

Development of the Rolling Technology Development Platform at China Steel

YEN-TING CHEN, YEN-LIANG YEH and MING-FA CHEN

*Iron & Steel Research & Development Department
China Steel Corporation*

The rolling production lines in the steel industry have been rapidly updated and expanded in recent years in order to improve production capacity. To efficiently solve process problems of each production line within a limited time, a rolling technology development platform was developed by China Steel (CSC). To provide full and complete information for the basis of rolling technology development, the platform performed real-time data unification of various data sources into the single database, which can be easily managed by a developed utility reducing excessive manual database manipulation due to frequent update of data variables. The data related to various process issues can be easily accessed through the proposed integrated information query interface for developing the process model. To efficiently develop and deploy as process analysis applications to each production line, the template-based application development framework was purposed by simple software component replacement. As a result, several successful applications were achieved in this platform and the product quality at CSC was significantly improved.

Keywords: Rolling technology, Template-based application development framework

1. INTRODUCTION

Under the pressure of severe market competition and the rapid update and expansion of the production line in recent years, quality improvement is constantly being pursued. To confirm that the quality level meets the requirement, various monitoring sensors and inspecting systems were developed and installed. To discover the bottlenecks of quality improvement as much as possible, process information and a handy managing platform is eagerly anticipated. For the purposes of efficiently solving process problems and improving data analysis skill within a limited time, a rolling technology development platform was developed by CSC.

The platform performed data unification to convert diverse data sources of the production line related to the process issues into the database along with an easy-to-manage utility to reduce excessive database manipulations. An Integrated information query interface is then provided for the experienced domain analyzers to easily retrieve the required data for developing the desired process model of various process issues. To efficiently develop and deploy web-based process analysis applications between each production line at CSC, a template-based development framework is applied so that the applications can be built up by simply software component replacement.

This paper describes recent development of this platform and successful applications.

2. SYSTEM ARCHITECTURE

In order to build up a platform with the capability of gathering sufficient information and allowing several simultaneous queries, the current widely used web-based style platform which consists of a database server and web server was adopted. The platform unified the data from the inspection system and mill computer through intranet by applying corresponding data transfer interfaces and stores the data organizationally in the database. An integrated information query interface allows process model developers to easily retrieve the required data from the database by choosing the desired variables and condition filters. A template-based application development framework is applied for the software team to accelerate developing the process model to web-based process analysis applications and deploying these applications between each production line at CSC. With the intelligence of experienced domain experts, numerous applications were developed. As a result, several cross-company and cross-system process analysis issues become feasible, and the analytical skills are upgraded to a higher level by using these applications. Figure 1 shows the system architecture.

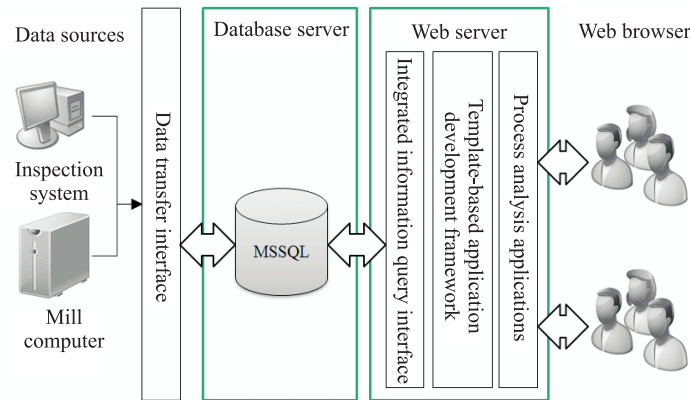


Fig.1. Architecture of the rolling technology development platform.

3. SYSTEM FEATURES

There are several elementary parts to support the wealth of information, efficient query of ,and fast development features of the rolling technology development platform, such as data unification, easy-to-manage database, integrated information query interface and template-based application development framework. They will be introduced in detail as follows:

3.1 Data unification

Since the platform covers various data sources with different data formats, for easy data query with a single type of search command, data unification is performed. As the data transferring program detects a block of data outputted by the mill computers or the inspection systems in the production line, the program will check the data format to apply the corresponding data conversion module. To decompose and store the excessive data into the database in real-time, the multithreading feature was implemented in the program to execute several conversion tasks in parallel⁽¹⁾. The corresponding flow chart of the data unification is shown in Fig.2.

3.2 Easy-to-manage database

This platform uses a Microsoft SQL Server⁽²⁾ as the database engine since it provides the advantages of convenient and fast data access. However, due to the need to determine the key factors of the process problem, it is essential to collect the related data as much as possible, which results in a frequent update of the data structure as well as the database table structure. To reduce the maintenance effort, as shown in Fig.3, a utility was developed so that the users just modify a common table-formatted file describing the data

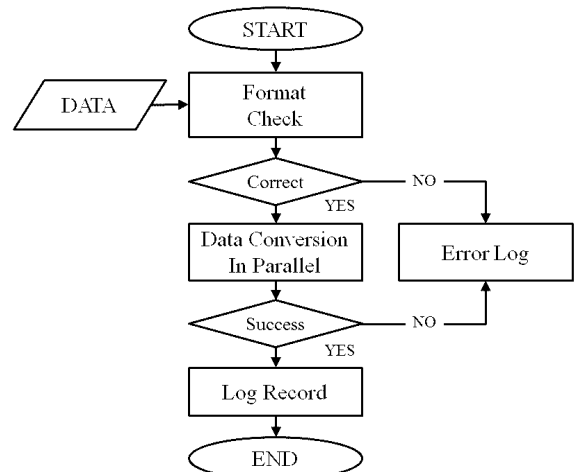


Fig.2. Flow chart of data unification.

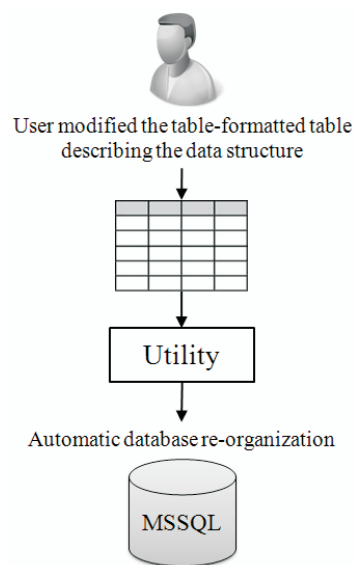


Fig.3. Flow chart of easy-to-manage database.

structure and the utility would automatically reorganize the database according to the change of the file structure.

3.3 Integrated information query interface

To standardize the way accessing the desired data aimed at various process issues, the integrated information query interface is developed. This interface works in a web service style, which supports keyword and additional condition filter feature as input parameters to pick desired data variables and coils. Finally, the raw data consisting of desired data variables corresponding to the selected coils can be outputted as file or stream of standard format for further analysis. The corresponding flow chart of the integrated information query interface is shown in Fig.4.

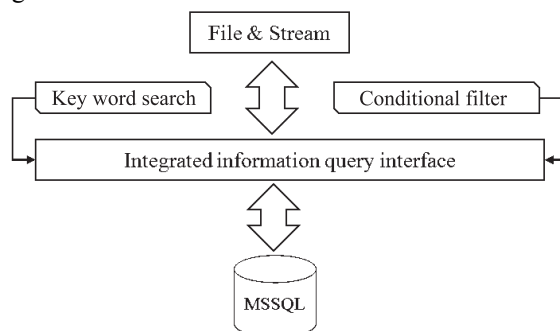


Fig.4. Flow chart of integrated information query interface.

3.4 Template-based application development framework

To efficiently develop and deploy the process model as a web-based process analysis application between each product line at CSC Group for knowledge sharing purposes, an application development framework based on the concept of component replacement is purposed. With this framework, the process model can be packaged as a web-compatible software component which can be directly embedded as a web chart template coded in popular NET language⁽³⁾. By simply replacing the component in the template, the application can be easily established or updated so as to reduce the programming efforts significantly. The corresponding flow chart of the purposed framework is shown in Fig.5.

4. SYSTEM APPLICATIONS

The rolling technology development platform is an important tool for process analysis and problem-solving. Several successful applications were achieved by using the developed analysis applications in this platform, such as key factors in the identification of process issues, process improvements evaluation via

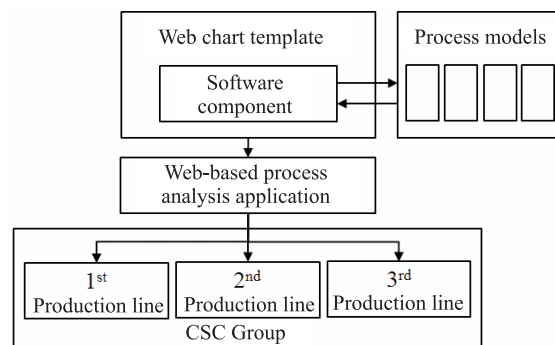


Fig.5. Flow chart of template-based application development framework.

batched automatic calculation, determination of the applicable range of the process models by statistical report, evaluation of the health of the rolling mill, identification of the possible damage by observing the historical trend of mill modulus, observation of the behavior of the strip segment among different stands and the response of the equipment, better understanding of the accuracy of the long-term rolling force settings and the primary cause of the setup error, process model optimization according to simulation results corresponding to parameter optimization, seamless experience and knowledge sharing between each production line at CSC.

4. CONCLUSION

The development of the rolling technology development platform at CSC has several features such as data unification, easy-to-manage database, integrated query interface and template-based application development framework, which allowed domain experts to easily access full and complete information to develop process models and construct web-based analysis applications more efficiently. A number of successful applications such as process model optimization, process diagnosis, process improvement evaluation, key factors identification and domain knowledge sharing between each production line were achieved by using this platform. This platform not only improved the overall operating efficiency but also increases the process analysis capabilities. As a result, the product quality at CSC was greatly improved.

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