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A New Process for Hybrid Development that Utilizes Preventive Activities

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The first mass production Hybrid system required the development of a large-scale, complex system that spanned many departments and fields, unlike previous developments. In addition to the conventional development schedule focusing on design and upper body development, we proposed the control system milestone meeting as a new development process focusing on control and system development. In addition, we report the details of the preventive activities that we were working on.

There are three approaches to solve product issues.

The first is the “solution of the problem that is happening” method. There are FTA (Fault Tree Analysis) and QC (Quality Control) methods. This is a method for analyzing the causes of failures and accidents.

The second is the “recurrence prevention and standardization” method that does not repeat the same problem. There are ISO9001 and technical standards, and past problems are defined by standards and managed with tools to prevent them from occurring.

The third is the “prevention” method of FMEA (Failure Mode and Effects Analysis) and DRBFM (Design Review based on Failure Mode). These are for discovering and solving invisible problems, and require completely different perspectives such as problem discovery and creativity, from “solving existing problems” and “recurrence prevention”.

The key of product reliability is “not change”. If you use proven parts in a proven environment, quality problems will not occur. However, it is often necessary to change due to requirements. Even if the design does not change, the load on the parts and environmental conditions may change depending on the surrounding conditions.

“Good Design” Clarifies good design conditions and does not change them.

“Good Dissection” Focuses on the facts in front of you and thoroughly observes and compares them in order to discover problems.

“Good Discussion” Discuss thoroughly and raise issues from a different perspective.

These three Good Ds are called GD^3 (G･D･Cube), and “DRBFM” was devised by Toyota Motor Corporation in the 1990s as a tool for prevention.

Compared to conventional gasoline vehicles, Hybrid vehicles have expanded control connections and communication ranges between ECUs (Electronic Control Units). There are many interference control requests, and it is intricately intertwined with vehicle performance such as NV (Noise Vibration). This is exactly the development of a complex system, and unified management and early decision-making are required.

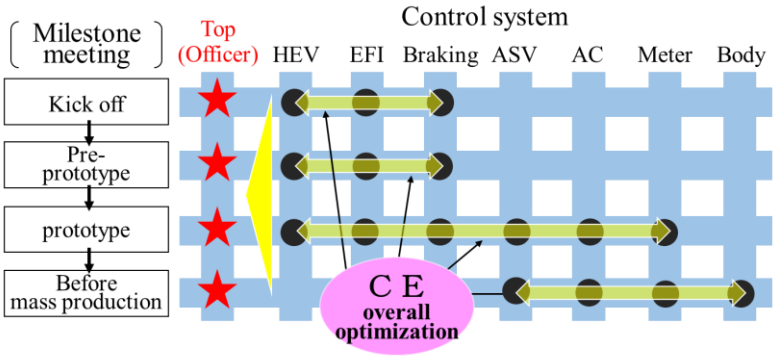

Fig.1 Management system by control system milestone

In Hybrid system development which became complicated, we had been working on progress management with control system milestone as a new management. We consolidated the whole and arranged a chief for each function. Set up a control system milestone meeting as the decision making in each development phase. Control system milestone meetings were used to share control logic and control parameter information for each ECU, and as a mechanism for decision-making. At that time, the Product Planning Division has been adjusting and optimizing the whole.

Although this preventive activity has been promoted mainly through system design, confirmation evaluation is also required. The limited conditions within the conventional test course are insufficient, and it is necessary to understand in detail the vehicle behavior in detail in the actual environment. Therefore, we submitted an application for modification of the prototype vehicle and made it possible to drive on public roads. We conducted and confirmed various driving evaluations by ourselves. In the actual driving evaluation of about a year, the mileage exceeded a million km, and total of 750 points of problems that would have been missed in the conventional evaluation and unforeseen system failures were extracted in advance. Improvements and countermeasures were implemented during development.

In addition to the conventional preventive activities, we worked on the application of the control system milestone meeting, examined a new development system and management system, and actually promoted it. It played the role of progress management of the development schedule, and was added for the control system as a standard development process.