Research on the service topic of intelligent electricity meters' full life cycle quality cloud service platform

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Abstract. The whole life cycle management of intelligent electricity meters is dependent on the construction of "Internet +". This paper introduces the design concept and method of the intelligent electricity meter quality in whole life cycle cloud service platform, the application of scenario planning principles is proposed based on the cloud service platform. This paper analyzes the regulatory agencies, power companies, production enterprises and the public’s present situation and the pain points in whole life cycle of the intelligent electricity meter management, and researches the present situation and the spot application scenarios according to the principle of planning design, including the design idea and implementation framework of the application scenarios, laying the foundation for the construction of cloud service platform. It provides a new direction and method for the whole life cycle management of intelligent electricity meters.

1. INTRODUCTION

With the improvement of state grid technical standards and verification methods, and the continuous improvement of r&d and manufacturing level of domestic intelligent electricity meters, the quality of domestic meters has made a qualitative leap. In the international medium and low-end markets (such as the African market, southeast Asian market) Chinese intelligent electricity meters account for a very high proportion, establish a good reputation. However, there is still a big gap between China and international developed countries (such as European countries) in high-end market and high-end product competition [1]. Therefore, it is necessary to establish a cloud service platform for the full life cycle management of intelligent electricity meters. Through the establishment of this platform, the overall quality of domestic meters can be improved, the r&d and production of high-end products can be accelerated, and the international high-end market can be explored, so that the technology and quality of domestic meters can be ranked in the forefront of the international meters industry.

At present, for the quality control and management of intelligent electricity meter, the production enterprises establish the corresponding information system, such as production enterprise's manufacturing execution system (MES), product life-cycle management (PLM) system, enterprise planning system (ERP), and the power companies establish the corresponding information system, such as power companies platform for the production scheduling system (MDS), electricity information
collection system, marketing system (SG186), etc. These systems use the Internet of things, big data and other technologies to provide effective means for product and process quality supervision through data collection and analysis of each link[2-5]. However, the current quality management is mostly limited in each business link, which restricts the further development of the application. There is an urgent need to open up the quality information island of each link. There is also an urgent need to integrate the quality data of each link, carry out quality analysis and supervision in the whole life cycle, and establish a technical platform for service regulatory agencies, power companies, production enterprises and the public[6-9]. Among them, the regulatory agencies include the quality supervision departments and third-party inspection institutions; the power companies include the power grid companies, power generation enterprises and power selling companies; the production enterprises include equipment manufacturers and component suppliers; the public refers to the public.

2. OVERALL DESIGN OF CLOUD SERVICE PLATFORM

2.1. Design concept of cloud service platform
Build a typical application mode of "measurement standard inspection and Accreditation" in the intelligent energy meter industry. Through the innovation of measurement technology, based on standardization and relying on information technology, the cloud platform for the whole life cycle management of intelligent energy meter is constructed, the quality basic resource information sharing database is established, and the quality data flow and information flow in all links of the design, manufacturing and use of intelligent energy meter are connected. Through new technologies such as "big cloud, internet of things and artificial intelligence", the interaction and integration of various elements of NQI (national quality infrastructure) is realized, providing quality big data analysis and services for governments, energy enterprises, equipment manufacturing enterprises, etc. Focusing on "interconnection, intercommunication and mutual recognition", we will comprehensively improve the quality and manufacturing level of intelligent electricity meter products, strive to achieve international mutual recognition, promote resource information symmetry and efficient utilization and sharing of resources, and form typical application cases that can be copied and popularized. It covers the whole process of research and design, material procurement, production and manufacturing, delivery, acceptance and testing, warehousing and distribution, installation and operation, demolition and scrapping of intelligent electricity meters, and realizes the full collection and deep sharing of quality data in all aspects of design, production, testing, installation, operation and demolition.

2.2. Design scheme of cloud service platform
The overall design of the cloud service platform is shown in figure 1. The cloud service platform obtains the full life cycle data of intelligent electricity meters from electric power companies, production enterprises and regulatory authorities, and provides relevant services to all relevant parties by using hybrid cloud technology and quality big data technology. The cloud platform is deployed to the unified cloud infrastructure, which is built and operated by the state grid company in a unified manner. The overall architecture is divided into application architecture and technical architecture. The application architecture provides core business functions and business operation functions for the cloud service platform, and provides services to various users through the cloud portal. The technical architecture provides technical services and technical support for the service platform.
Cloud service platform application architecture mainly includes the basic support, big data platform, cloud portal and other aspects. Basic support is mainly to provide the entire cloud platform with basic resources in the aspects of development, operation, monitoring, operation and maintenance, security, etc., including all kinds of infrastructure, micro-service architecture, development and operation of integrated tools and management, security management, etc. The big data platform is used to provide services such as data access, data cleaning, data storage, data integration, data calculation, data analysis and data exchange for all kinds of applications, so as to facilitate the upper level applications and services to quickly utilize resources such as big data storage and computing. The cloud portal is the total gateway to all services and the only way to access them. The cloud portal provides application services and data services to regulators, power companies, manufacturers, and the public. Services for all parties are nested in the cloud portal and jump to specific service function pages through menus or links. At the same time, it provides services for daily operation management, including access to power companies, production enterprises, access to all kinds of applications, publication, change, subscription, monitoring, etc.

The technical architecture of cloud service platform mainly includes: cloud infrastructure layer, data layer, platform layer and application layer.

Cloud infrastructure layer mainly realizes the centralized management of all servers, storage, network, database and other resources in the cloud, and provides users with integrated, highly available and rapidly deployable IT infrastructure services through template configuration and dynamic adjustment. Data layer provides all kinds of application data access, data cleaning, data storage, data integration, data calculation, data analysis, data exchange and other services, convenient rapid upper applications and services using big data storage and computing resources. According to the needs of different customer groups and different businesses, the data processing results are encapsulated to form a data set urban area. The platform layer provides a cloud application support platform for software design, development, verification, release, operation, maintenance and operation with a complete life cycle, and establishes a unified micro-service architecture and ecosystem to provide end-to-end services for developers, operators, users and service providers. The application layer is the core of the cloud service platform, providing application services, data services and public services for regulators, power companies, production enterprises and the public, and developer services for platform developers. The full life cycle data of intelligent electricity meters collected by the cloud service platform is reflected through specific application scenarios. The application scenarios rely on the cloud infrastructure layer, and use technologies such as big data and cloud computing to store, process and mine the data of the whole life cycle of intelligent electricity meters, and provide services to regulators, power companies, manufacturers, the public and other users through portals and mobile apps.
3. APPLICATION SCENARIOS DESIGN OF CLOUD SERVICE PLATFORM

The application scenarios of cloud service platform are divided into four categories: regulatory agencies, power companies, production enterprises and the public. Relying on the comprehensive advantages of CETC in measurement technology, standards, inspection and testing, certification, recognition and data and the platform resources of the third party, with fully consider of the current situation and needs of regulators, power companies, production enterprises and the public around the life cycle management of intelligent electricity meter, we plan application scenarios and design typical application scenarios in detail.

3.1. Application scenarios for regulators

Take the quality level analysis service of electricity meters as an example.

The quality level analysis service of electricity meters is based on the analysis of three aspects: the basic capacity of electricity meter quality technology, the manufacturing quality level of electricity meter and the operation quality level of electricity meter. In this scenario, the relevant data of power meter quality will be displayed to the regulators in the form of reports, so as to monitor and control the industry trend in a timely and effective manner.

The scene is divided into three parts. The first part is the technical ability analysis of the quality of electricity meters, which is demonstrated from the aspects of measurement, standards, inspection and testing, and NQI certification. Among them, the metrological aspects include the situation of metrological technicians, the situation of metrological organizations and the construction of metrological laws and regulations. Standardization includes the standards issued by the state, the standards issued by the industry, the standards released by enterprises, etc. Inspection and testing includes inspection institutions, employees, instruments and equipment, etc. The certification includes the number of CNAS certification enterprises, the number of CMA certification enterprises, the number of MID certification enterprises and so on. The second part is the analysis of manufacturing quality level of electricity meter. It mainly makes statistical analysis on the qualified rate of spot check of key components (CPU chip, metering chip, battery, 485 chip, LCD, etc.) and the qualified rate of production process (assembly, adjustment and inspection, packaging, etc.) of production enterprises, and selects the high-quality enterprises in the industry. It can make regulators understand the manufacturing quality level of the industry and the high-quality enterprises of the industry more clearly and accurately. The third part is the analysis of the operation quality level of electricity meters, mainly through three aspects to show the operation quality level of electricity meters. The first part is the measurement accuracy statistics of intelligent energy meter, showing the proportion of positive and negative errors of single and three-phase meters respectively. The second part is the statistics of the qualified rate of the intelligent electric energy meter, including the qualified rate of the arrival spot check, the arrival full check and the operation spot check. The third part is the statistics of the distribution of the operation quantity of the meters with the operation years.

3.2. Application scenarios for power companies

Take fault analysis and early warning service as an example.

Fault analysis and early warning service conduct unified analysis through operation fault data and disassembly table detection fault data. The distribution of faults, the correlation between various faults and production enterprises, meter models and components can be found. According to the characteristics of relevance, early warning notice shall be sent to specific production enterprises and specific electric power companies to facilitate the timely emergency treatment of electric power companies, ensure the operation quality of metering equipment in operation, and improve the quality service image of electric power companies. Fault analysis and early warning service is divided into two parts. The first part is through the design scheme and material related supply area early warning. The second part is through the component related supply scope early warning.

Through the early warning part of design scheme and material related supply area, the distribution and failure of electric energy meters of related production batches using the same design scheme and
material in the whole country, as well as the distribution and failure in a grid province are displayed. With early warning of relevant power companies, we indicate that there is a high risk of failure.

Through the way of component related supply scope early warning, mainly based on the highest fault of a batch of meters whose fault rate exceeds the early warning value of the fault rate, combined with the component data of the production enterprise, locate the relevant components, and analyze the data of the same batch of components supplied by these component manufacturers to the energy meter production enterprise. We warn related network provinces and production enterprises to prepare for prevention.

3.3. Application scenarios for production enterprises

Take industry positioning analysis services as an example.

The industry positioning analysis service constructs the evaluation model of the quality and technology foundation ability of the intelligent electricity meters industry, studies the key points of the evaluation results of the quality and technology foundation ability of the intelligent electricity meters industry, such as quantitative classification, evaluation ability and analysis means, and forms the multi-attribute comprehensive evaluation model and method. At the same time, we carry out the evaluation and analysis of the quality and technical basic ability of the intelligent electricity meter industry, mainly divided into two parts, the first part is basic competence index analysis, with eight link corresponding to the whole life cycle of the intelligent electricity meter, mainly inspects the following six indicators: basic ability, material purchasing, manufacturing, research and development design, factory supply, installation, operation. The second part is NQI capability index analysis, corresponding to the four elements of NQI, covering the core elements such as measurement, standards, certification, inspection and testing, quality management, etc., used to measure the level of quality technical foundation of production enterprises.

Production enterprises can determine their development direction according to their own positioning in the industry: first-class enterprises can determine their benchmark status through the service, can be committed to technology pilot and standard formulation; Non-first-class enterprises master the industry average level and industry benchmark level, and compare with their own positioning to determine their development direction.

3.4. Application scenarios for the public

Take the whole life cycle information service of electricity meters as an example.

The service includes a public information display area and a user inquiry area. Public information mainly displays the contents of some topics of common people's concern, and public announcements may also be issued. The user inquiry area allows the user to query the relevant data in each link of the whole life cycle of a certain electricity meter.

The whole life cycle information service also includes the quality supervision system of intelligent electricity meters, which explains that there is supervision by relevant organizations such as the bureau
of quality and technical supervision at each stage of the preparation, production, installation and operation of electricity meters to ensure that the quality of electricity meters can be controlled. As shown in Figure 3, the third-party testing organization issues the production license through the type evaluation test in the r&d and design phase, and the product access license through the full performance test. The manufacturer shall issue the product certificate through the factory inspection in the delivery and supply link. Electric power company issues product use certificate through full inspection and acceptance test in the process of acceptance and detection. Through the meter number, the public can inquire the information of each link from production to installation, including product certificate, test report, verification certificate, etc. The public complete the traceability and display of the whole life cycle quality control of an intelligent electricity meter.

Fig.3 Intelligent electricity meter quality supervision system

4. CONCLUSION
In the context of the energy Internet, the use of cloud computing, big data, artificial intelligence technology to solve business problems is increasingly common. This paper proposes to build a full life cycle quality cloud service platform for smart meters, and establish an effective quality data service system for service regulators, power companies, production enterprises and the public. The cloud platform meet the quality development needs of all parties, and finally achieve the goal of promoting and improving product quality, optimizing and improving industrial level, and enhancing international competitiveness of products. Through the research on the application scenarios of the cloud service platform for the whole life cycle quality of smart electricity meters, characteristic service scenarios are designed. In response to the deepening of related businesses and the improvement of various management requirements, the cloud service platform for the whole life cycle quality of smart meters will continue to meet the future development.

ACKNOWLEDGMENT
This work is supported by Science and Technology Project of SGCC. (Research and demonstration application of NQI key technology supporting quality improvement of Intelligent electric energy meter, No. SGHADK00JLJS1900063).

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