Accurate Traceability of Key Auto Parts in China Automobile Factory

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Abstract- Based on barcode specification and quality error prevention, the manufacturing plant controls traceability information of logistics distribution, automobile assembly and quality inspection, and realizes accurate traceability of key parts of the vehicle. This thesis discusses how to realize the KPC of key parts and the quality traceability of production and assembly process when quality defects occur in a company.

1. Introduction
On October 1, 2004, China promulgated the "Regulations on the recall of defective vehicles", which declared that the biggest challenge faced by automobile manufacturers in the 21st century would be the rising cost caused by poor quality, which may bring serious market and legal problems. This marks the recall of defective products and has become the basic requirement for enterprises. Therefore, in the mass production environment, quality assurance has become an increasingly arduous task. But at present, many factories in the automobile industry rely on manual quality management. Once the quality recall occurs, the workload of traceability is very heavy. Moreover, the traceability of key parts in the production process completely depends on the quality information statistics of suppliers, and the workload can not be underestimated.

The systematic quality traceability system runs through the whole process of vehicle production. It not only meets the production requirements, but also improves the quality level of various models and meet the quality traceability of key parts of the whole vehicle.

2. Product traceability management

2.1. Definition of traceability
ISO 9000-2000 "quality management systems - Fundamentals and terminology" stipulates that "traceability" is the ability to trace the history, application or location of the object under consideration. It can provide a reliable basis for enterprises to implement the quality responsibility system, analyze and find out the potential defects of product quality, and control and adjust the technical instability factors, human factors or management factors that cause the defects, so as to continuously improve the product quality.

Quality traceability refers to finding out the root cause of the failure and the relevant defective parts for the same type of automobile products, tracking their original status, production process and usage through barcode, and tracing all the original parts that constitute or process into the defective parts.

Accurate traceability refers to accurately tracing the part template to the manufacturing factory,
identifying vehicle models according to different platform projects. The traceability information includes KPC / PQC of key parts, sor timing of parts, corresponding barcode type of parts and scanning position, etc. The following table briefly explains the parts list in the parts template accurately traced to the manufacturing factory. It is mainly divided into six systems: engine assembly, transmission assembly, engine control and diagnosis system, chassis, interior decoration and vehicle electrical appliances. Key parts are identified and tracked according to these six systems.

Table 1. Traceability summary

| SYSTEM                | PART NUMBER | SMT Power Generation | Transmission | Powertrain Control & Diagnostics | Chassis | Interior | Elec |
|-----------------------|-------------|----------------------|--------------|---------------------------------|---------|----------|------|
| Engine                | 4           | Automatic Transmission | 7            | Engine Management               | chassis | interior | elec |
| Manual Transmission   | 4           | Powertrain Control & Diagnostics | 11          | Transmission Management         |         |          |      |
|                      |             | Specialty Powertrain Control | 27          |                                 |         |          |      |
|                      |             |                      |              |                                 |         |          |      |
|                      |             |                      |              |                                 |         |          |      |

Figure 1. Number of parts accurately traced to each module

2.2. Product traceability management process
The manufacturing factory sets up a working group for accurate traceability of parts template, which is composed of relevant personnel from quality department, structural engineering department, purchasing department, it department and manufacturing department (General Assembly Workshop). It formulates and approves the precise traceability part template of manufacturing factory products, and approves the increase and decrease of precise traceability parts of specific vehicle models. The product engineering department is responsible for issuing engineering and technical documents related to product traceability Parts (specify bar code identification requirements, paste position, etc. in GPDS, drawings and / or SOR), and reflect them in the accurate traceability part template of the manufacturing plant, and then issue the first draft to the accurate traceability team to check whether it conforms to the existing vehicle model; after the audit, PE will release the first draft of the accurate traceability parts list to the downstream departments, including logistics, purchasing, information and general assembly departments. General assembly and logistics plan the site process and equipment selection point according to the accurate traceability list, fill in the accurate traceability part template and deliver it to the information department. The information department is responsible for the formulation, release, maintenance and update of bar code specifications, and assist the manufacturing department in the implementation of barcode scanning related work (equipment procurement, selection, wiring, commissioning, maintenance). In addition, the
procurement department shall implement the traceability related technical documents issued by the suppliers and incorporate them into the supplier quality monitoring system, and be responsible for monitoring the supplier scanning work.

At present, a company has released the first draft of accurate parts traceability list for a certain vehicle project, scanning a total of 17 parts assemblies and 34 first-class parts; at the same time, the general assembly and logistics have completed the preliminary planning of scanning information points, and are currently in the information department's information wiring planning of scanning points.

Table 2. Precise parts traceability list of a certain vehicle model

| SMT              | System                  | VPPS  | UPC | FNA     | Part Name                      |
|------------------|-------------------------|-------|-----|---------|--------------------------------|
| Power Generation | Engine                  | 10.01.01 | 6   | 0047A   | ENGINE ASM                    |
| Power Transmission | Automatic Transmission | 10.02.01.11 | 7   | 0326D   | TRANSAXLE ASM-AUTO             |
|                  | Manual Transmission     | 10.02.01.11 | 7   | 0100A   | TRANSAXLE ASM-MAN              |
| Powertrain Control&Diagnistics | Engine Management | 10.03.01 | 12F | 0500B   | ECM                            |
|                  | Suspension              | 20.02.01 | 4D  | 7818A   | MAIN welded Axle on Non-driven Axies |
|                  | Suspension              | 20.02.02 | 3F  | 0625A   | Struts shocks                  |
|                  | Suspension              | 20.02.02 | 4E  | 2695A   | Struts shocks                  |
| Chassis          | 40.07.01                | 1A2R   | 0060A | Driver Air Bag Module     |
|                  | 40.07.02                | 1A2R   | 0087A | Passenger Air Bag Module   |
|                  | 40.07.03                | 1A2R   | X0040 | Side and RoofRail Air Bags Module |
| Interior         | 70.02.03.01             | 1A2R   | 0054A | Ignition Switch              |
|                  | 80.01.01.01             | 1A2R   | 0345A | Control Unit(SDM)            |
|                  | 861.07                  | 12H    | 5550A | IP Main Harness              |
|                  | 861.01                  | 12H    | 1510A | Bodyhamess                    |
|                  | 80.01.01.02             | 1A2R   | 0115A | ImpactSensor                  |
| Program newadded trace part | 20.02.01 | 3      | X0007 | FRONT HORIZONTAL SUSPENSION-HEAD ASM NUMBER |
|                  | 20.02.02.04             | 4E     | 2700A | STRUCT ASM-RR SUSp           |

3. Process quality control of vehicle product traceability system in automobile factory

The process quality control of vehicle product traceability system in manufacturing factory is mainly divided into two stages. One stage is to check whether the optional model of the parts matches the vehicle model through scanning the online part label in the whole vehicle production process, so as to achieve the function of error proofing. The other stage is the detection of defective products. For the traceability of automobile defective products, the production process of defective products can be effectively traced through the accurate traceability system. Even the manufacturing process of defective parts can be traced back.

3.1. Part traceability bar code management

Accurate traceability assembly products require a unique identification label, and the label bar code
must meet the factory requirements (gm1737 / smw15862). Through the assembly barcode label, it is necessary to trace the production batch number of secondary parts, otherwise, reverse traceability can also be achieved; for part traceability, it needs to correspond with the product KPC one by one.

Figure 2. Bar code specification of a certain car factory

Except that the supplier code is determined by the purchasing department of the manufacturing factory, the barcode data is provided by the engineering department. The traceability number data is generally determined according to the production date and serial number of the parts on the same day. The data of "part identification code", "part number" and "supplier code" in the barcode are determined by the manufacturer. And the traceability information must be composed of 7 fixed codes and 8-9 additional positions at most. The seven fixed codes must be composed of two letters as the component identifier, four part numbers (less than four digits must be supplemented with spaces, the last four digits for parts with more than four digits, and the factory standard can be used for powertrain parts) and one supplier code. It is required that multiple suppliers (including historical ones) supplied by the same part must have different supplier codes. The traceability number in the table above is 8-9 positions for serial number, date of manufacture or any data transformation or combination code that any supplier considers necessary for efficient traceability of parts.

Figure 3. Bar code specification in a certain standard
3.2. Implementation method of batch traceability

The supplier shall guarantee that the final products delivered from the factory shall be marked with the production batch number (year, month and day of production, including shift number or sequence number); the supplier logistics and manufacturing factory logistics shall ensure that the raw material production, warehouse storage and transportation, and final product delivery shall be implemented in a first in first out manner. Meanwhile, the delivery record of finished products shall be made to ensure that the material rack number of the manufacturing plant corresponds to the production batch number one by one. It is required that, through batch traceability, the minimum traceability can be traced to the KPC specified in the manufacturing plant drawings.

Because the batch traceability is based on the production batch number, and the production batch number corresponds to the material rack number of the manufacturing plant, the batch traceability can be carried out by using the material rack traceability as the medium. There are three levels of material rack traceability. Level-1 is the supplier's internal binding of quality information and material rack barcode, and all recording work is the responsibility of the supplier; level-2 supplier manually inputs the quality information and corresponding material rack barcode into the factory portal website for preservation; level-3 supplier binds the quality information and material rack information through the quality bar code system, and uploads the quality barcode to the factory portal Station preservation.

3.3. Realization of batch information tracing and matching

The traceability process of automobile defective products includes two stages: one is reverse tracing, in which the vehicle manufacturer queries the traceability of all production vehicles matched with the batch of defective parts through the system; the other is forward tracing, in which the part manufacturer traces the production related information related to the defect causes of the batch of products.

4. Requirements for accurate traceability review

The traceability of defective automobile products is an inevitable requirement for error proofing and product defect control in vehicle manufacturing process. The vehicle manufacturer shall incorporate the traceability review into the layered audit, and continuously improve the missed scanning, wrong scanning and repeated scanning, so as to ensure that the factory can start the quality traceability work in time when the product defects occur, and ensure the traceability effect and efficiency.

4.1. Supplier traceability review

According to the previous traceability audit results, the accurate traceability team found the following problems in the supplier parts traceability work: 1. The product accurate traceability barcode does not conform to the manufacturing factory specification, especially the two-dimensional code does not meet the factory standard; 2. Some accurate traceability suppliers have only one sequence of accurate traceability barcodes, and the product key KPC and corresponding two or three cannot be traced through the assembly barcode Third, most of the suppliers lack of traceability procedure documents and hierarchical audit plans related to traceability; fourth, the traceability and error proofing system of VAA suppliers needs to be improved.

4.2. Manufacturing factory traceability review

At the same time, the accurate traceability team also reviewed the factory product traceability work, and the review results are as follows: 1. For KPC / KCC traceability, the manufacturing factory can trace the KPC corresponding to each assembly barcode through the system database, reaching the advanced level in the industry; 2. For the traceability of key level II and III parts, the manufacturing factory manually records the batch information and change points of parts, which basically meets the business requirements 3. Assembly parts traceability. The manufacturing factory independently developed the material rack traceability system of the manufacturing factory to ensure the efficiency and effect of batch traceability and reach the advanced level in the industry.
5. **Accurately trace the future development direction of the work**

5.1. *Tracing the development direction of quality accurately*

In the previous bar code specification, only the factory information and batch information of parts are standardized, and there is no specific bar code specification quality information. In order to strengthen the pertinence of defect parts traceability of vehicle products, the future development direction of quality traceability will be to add quality information in the first traceability barcode. Quality information is composed of quality basic code and quality extension code. Quality information is mainly used to identify breakpoints or differences of parts except part number and Duns of suppliers, so as to facilitate better traceability management of supply chain.

The quality basic code segment has 25 digits, and the quality extended code segment has 17 digits. The first three digits are the production batch information of the parts, and the key five digits are the date of the part's appearance. The following nine digits are the same as the definition of traceability number in the standard.

5.2. *Future development direction of traceability in manufacturing plant*

According to the above review results, the development direction of factory traceability work has three aspects: 1. Reduce the error rate of suppliers, and the accurate traceability of suppliers shall be approved by DRE; 2. The readability test of barcode shall be added to ensure the readability of barcode; 3. As the delivery of PPAP valve opening, accurate traceability shall be unified in the delivery format of traceability work.

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