

Upgrading Plan for Utilizing of MBD

1. INTRODUCTION

The recent trend in the development for the Electric Control Unit (ECU) of the automotive is in response to the Functional Safety Standard of ISO26262 and is introducing the Model Based Development (MBD). The standard takes the MBD up with a good verifiable development method and many car manufacturers and suppliers are adopting it in their research and development.

The Automotive System & Device Laboratories of Furukawa Electric has been using the MBD for the research area; however has less experience in the software development area. The laboratory is beginning to expand the MBD in more applicable scope.

This topic shows examples of the introduction of the MBD and its difference and its effectiveness when compared to the conventional development method.

2. CHARACTERISTICS

The MBD is a development method using simulation and it has been introduced in the automotive industry recently. The method has been recognized as the technology that contributes to the decrease in the man-hour requirement for developing and to the enhancement of quality.

2.1 Model

The MBD generates a relevant model to combine with the existing functional block and checks its operation on the microcomputer through the simulation. The model is divided into the following two components.

- **A Plant model**

It is the model for the controlled side which is simulated on the physical property and the mechanical property.

- **A Controller model**

It is the model for the controller side which is simulated on the program operated on the microcomputer.



Figure 1 Overview of the model.

2.2 Difference From the Conventional Development Method

Since MBD simulates the controller model in the earlier development stage shown in Figure 2, the development efficiency is expected to improve.

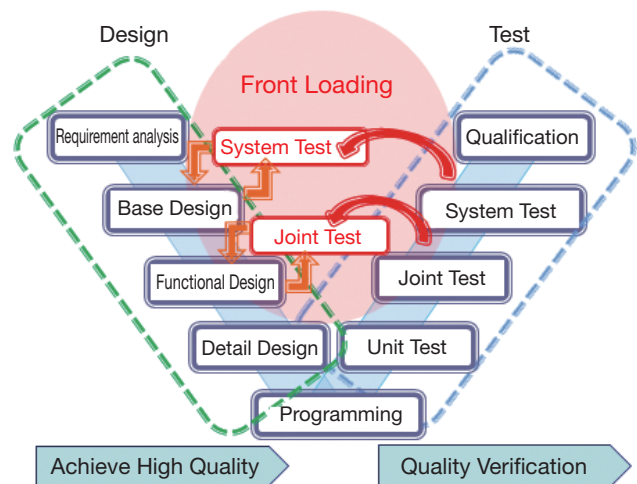


Figure 2 V-model for developing.

2.3 Merit to Introduce the MBD

The MBD has the following advantages.

- **Review of the development specification by the simulation**

The cost reduction and the speeding up the process of the development, because of the decreasing of the numbers of the trial in manufacturing.

- **Front loading**

Since checking of the operation (requirement check and mounting mistake) is achieved in the early stage of development, the hours of production rework will be expected to decrease.

- **Auto code generation of the program**

C-language program is generated automatically from the controller model and the code quality is even between programs.

- **Availability of interactive development of the hardware**

The operation check of the model (program) can be achieved before finalizing the hardware.

- **Communication of language**

In the communication with the overseas affiliated company, it allows to narrow the language gaps.

3. APPROACH FOR THE MBD

The company has been introducing the MBD in the development of an algorithm in the research area and to use the Hardware-in-the-Loop Simulator (HILS) in the development department. However, the conventional software development has the following concerns stated below.

Research Department

- The man-hour of defining the algorithm specification by the algorithm developer is large.
- The change of the software specification is repetitive through trial and error for the algorithm in the upper stream.

Development department

The following improvement is expected through the decreasing of the skill dependency

- Productivity improvement
- Review efficiency improvement

On the other hand, the investment in the MBD has been proceeding to get the improvement of the design process and the software inspection through the simulation, as shown in Table 1.

Table 1 Investment for MBD.

Year	Contents
2006	Introduction of Hardware-In-the-Loop Simulation (HILS)
2010	Development of the tool chain, Partial trial Manufacture
2011	Partial trial Manufacture
2012	Trial manufacture, Development of Guideline

3.1 Trial Manufacture

The trial manufacture was carried out and the capture of the issues/its solution and the validation was completed. The framework of the trial manufacture is shown in Figure 3 and the controller model, the plant model and the Graphical User Interface (GUI) were made. After checking the whole operation on the PC, the auto code generation of C-language program was made from the controller model and was integrated with the driver module composed of C-language, which in turn was installed in the microcomputer and checked the operation, and the generation of the expected program was confirmed.

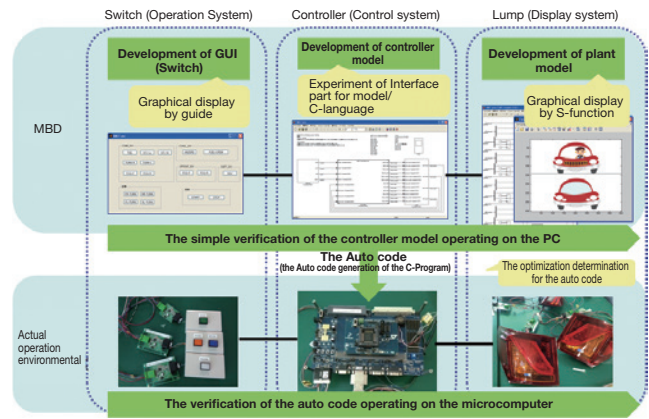


Figure 3 Composition of the trial manufacture.

3.2 Effectiveness

The result of the trial manufacture is shown in Figure 4. The man-hour of the base design, the detail design and the programming process sharply dropped. The result shows that it is more effective at the development of algorithm (Algorithm design, Software design and validity).

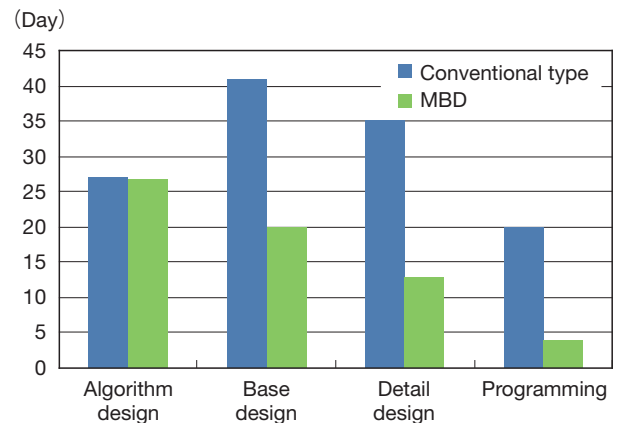


Figure 4 Comparison of the man-hour.

It also demonstrates that MBD is effective on solving the issues of the conventional software development.

- As the interactive development with the hardware is achieved, the risk of the schedule for software development decreases.
- Since the quality is checked in the prior process with the front loading, hours of production rework decrease as shown in Figure 5.
- High verification (Repetition of irregular operation, repetition of test, automatic execution) can be achieved.

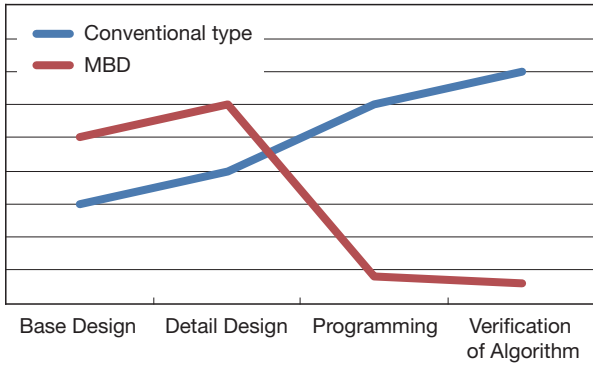


Figure 5 Comparison of bag appearance.

Table 2 Subject in near future.

Process	Upgrading of the standard of the operating procedure
Quality	Version up of the guideline and improving of the review
Productivity	The automation operating

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4. ACTION PLAN IN FUTURE

As increasing of the size and the complexity of the software in vehicle, the improving of the development efficiency and the quality assurance are very important. Furukawa Electric keeps dealing with the above issue and improves the efficiency of the research and development.