quality requirements.

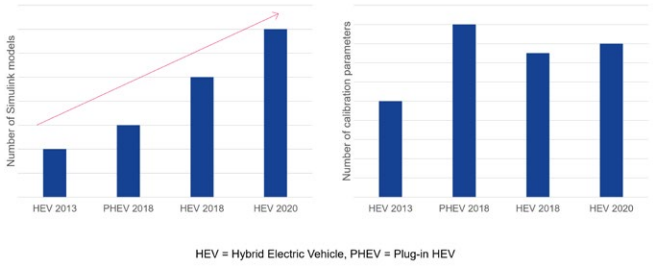


Fig. 1: Complexity and workload of hybrid control software.

Nevertheless, the specialists carrying out the work must in each case quickly gain an overview and develop a basic understanding of the software, its functions, and specifications. This begins with the fundamental question of exactly which function is affected by the input of variables, how this change affects the vehicle behavior, and to what extent correlations and dependencies with other settings occur. This familiarization alone is time-consuming. It applies even more for the detective work described above when looking for the causes of bugs that arise. "Debugging in particular takes a lot of time," admit the responsible parties.

Intelligent, interactive documentation

Honda has switched from manual searches in Pdf documentation to a smart interactive process to prevent calibration specialists from spending a long time searching for answers and to enable them to understand the details of the measured variables and signal flows more quickly.

ETAS EHANDBOOK is the key: previously distributed documentation is merged, enabling users to navigate quickly and focused between overview level and detailed view. The information presented in EHANDBOOK is already intelligently linked, complemented, and indexed during the creation of the automatically generated software documentation.

Thereby, the build process collects metadata about functions as well as measurement and characteristic values from various sources and stores them in a central database contained in the EHANDBOOK Container file.The meta-data enables the representation of the interconnections of functions, as well as the display of detailed information about individual elements directly in the text or in the model. EHANDBOOK quickly provides clarity through seamless graphical overviews of ECU software. It is also helpful that it is possible to quickly switch between cross-functional display and individual ECU functions.

> "The efficiency of our analysis and investigation work has increased significantly compared to the time before EHANDBOOK was introduced."

Yui Nishio is Assistant Chief Engineer in the Energy System Design Development Supervisory Unit at Honda Motor Corporation in Japan.

EHANDBOOK seamlessly merges multiple software and function development documentation. This merger in one user interface eliminates the need for users to switch between multiple files that are open in parallel. In addition, the overall view remains visible when calling up detailed views, which provides orientation in the system. EHANDBOOK can display graphical illustrations of ECU software in the form of interactive models of the relevant Simulink® or ASCET models. Without scrolling, Honda specialists can find measurement and application parameters in the models and track relevant signal flows. Thanks to this consistent graphical representation of all functions of the respective ECU softwarein interactive models, they can understand dependencies much more quickly, access details, and still maintain an overview of the system.

Interaction with measurement and calibration tools

Not only does this visualization make it easier for the Honda team to navigate through the highly complex material, EHANDBOOK can be coupled with measurement and calibration tools such as ETAS INCA and MDA 8 to allow calibration engineers to seamlessly transfer this knowledge into their existing workflows. Especially when it comes to root cause analysis for bugs, this coupling capability is a great help. After all, they can capture a large number of signals with the measurement tools during test runs. Possible causes of errors can be identified more quickly with MDA 8 in combination with EHANDBOOK. To do this, EHANDBOOK takes measurement data from MDA 8 and make them visible in the signal path. The interactive system thus provides the experts with a starting point from which they can begin the systematic analysis of the software's calculation and decision chains. In most cases, the correlations and causes of errors quickly become visible.

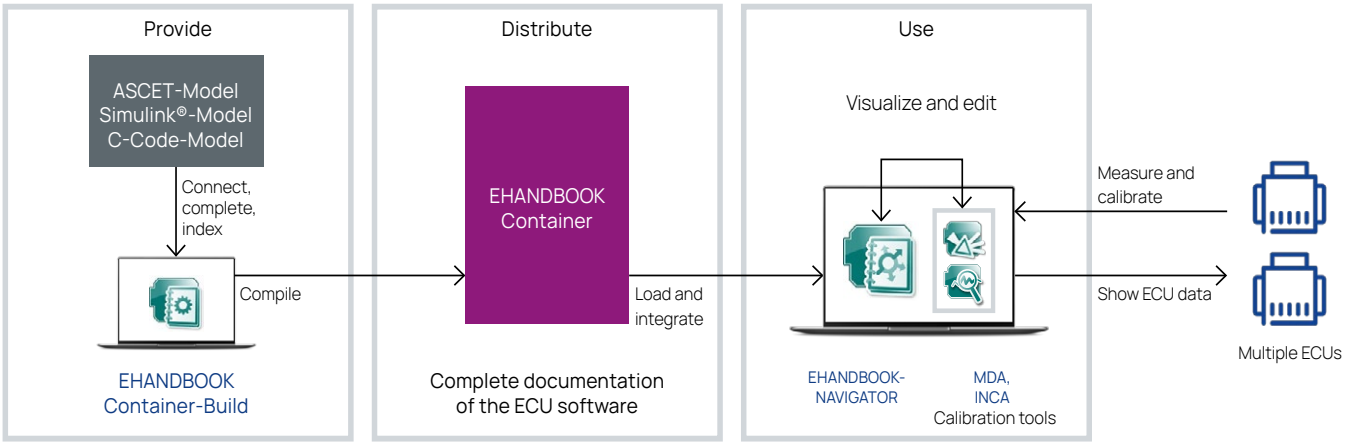


Fig. 2: Systematic preparation of ECU documentation with EHANDBOOK to provide and use knowledge in a targeted manner.

The previously time-consuming calibration of complex functions and debugging is thus significantly accelerated, which considering the tightly scheduled tasks at this late stage of vehicle development, noticeably reduces the workload. According to the Honda specialists involved, the convenient search functions, the simple switching between different system, display, and task levels, and the simplified option to trace relationships between the individual specifications of ECU functions and to confirm calibration fixed values within the specifications have also had a very positive effect on their workflows.

They conclude: "As it is now much easier to check and understand behavior during real vehicle tests, the efficiency of our analysis and investigation work has increased significantly compared to the time before EHANDBOOK was introduced."

Measurable efficiency benefits during calibration

The Honda developers say that EHANDBOOK has led to increased operational efficiency in the field. In simple terms it's like the switch from a printed road atlas to an electronic navigation system. According to internal analyses, the ability to quickly search through the extremely extensive software documentation for specific questions saves time.

The number of working hours spent browsing the specifications is reduced by about 2/3. Valuable time that the highly qualified calibration and test specialists have now been able to use for their actual tasks in ECU calibration and in fine-tuning the powertrain control parameters.

Use of interactive documentation is extended

Given the positive experience, Honda plans to expand the use of EHANBOOK and also use it for ECU calibration in other domains. Therefore, the company is working on optimizing the initial filling of the EHANDBOOK container. "Our goal is to minimize prep time by automating Honda-specific preprocessing to allow us to leverage EHANDBOOK's efficiency benefits even more extensively in the future," report the responsible parties of the project. With its high level of usability, the interactive manual is a great help in mastering the challenges of electrification – and in coping with the increasing calibration and testing effort of ECU software in the future.

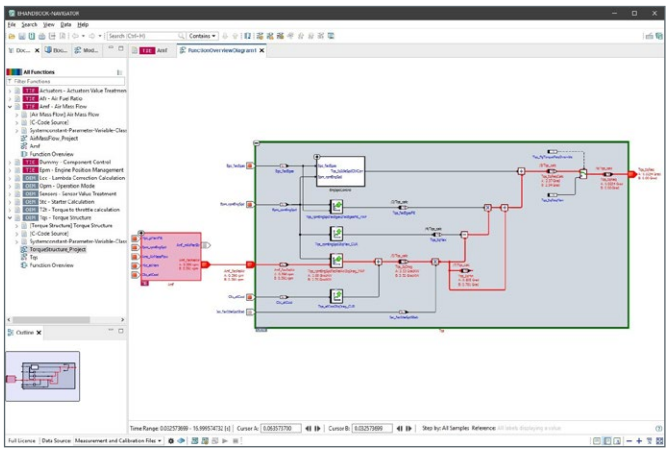


Fig. 3: Example for a display in EHANDBOOK: interactively, signals can be found quickly and signal paths can be easily tracked across functions.

Author

Tomoharu Oowaki is Field Application Engineer and EHANDBOOK Expert at ETAS in Japan