

ECU Variant Coding System

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Abstract

Mitsubishi Motors Corporation (MMC) has developed and introduced the new integrated system allowing design, production, and after-sales sections to support Electronic Control Unit (ECU) variant coding, and this system was first installed in the new OUTLANDER. The said system makes it possible to create and manage variant coding data within an existing list system through specifications of model and equipment information; furthermore, this data can be supplied to vehicle assembly lines and after-sales departments without the need for manual input.

Key words: Electronics, Information System, Production Engineering, Service

1. Introduction

In certain cases in the past, ECUs installed into vehicles were assigned different part numbers in accordance with the model or specification of the vehicle in question, even in situations where the electronic control system was identical. However, the differences between these ECUs were limited to slight changes in specifications at the software level, and the resultant setting of individual part numbers generated a large amount of administration expense. Meanwhile, when compared with a little over ten years ago, the number of ECUs installed into vehicles has increased significantly, and these control units are connected via a Controller Area Network (CAN) bus, making it possible for them to communicate with tools outside the vehicle.

Against this backdrop, a technology known as "ECU variant coding" is spreading in the industry, particularly amongst US and European auto makers and ECU manufacturers.

At MMC, we began to adopt the technology related to ECU variant coding with the 2004 European COLT. However, as a large number of variant coding items are required for the new OUTLANDER, the need arose for a full-fledged data management system.

Accordingly, we established the in-house ECU Data Coding System (e-DaCS) project, with design, production, and after-sales cooperating as one in its execution.

In accordance with the realization of this data management system, evaluation of the system and its operation processes was carried out with respect to the following four core issues.

- Capability for seamlessly handling variant coding data through the various stages of design, production, and after-sales operations
- Ability for permitting variant coding data set in an upstream process to be used in downstream

processes without the need for manual editing

- Capability for management and tracing of variant coding data, which is unique to individual vehicles, based on the vehicle identification number (VIN)
- Provision of production and after-sales with the ability to process changes in variant coding data in accordance with design change

This report gives an overview of the technology related to ECU variant coding, and describes the system development and application methods employed at design, production, and after-sales.

2. Overview of ECU variant coding

The term "ECU variant coding" refers to a process where common ECUs, for which initial setting is carried out by the manufacturer thereof, are delivered with a single part number, and are set to appropriate control specification on the vehicle assembly line or by the dealerships based on information classifying the vehicle or equipment specification (i.e., variant coding items).

3. Design application

3.1 Overview

A vast number of variant coding items exist for the new OUTLANDER, and these are managed within a variant-coding data list based on vehicle model, destination, and type. This list is created and managed in accordance with an existing MMC design management system.

Without the need for manual processing, the information defined in the variant-coding data list is delivered to vehicle assembly lines and after-sales departments via the internal LAN established within the company.

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3.2 Converting variant coding data to component lists

Since the list containing the model, destination, and equipment information which forms the basis of variant coding data is managed in accordance with an existing in-house design management system, it is desirable that the variant-coding data list also be managed based on the same system.

For the purpose of management, variant coding data is linked with information specific to the model or vehicle in question, and also with equipment specification information that determines vehicle settings and options for each customer (Fig. 1).

The variant coding data for each individual vehicle is determined uniquely based on this information.

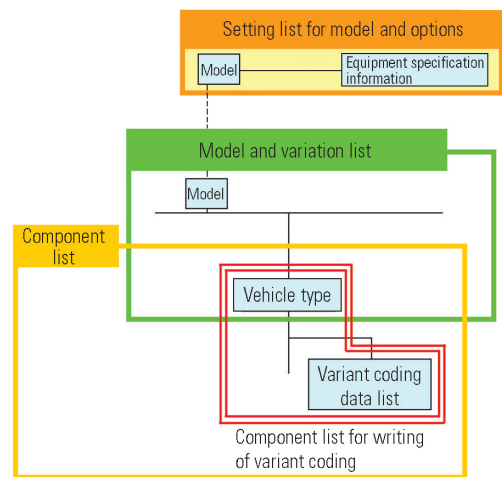


Fig. 1 Interlinking of design data

3.3 Management and administration of variant coding data

As described above, variant coding data is managed in the form of a list and based on an existing design management system; however, relative importance in terms of management is set to the same level as the list that regulates design information for the variant coding ECU. In other words, variant coding data is treated as a component assembled within the vehicle. Accordingly, if a modification or addition is required to be made with respect to the content of the variant coding data list, notification is provided to the relevant departments through the issuance of a design change notice by the design department in question, in the same way as would be done in the case of a so-called “design change”.

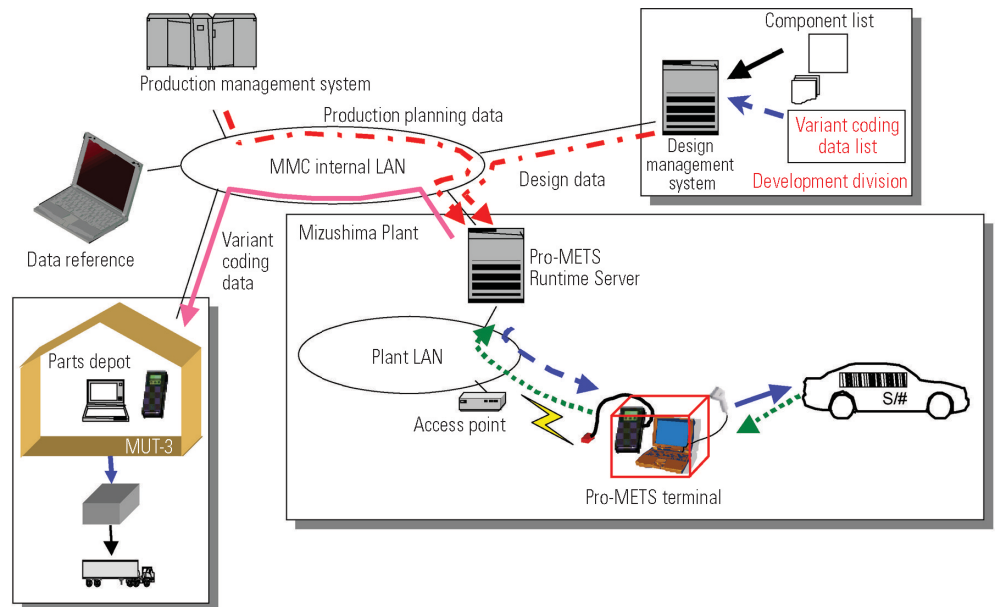


Fig. 2 e-DaCS overview

4. Production application

4.1 Overview

The Pro-METS* Runtime Server (PRS) was newly developed in order to manage the ECU variant coding (Fig. 2).

*Pro-METS: Mitsubishi ECU Test System for Production

The main functions of PRS are as follows:

- Automatic creation of the variant coding data based on the production planning information and design specific information.
- Creation and adoption of the proper variant coding data by using the design change notification with effective date.

- Storage the variant coding data written in the ECU as a historical information by using Pro-METS.

4.2 Creation of variant coding data

Variant coding data based on equipment specification information for each vehicle is created by the PRS on a daily basis from production plan data for each mass-production vehicle, which is managed in accordance with the production management system, and design data, which is created by the design division (Fig. 3).

4.3 Application of design change to mass-production vehicles

In situations where variant coding information is changed, there is a possibility that the corresponding design changes will be applied using design change notification prepared by the design division.

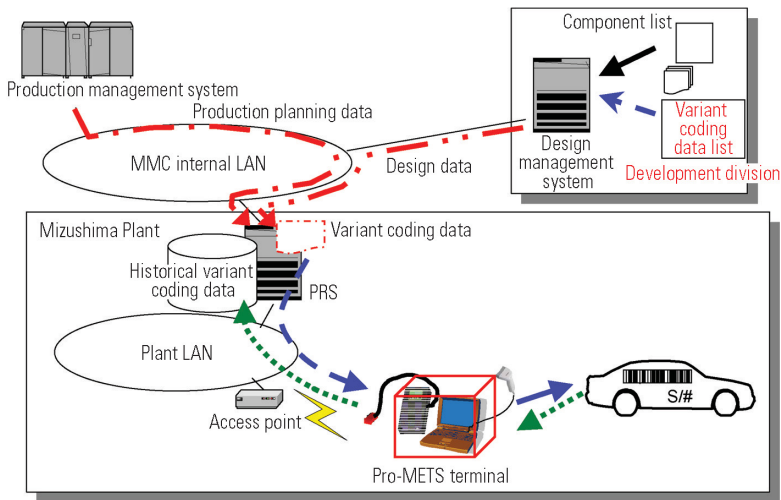


Fig. 3 Variant coding information and flow of data

When design change is being used to update mass-production vehicles, the corresponding model and implementation timing must be specified from the Web screen of an office terminal (Fig. 4).

4.4 Storage of variant coding logs

The diagram of keeping the log data flow is shown as Fig. 5. Variant coding log data from a Pro-METS terminal is forwarded to the PRS via the plant LAN, and this is stored together with design change implementation logs. Furthermore, this log data is reused as writing data when replacing an ECU in the market.

5. After-sales application

5.1 Overview

When performing the replacement of the ECU should be done variant coding at a dealership, it is necessary to install an ECU in which the correct variant coding data for the vehicle in question has been recorded.

Accordingly, the MUT-3 breakdown diagnosis tool has been provided with functionality for the writing of variant coding data. The fundamental concepts of

- Usage of variant coding data, which is downloaded from the PRS, without modification, and
- Implementation of variant coding data with complete correlation with the VIN and the ECU part number were adopted as preconditions during the development of this functionality.

5.2 MUT-3 variant coding process

The method for writing variant coding data using an MUT-3 requires that, first of all, the variant coding data file corresponding to the vehicle in question be downloaded from the PRS using the VIN and the ECU part number as keys, and that it then be written to the MUT-3.

Using the VIN that was input and the part number read from the ECU, the MUT-3 performs a comparison with the VINs and ECU part numbers in the variant coding data file and displays a list of the matching files (Fig. 6).

Next, the data to be actually written to the ECU is extracted from the matching variant coding data file, and a CRC operation is carried out. The results of this CRC operation are compared with CRC operation result data already contained in the data file, and if they match, actual writing of data to the ECU takes place.

Finally, the content read from the variant coding data file (b) and the content read from the data written in the ECU (a) are dis-

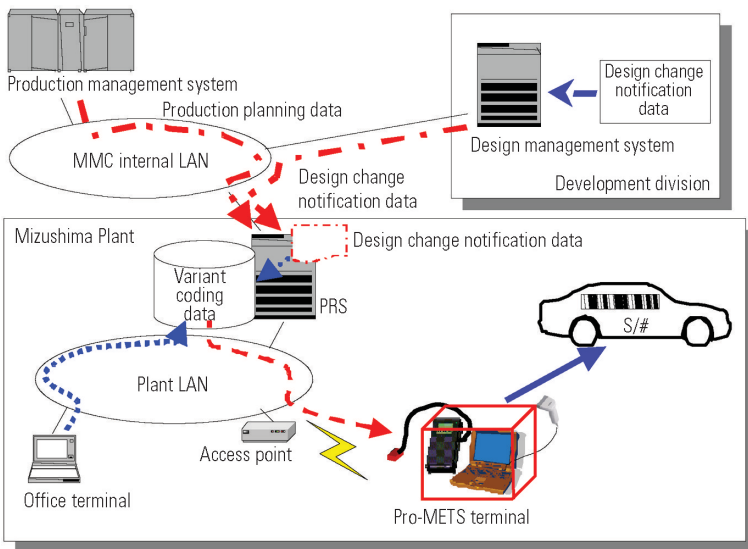


Fig. 4 Support for design changes

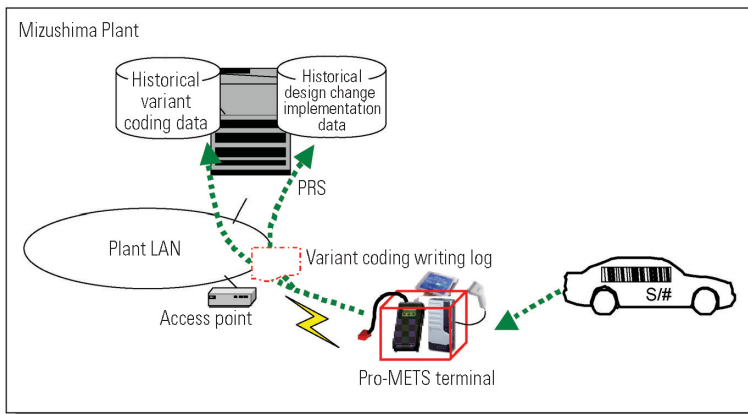


Fig. 5 Flow of data during the recording of logs

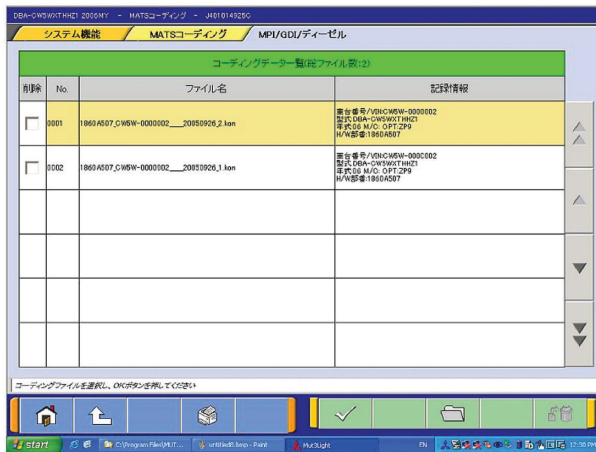


Fig. 6 Searching variant coding data

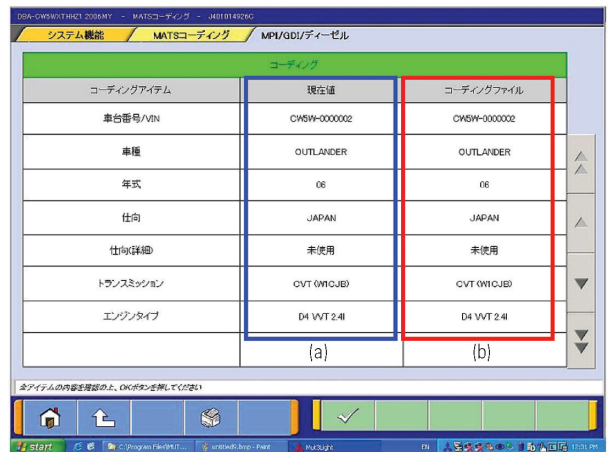


Fig. 7 Data verification

played simultaneously in order to allow visual confirmation of the match between them (Fig. 7).

5.3 Issues to be addressed

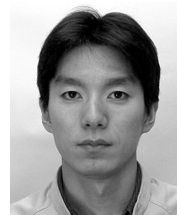
At the domestic startup of the new OUTLANDER, support for the replacement of the ECU should be done variant coding at dealerships has been provided by writing of variant coding data using an MUT-3 at the Spare Parts Supply Division, and by then sending the fully-written ECU to the dealerships in question.

Although this process will be employed for the present, a study is currently underway to evaluate the feasibility of having the writing of variant coding data performed at domestic and overseas dealerships as soon as possible.

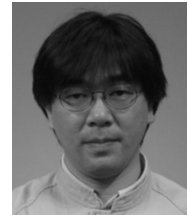
6. Conclusion

In order to provide support for the writing of variant coding data to ECUs, an integrated system for development, production, and after-sales servicing was developed and implemented. In this way, it has been possible to limit the amount of ECU part numbers and reduce the associated administration costs.

To conclude, we would like to express our heartfelt thanks to all who contributed to the development of this system.



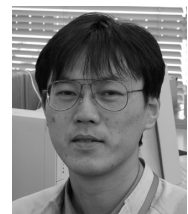
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