

THE CLOUD MANUFACTURING SERVICES PLATFORM STRUCTURE AND KEY TECHNOLOGIES RESEARCH IN THE MOULD INDUSTRY

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ABSTRACT

The phenomenon of uneven distribution of manufacturing resource and capacity is more serious in mould industry, but the approach of existing manufacturing models is difficult to strike a balance in terms of stability, quality and credit of services. On the basis of the analysis of the problems of mould industry, this paper proposes the mould cloud-manufacturing platform supporting industrial clusters cooperation; then analyzes the content of the platform in which the service of platform focused on the full life cycle platform of the product and the upstream and downstream of industrial chain. The system structure of the platform and key technologies are studied. This research will play an exemplary role for application of cloud manufacturing in other industries.

Keywords: industrial clusters, mould, cloud-manufacturing platform, system structure

1. INTRODUCTION

Mold is the basic process and equipment of the modern manufacturing industry. About 60 to 80 percent of parts that are employed in automobiles, home appliances, electronics, communication, instruments and aerospace mainly depend on the mold to manufacturing. At present, mould industry characteristics in China mainly present as follows:

1. Most mold enterprises are small or medium. The fund which enterprise offered is on a smaller scale, and the industry owns high concentration accompanied with regional characteristics.
2. The apparent demands of product individuality lead enterprise production management to be very complex. What's more, product design ability and relevant performance have important significance to the enterprise development.
3. Manufacturing equipment resources, mainly in the numerical control equipment, are not balance.

4. The driving type production comes true through small batch production facing to resources; business process is complicated; the collaboration of resources is also strong.
5. The requirement of intermediate and high-end production is strong, but in short supply.

In China, the above shortages always lead the mold industry to the following main problems: most enterprises owing low proportion of technical personnel, absention of independent research and development capacity, lacking of sophisticated testing equipment, lowing level of enterprise management, and being short of modern methods and means in product development, and so forth .

Facing the mold production shortages and existing problems, mould industry urgently need to use the advanced manufacturing model and related technologies, to integrate all available resources, so as to realize the mold production flexibly and agilely through effective manufacturing resources sharing and cooperative management, in response to the changes in demand of the customer and the market.

China's manufacturing industry informatization has done a lot of exploration and practice in manufacturing mode, such as the network manufacturing ^[1], the Application Service Provider (ASP) ^[2], and manufacturing grid ^[3], and it has promoted the development of small and medium-sized enterprises. However, it is difficult to establish the public platform for industrial cluster cooperation to offer an agile, high quality, low price and integrated service, for the problem of the service and operation mode, the personalized service support, operation mechanism and so on.

Reference the thought of cloud computing "on-demand service", the cloud manufacturing is a new manufacturing mode combined with all kinds of advanced technologies. Academician Bohu Li ^[4~6], professor Haicheng Yang ^[7], and professor Xinjian Gu

[8] etc have made full discussion on the concept of the cloud manufacturing, and point out that the cloud manufacturing is a new mode and new technology owning characteristics, such as facing to service, high efficiency, low energy consumption, and agile manufacturing. Cloud manufacturing emphasizes the use of information technology to integrate all kinds of manufacturing resources, and through virtualization technology to provide users with standardization service. Users can acquire all kinds of services through the cloud-manufacturing platform. At the same time, these services have a quantity of features, such as real-time utilization, paying according to the demand, safety, reliability, high quality and low-cost. In conclusion, cloud manufacturing process to the concept of manufacturing as service which is different from the traditional WEB mode (software as a service).

On the basis of the characteristics of mold industry, we build the mould cloud-manufacturing platform which can support the collaboration of industry clusters. We firstly put forward the construction content of the platform; then study the system structure of the platform; lastly discuss the key technology in the platform construction and operation process. The platform will contribute to promoting the sharing level of ability and region internal manufacturing resources, improving the overall industry utilization rate of resources and capacity, and promoting mold industrial upgrading.

2. THE PLATFORM CONTENT RESEARCH

The cloud-manufacturing platform is a trading platform between manufacturing resources and manufacturing ability, and mould enterprises can trade equipment, technology, human resources and management on the platform, so the service content of the platform is mould product life cycle, service object is mold industry chain upstream and downstream. At the same time, the relationship between the platform and the enterprise is loose coupling, therefore the service provided through the platform need to be integrated and to achieve more grain size and multi-scale control. In the product life cycle service, the platform can provide six big tool set, namely product design, performance analysis, process simulation, precision processing, quality inspection, and production management. Therefore, the six tool set basically covers the whole process of mould manufacturing. In the aspect of upstream and downstream industry chain, the platform provides support for coordination and cooperation among mould equipment manufacturing, mould, home appliances, automobile, electronics, hardware, and other enterprises. The whole platform is divided into three levels, including cloud platform, cloud services and cloud application. Moreover, its specific content is as shown in figure 1.

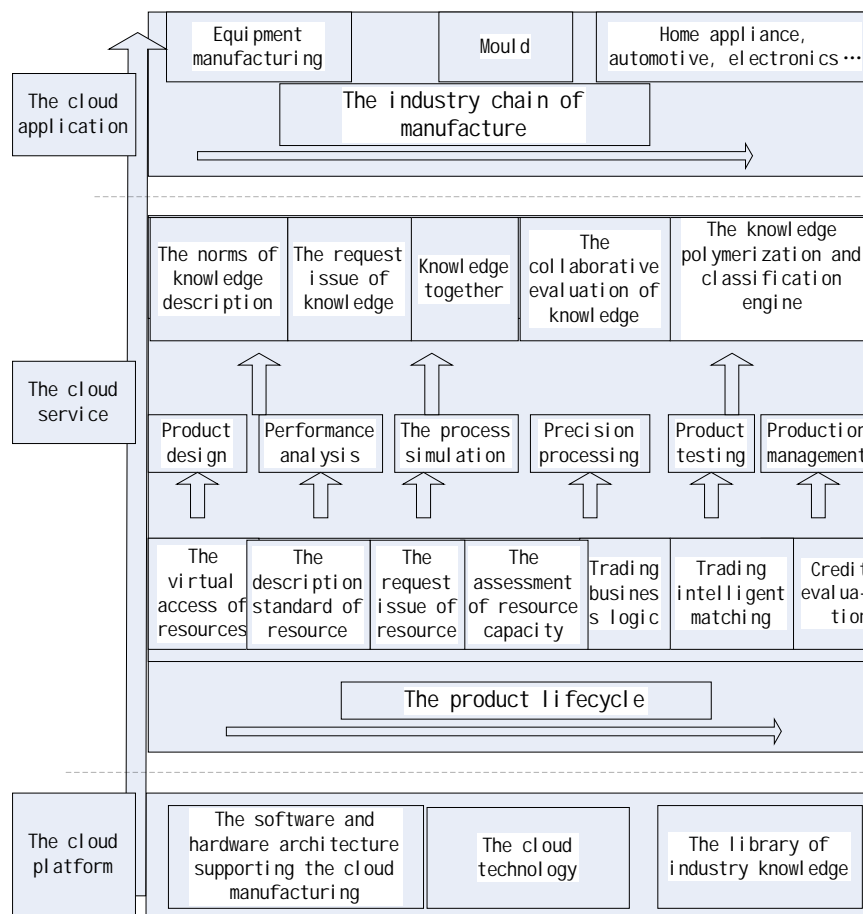


Fig 1: The Content of Mould Cloud-manufacturing platform

Cloud platform is the infrastructure of the whole platform, builds the structure system of the software and hardware to support the cloud manufacturing, researches various technologies of clouds by soft and hard resources, and arranges related knowledge base about the mould industry. Cloud services is the middleware layer of whole platform, and it will make service resources virtual, integrate various service tools, and offer multi-granularity and multi-scale service interface for the upper. The cloud application is the presentation layer of the whole platform, calls all kinds of the tools set according to the demands of users, directly provides service for the upstream and the downstream mold firms.

3. THE RESEARCH OF PLATFORM SYSTEM ARCHITECTURE

Professor Chao Yin expounded a general cloud manufacturing service platform in literature [9] orienting to small and medium-sized enterprises, which includes fundamental support layer, integrated operation environment, platform tools layer, the manufacturing resource layer, platform service building layer, service component layer, business model layer, trading layer and user layer. In this paper, we build the cloud-manufacturing platform used in the mould industry which can stand by the industry clusters writing according to the characteristics of mould industry and the feasibility of the technology, just as shown in fig2.

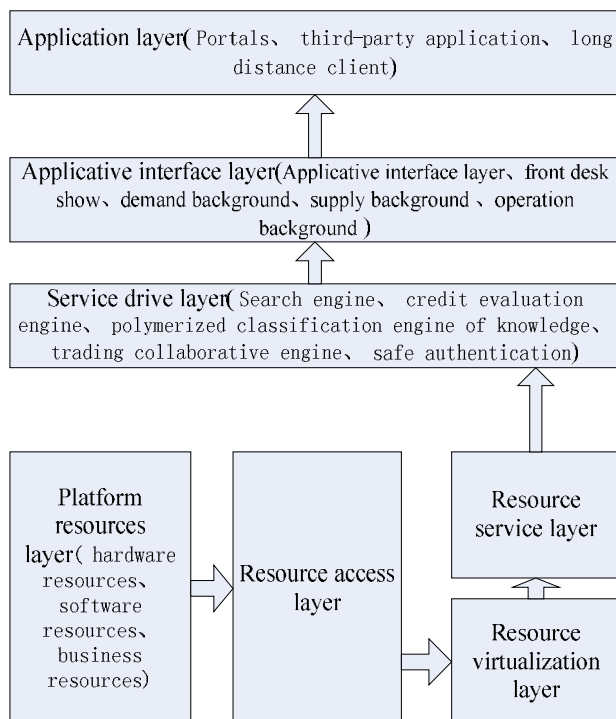


Fig 2: The Cloud Manufacturing Platform System Architecture

On basis of the source, platform services resources can be classified to the operator's own resources and private resources which can be moved to cloud-manufacturing platform through the lease. From the

nature, platform services resources also can be divided into hardware resources, software resources and industry knowledge base. Therefore, it is possible to solve heterogeneous structure of resource description by building platform resources and resource access layer to standardize the source and classify of the resources.

The resource platform needs to realize functions, mainly including multiple conditions retrieval, trading, monitoring and evaluation, etc. Thus, constructing virtual layer abstracts physical resources, features descriptors can be built to match with all kinds of resources, and resource virtualization layer also needs to construct related grain size parameters to provide interfaces for controlling after instantiation of resources.

The platform is wide range of resources, which are different among different resources. Constructing resources services layer can classify and integrate virtual resources, and provide unified descriptors of service interface to outside in order to afford integrated service conveniently. Resource service layer establishes relevant scale parameters supplying interface for scale control of the service.

The platform service drive layer that includes search engine, credit evaluation engine, polymerized classification engine of knowledge, trading collaborative engine, safe authentication with trading caused and so on is the control layer of the whole platform. And it formulates the basic operation rules of the working platform, monitors all information imported to the platform, analyzes semantics intelligently, submits to the relevant engine, and exports result to the specific page.

The applicative interface layer of the platform utilizes the function provided by the service drive layer to create the basic function and service module. The object of service includes four major categories (platform operators, platform providers, operator resources platform demanders, professional software and hardware resources development team). The four levels of service respectively are the front desk show, the demand background, the supply and demand background and operation background. In a word, the applicative interface layer constructs the application of the whole cloud manufacturing services system.

The application layer provides support for trading and using of the whole cloud-manufacturing. Web portal offers the foundation of the multilateral trade, remote client to control the cloud manufacturing resources (mainly for the soft resources, including local application, online application, cloud computing platform application and SAAS application) and third party applications to afford expansion ability of the cloud-manufacturing platform, such as the third party pay and CA certificate, etc.

4. THE KEY TECHNOLOGY RESEARCH OF THE PLATFORM

Professor Lin Zhang [10] discusses the key technology research of generally manufacturing service platform. In addition, this paper will continue to research the key

technology of this cloud-manufacturing platform in the process of creating and running combined with the characteristics of the mold industry. The key technology mainly consists of the platform service model, resources ability access, resources intelligent search, credit evaluation, service life cycle management.

4.1. The research of platform service pattern

To ensure the normal operation of the platform, the platform will use the cloud service mode of the four winds cooperation which includes service platform operators, the manufacturing capacity providers, the demand side of manufacturing services and developers of service tools, and its can make full use of the professionally technical resources, the market demand of resources and software development resources, its as shown in figure 3.

4.2. The platform resources access research

The cloud manufacturing services platform provides services including hard resources (processing, testing, designing equipment instrument), industry resources (designing model, analyzing data, etc) and software resources (designing, analyzing software and all kinds of application management system).Therefore, in platform

resources and access of services, we first need to analyze the characteristics of the resources and services, extract the characteristic parameters of each type resources, and establish appropriate and convenient assessment, so as to the access and application of resources and services. The access process is as shown in figure 4.

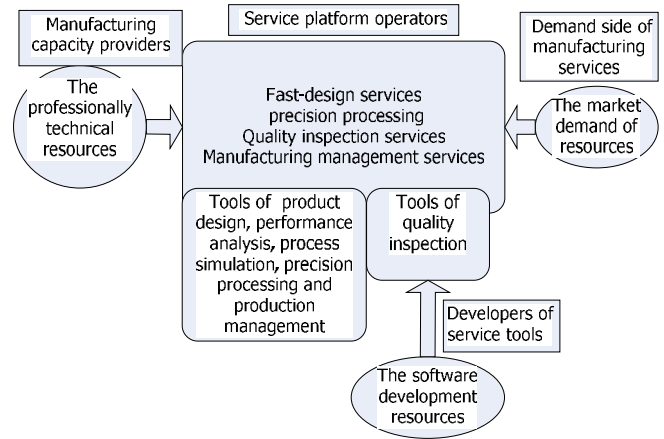


Fig 3: Platform Service Mode

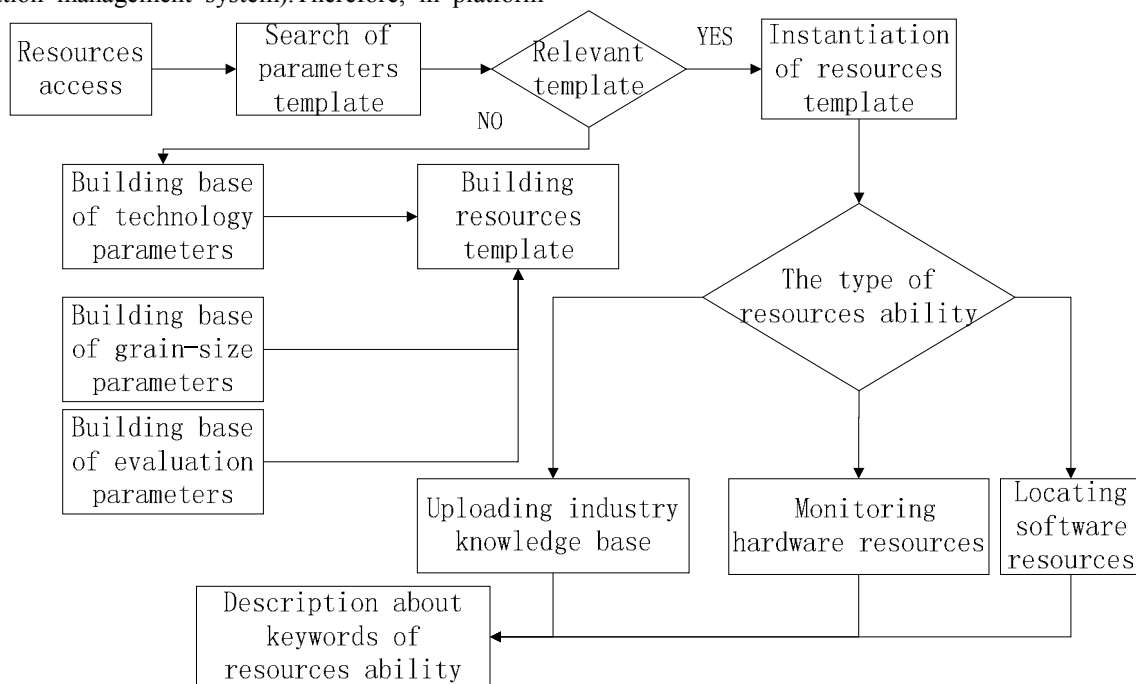


Fig 4: The Platform Resources Access

4.3. The intelligent search research of platform resources

It is necessary to establish engine system in the light of mould manufacturing resources and standard search of manufacturing ability. And then, this engine system can be used to search related products, services and industry knowledge. Combining mould manufacturing products with service classification standards, the engine system realizes precise search of knowledge, the manufacturing

resources and the ability of manufacturing. Platform will establish the standardization of the industry, the unified technology parameters database, establishing a uniform product manufacturing base, the service base, the enterprise library, can realize the configuration of the parameters template, realize manufacturing capability/service ability trading standardization. On this basis, the platform makes business cooperation between the demand side and service provider true. Platform

resources construction of intelligent search engine is as shown in figure 5.

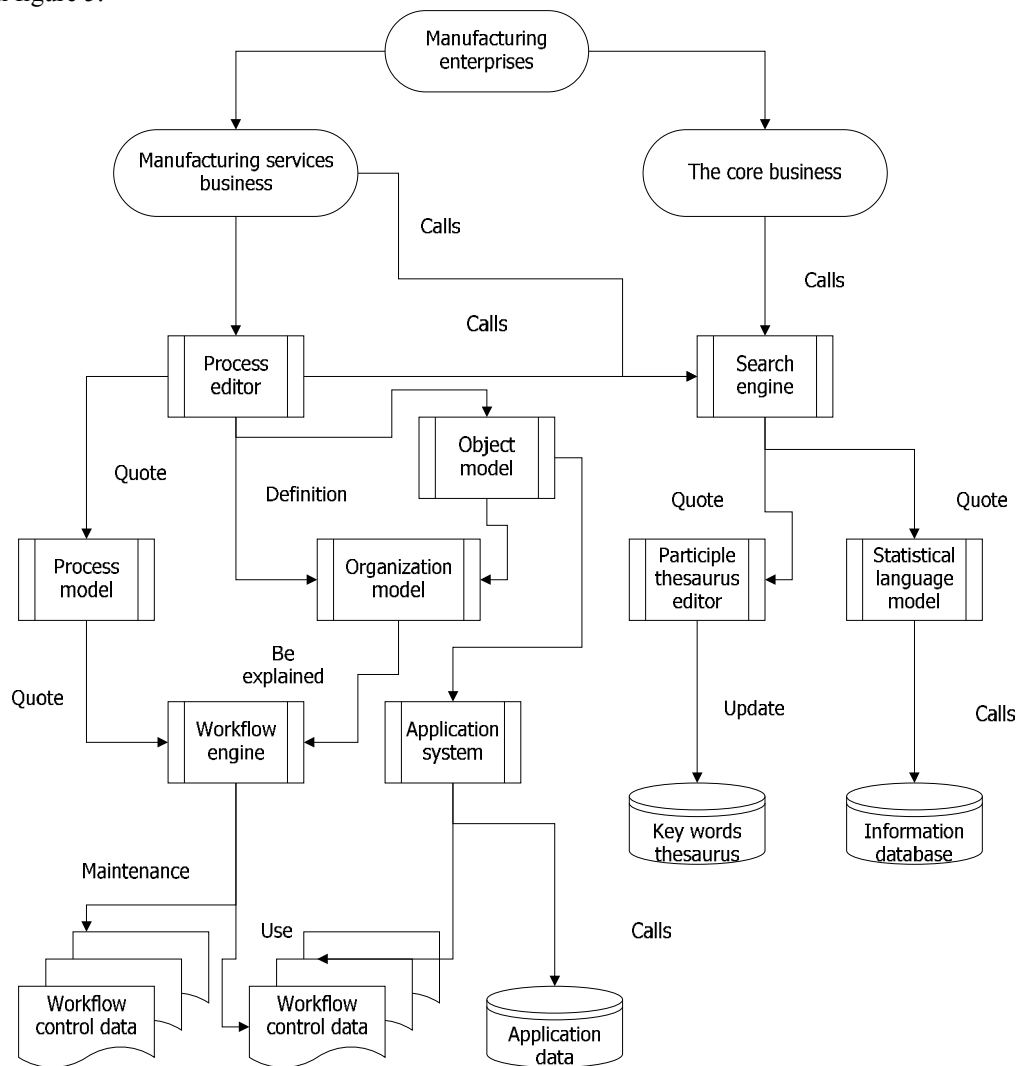


Fig 5: The Model of Intelligent Search of Platform Resources

4.4. The credit evaluation research of the platform

Because the cloud-manufacturing platform owns itself characteristics, such as trading platform remote, virtual, information asymmetry and silver goods delivery lag, it is destined to be the business model accompanied with the high efficiency and high risk. As a result, the control risking is the foundation of successful operation. Platform will build validation, evaluation, evaluation, classification, audit, supervision mechanism on the business. Operators of the cloud-manufacturing platform, as an third independent and authority institutions in credit evaluation, the authentication and management, establish seamless linking relationships with internal credit management institution or related departments. The trust of system,

enterprise relationship and mutual combination are considered as a core engine for them to realize trade of the cloud manufacturing. The platform can monitor the whole tracking management of the cloud platform and the credit of related enterprises. Namely, the cloud services will offer the services of monitoring, evaluation and after-sales service system. In addition, the management agency that has no relationship with the related enterprises described on above carries out this two-interconnected mechanism of the credit management, so as to establish support system of network services for all the service objects. The credit evaluation system of platform is as shown in figure 6.

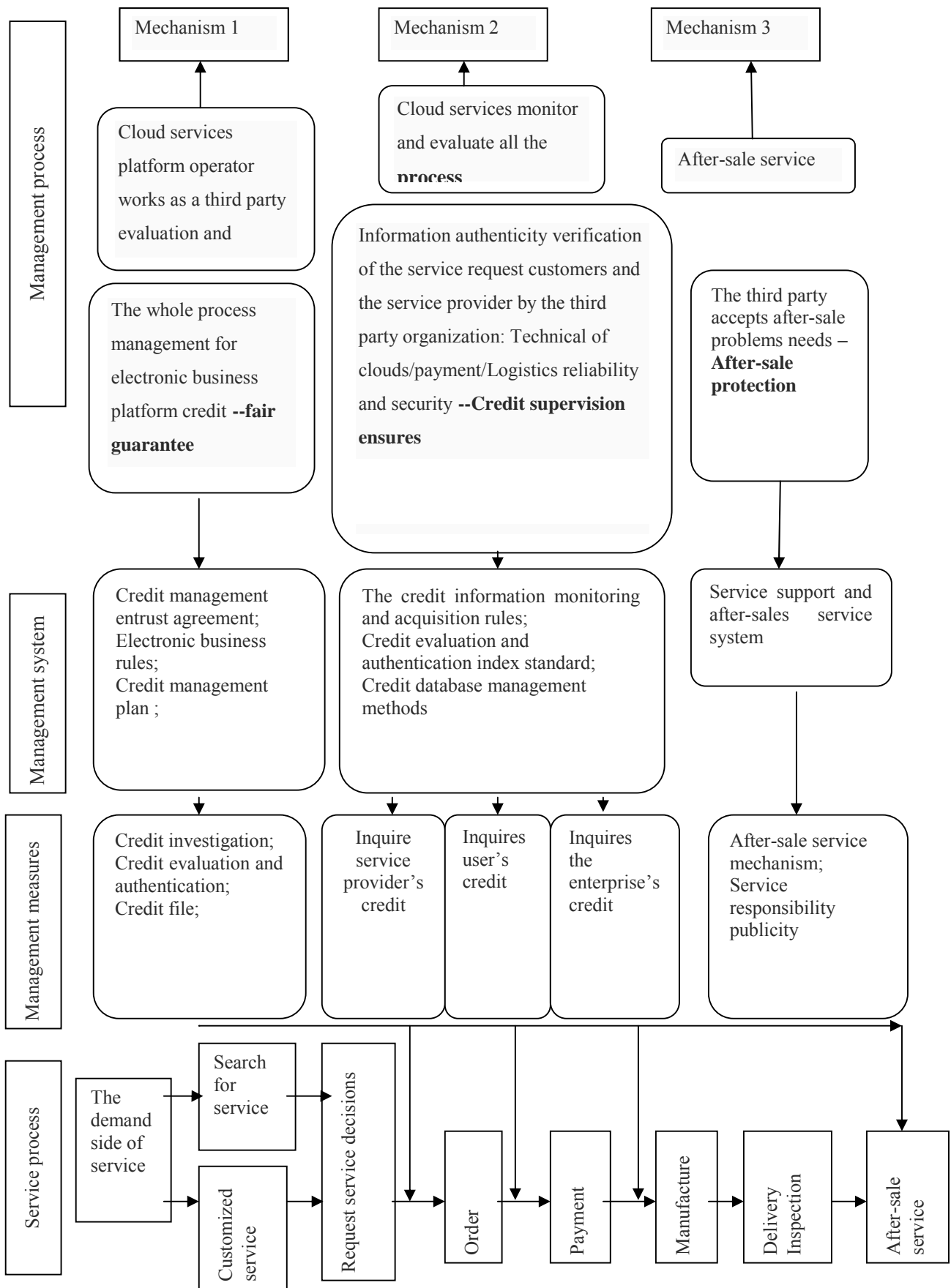


Fig 6: The Credit Evaluation System of Platform

4.5. The research of life cycle management about the platform service

To improve the service level of the platform, and promote enterprise adhesion of the platform, the service afforded

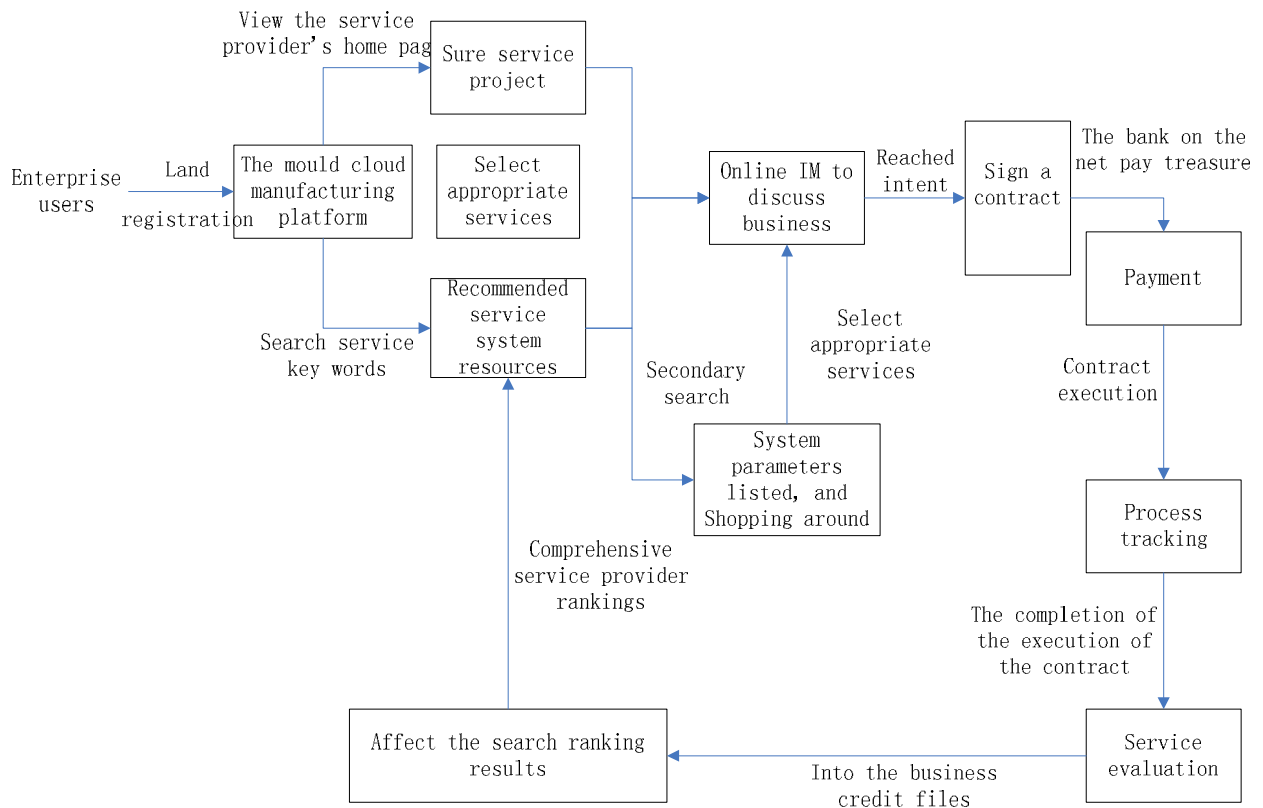


Fig 7: The Life Cycle Management of the Manufacture Service

5. THE LAST WORD

Some cities of China, such as Beijing, Jiangsu, Zhejiang and Guangdong provinces, have already set up a batch of special industrial cluster towns, and been existed a kind internal relationship of competition and development, but existing manufacturing mode is hard to develop information service platform for industrial clusters of collaboration. In this paper, according to the characteristics of the mould manufacturing industry, the cloud-manufacturing platform in the mould industry is put forward to support industrial cluster cooperation, and we analyze content needed to build and research the system structure and key technologies of the platform. The establishment of platform will contribute to integrating regional internal resources and ability, improving the competition ability of the industry, and promoting the development of the manufacturing industry to a higher level. However, it is for a long time to create relate database used to been search.

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by the platform is the life cycle of manufacture with the universal technology of human computer interaction, and the life cycle of manufacture is shown in figure 7 below.

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