

Paper 090-2013

Using the Power of SAS® to Analyze and Solve Quality Problems at Shanghai General Motors

Yu Zhang, Ying Wang, Shaozong Jiang, Yahua Li, Jiawen Zhang,
Nanxiang Gao, Jian Li, Minghua Pan, Shanghai General Motors Corporation

ABSTRACT

Data to assist in solving quality problems is of enormous value to quality departments in the automotive industry, including that of Shanghai General Motors (SGM). However, millions of claims records, tens of thousands of solving reports, dozens of language descriptions, and heterogeneous regional code present great difficulty for dataflow and knowledge management. This paper explores SGM's information system, known as Problem Solving Analysis (PSA), which uses several foundation tools of SAS®, such as Base SAS®, SAS/CONNECT®, and SAS/ACCESS®, to solve business problems faster, and which has used advanced SAS® Enterprise Content Categorization to establish 26,000 text rules for word recognition and accurate classification. PSA incorporates effective data infrastructure building, report linking, fast information searches, and diagnosis and forecasting of enterprise problems.

INTRODUCTION

Shanghai General Motors (SGM) is the largest passenger car manufacturer in China, ranking third in terms of Chinese market share. We are proud of our position as the industry leader for warranty best practices and live up to outperform other automobile industrial giants.

After introducing SAS Warranty Analysis used to achieve early detection, we still face a great challenge:

First, Information silo Different teams in SGM quality department have their own function code or query language to describe the same type of quality problems. Different area code is difficult to unity, which brings a big trouble for multi-department information workflow, so we need to establish a standardized classification method to unify department language.

Second, we need a text analysis tool. The tool can be used in writing rules to automatically extract keywords, topics, field section from dozens of problem solving reports, and categorize content, put effective things in the right category done by first step.

Third, we need an information platform to provide interface to maintain and follow up the quality problem, in which it can also provide effective problem query and statistical reporting input/output, Data visualization. This platform gradually forms a semantic knowledge library of quality problem, finally can help engineers' position quality problem and inquire the list of previous record.

HOW WE USE THE POWER OF SAS TO SOLVE PROBLEMS

THE FIRST STEP—REASONABLE CLASSIFICATION SYSTEM AND CATEGORIES.

The automobile industrial quality problem solving report often appears such words: fault time, fault frequency, fault environment and so on. According to the surface of the discovery in the report, quality engineers are needed to track the crux of the matter, which is probably caused by parts or production link problem. In the long run, when quality engineers know the root causes of the problem, they will prevent similar problems. From the view of system classification, all quality problems can be divided into two dimensions, which are "failure representation" and "failure root cause"

Building the classification system is just the beginning. The most difficult step for transformation from problem solving report to knowledge depends on the segmentation of "failure representation" and "root cause". The project group has gathered experienced senior engineers in each team, who consider tens of thousands of historical quality problem solving cases, current business functional coding standards and Automotive quality standard. They have established the basic logic classification categories after the daily 5-hour-work for 6 weeks.

The figure 1 shows the reasonable classification system and categories. The classification system contains "failure representation" and "failure root cause". Eventually, "failure representation" is divided into two layers, the first level 35 class, second 1088 class hierarchy, while "failure root cause" is divided into four layers, SMT 11 class, BOMROW 129 class, third parts 611 class, fourth detailed causes 9525 kinds class hierarchy.

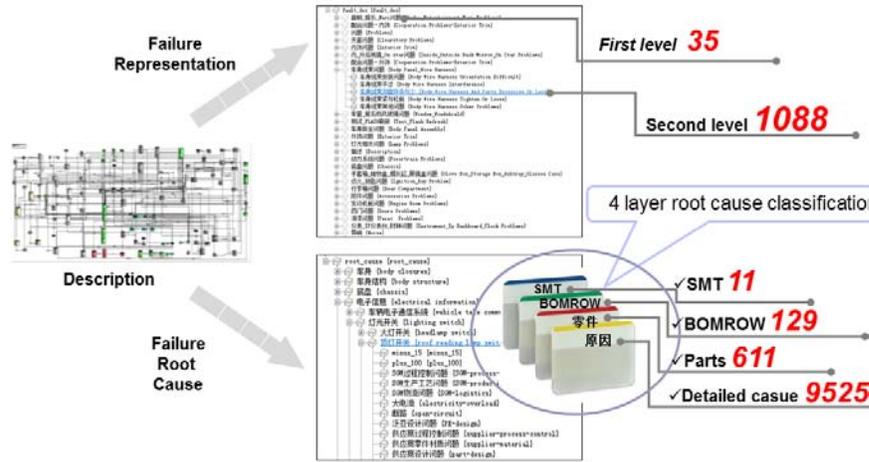


Figure 1. Reasonable classification system and categories

THE SECOND STEP- BUILD RULES USING THE ADVANCED SAS® ENTERPRISE CONTENT CATEGORIZATION SOLUTION.

SAS® Enterprise Content Categorization solution is one of the world's leading information management system solutions for text analysis, mining and accurate classification. Specifically, the second step uses SAS® Enterprise Content Categorization solution, which has statistical text analysis tools, lexicon and concept technology, to write over twenty-six thousand rules text (Shown in Figure 2) , which can identify the historical verbal description about quality problem solving, finally classify issues into the respective categories of “failure representation” and “failure root cause” systems.

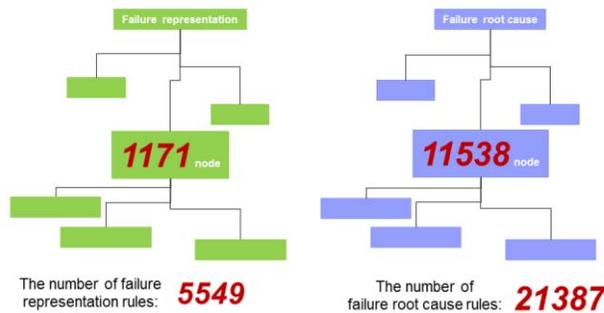


Figure 2. Number of rules

The Utility of SAS® ECC

1. Recommendation of classification system and categories



根本原因: (Root cause)

角总成设计较敏感, 制动片批次间的差异导致异响。
The design of Knuckle ASM is too sensitive to cover the difference of production batch.

短期措施: (S/T)

长期措施前的每个批次制动片上线前必须经过台架和路试验证。
BP: 2008-11-20
Every batch of brake pad must get validation by bench test and driving test.

长期措施: (L/T)

1、供应商加强工艺控制来避免制动片摩擦层和底层出现裂纹。
Supplier TMD enhance to control technology to avoid the cracks on the pads.
TMD BP : 2009-1-16 SGM BP: 2009-4-10
2、工程更改摩擦片倒角和消音片。

QUEEN PSA
QUALITY EXCELLENCE ENGINE

层次0 (Class 0)	层次1 (Class 1)	层次2 (Class 2)	层次3 (Class 3)
<input type="checkbox"/> chassis-底盘	front brake corner-前制动角	brake pad-制动片	
<input checked="" type="checkbox"/> chassis-底盘	front brake corner-前制动角	brake pad-制动片	part-design-供应商设计问题
<input type="checkbox"/> chassis-底盘	front brake corner-前制动角	brake pad-制动片	supplier-production-processes-供应商生产工艺问题

确定 取消

Press "Yes"

SMT: chassis-底盘

Bomrow: front brake corner-前制动角

Part: brake pad-制动片

故障原因: 供应商设计问题

SMT: chassis-底盘

Bomrow: front brake corner-前制动角

Part: brake pad-制动片

故障原因: 供应商生产工艺问题

Figure 3. Sample Root Cause Representation

2. Intelligent search

Intelligent Search is one of the heavy fruit in PSA. Based on the reasonable classification system and categories, intelligent search rules were built, which will make users more efficient to lock one issue. Figure.4 presents intelligent search demo. We can easily find every issue can be divided into four categories: Failure sort, Failure Cause, Origination and Vehicle Model. From left to right, describe for issue will be more and more in detail. Each client exploring text will fast match one of rules, then the related information will be provided for clients to solve issues at once.

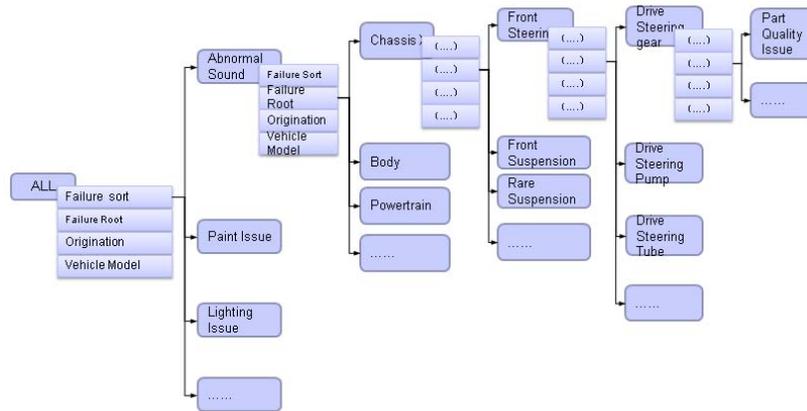


Figure 4. Intelligent search

3. PSA Rule Matching Rate

To verify the rule validity, statistical data matching rate of rule is presented in Figure 5. For failure phenomenon, accuracy rate reaches to 97.7% (including one-to-many matching) while rate to 98% for failure cause (accurate to part layer).

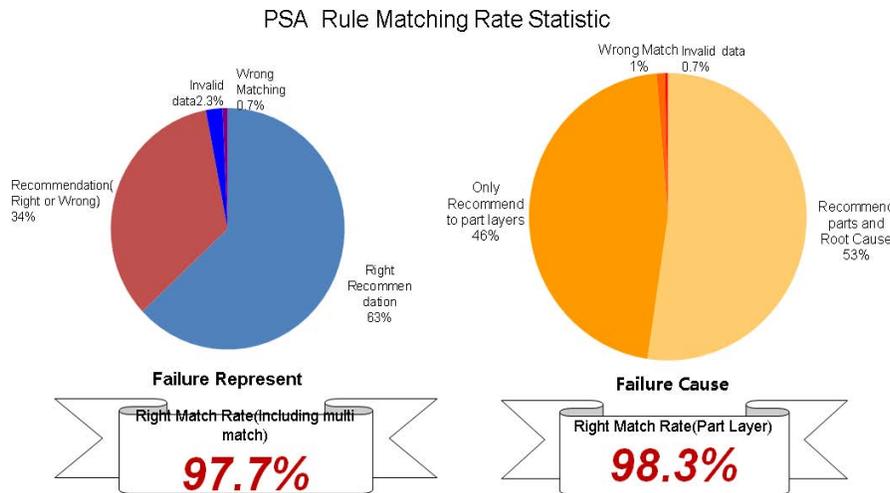


Figure.5 Rule Matching Rate

The text rules also can reuse in other quality language application domain, such as call center, warranty and ve rbatim. The rule is used in classifying network data according to issue phenomenon, the accurate matching rate of which reaches to 73.5%. The accuracy will increase after improving rules of network language.

THE THIRD STEP– AN INFORMATION SYSTEM PLATFORM

Using SAS Content Category as core, PSA build three layer information system platform based on network. As shown in figure 6, Blue stands for SAS server layer, yellow for Web server layer and white for Client/Admin layer. Physical Implementation will classify different layers in different box or combine them together.

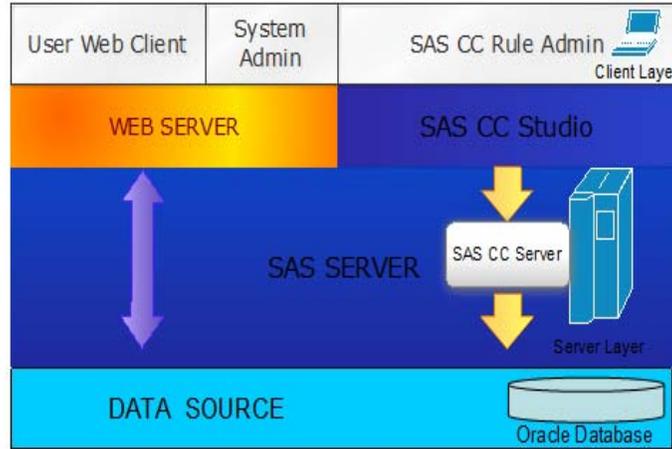
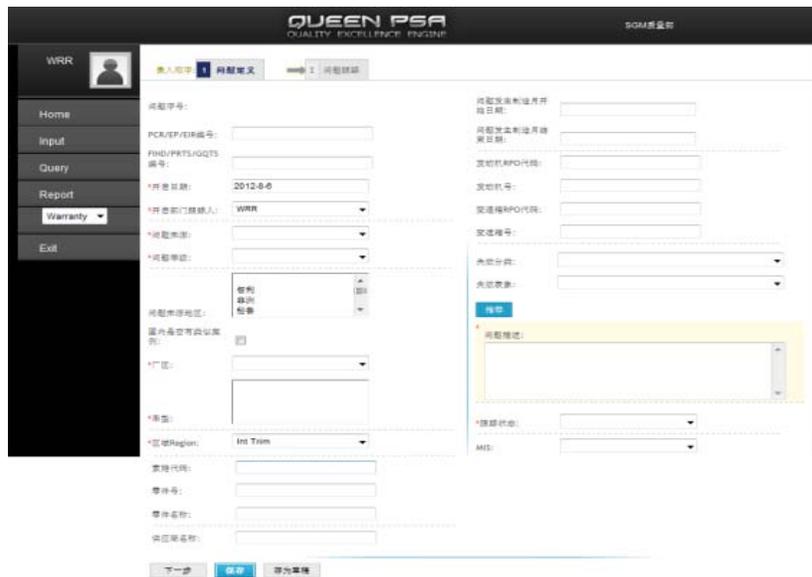


Figure.6 Logic Architecture

SAS Server layer concludes server function of the core calculation, which is required by the solution. Each core model, such as base SAS, SAS Connect, SAS CC Server and SAS Data Set, can be deployed on the same server, user can send analytic request from the network. Data, originating from QD problem solving report record and network public opinion data, is extracted, transformed and loaded, then provided to SAS data base.

Web server layer is the link during system data and Admin/Client. During the extensible application, user can access SAS web application through server Web Logic, such as quality list input interface (Display 1) and query interface (Display 2).



Display 1. Input interface



Display 2. Query Interface

PSA system terminal is user. Main users are shown as Figure 7. They need to adopt interactive method to explore problems and find out reasons.

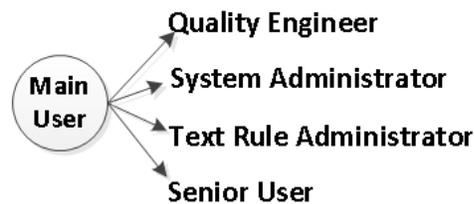


Figure 7. Main Users

THE FUTURE

The building for PSA in this phase is the foundation of the future SGM Enterprise Knowledge Base, which will provide rich reused rules to quality engineers and fully satisfy requirement for future sustained growth. The future developing prospect can be clearly seen from the following aspects.

1. Support issue diagnosis and vehicle model design
2. Embryo as SGM enterprise knowledge base: Introduce more text source, and build SGM QD quality text analytic platform, Ensure technical architecture for SGM text mining orientation..
3. Analyze and integrate with structured data, then create quality intelligent analytic platform.

CONCLUSION

On the one hand, PSA keep three layers architecture web application, allow user to link so many reports, fast define new issue and provide information platform. On the another hand, the integration between category method and vehicle major vocabulary helps to lock issue faster and improve issue analysis accuracy. As for different user, we set different permission to meet their business requirement.

On the whole, the feedback from the multi-department user is positive. With use further deeper, PSA will be more and more excellent.

CONTACT INFORMATION

Your comments and questions are valued and encouraged. Contact the author at:

Name: Nanxiang Gao
Enterprise: Shanghai General Motors Corporation
Address: 1500 Shen Jiang Road, Jin Qiao, Pu Dong
City, State ZIP: Shanghai, 201206
E-mail: nanxiang_gao@shanghaigm.com

Name: Ranran Tu
Enterprise: Shanghai General Motors Corporation
Address: 1500 Shen Jiang Road, Jin Qiao, Pu Dong
City, State ZIP: Shanghai, 201206
E-mail: ranran_tu@shanghaigm.com

SAS and all other SAS Institute Inc. product or service names are registered trademarks or trademarks of SAS Institute Inc. in the USA and other countries. ® indicates USA registration.

Other brand and product names are trademarks of their respective companies.