Research on Cloud Platform Service Based on Industrial Design Industrial Chains: Taking ‘the research and develop demonstration platform of Sichuan Industrial Design Platform Service’ as an example.

Yujia Jia\textsuperscript{1}, Renhua Zheng\textsuperscript{1}\textsuperscript{*}

\textsuperscript{1} College of Nuclear and Automation Engineering, Chengdu University of Technology, Chengdu, Sichuan, 610059, China

\textsuperscript{*}Corresponding author’s e-mail: 236667991@qq.com

Abstract. In recent years, the government has vigorous carried out for the policy of industrial design industry, so that it has enabled the industry to develop rapidly. However, for the industrial design industry, the poor connection between the upstream and downstream industrial chains of industrial design has become an important factor which is restricting the development of this industry. This paper analysed why the industrial design industry chain cannot be linked closely through investigation and analysis as well as the pilot project in Sichuan. According to the pilot project of Sichuan Industrial Design Cloud Service Platform (\textit{SCID Platform}), it realized the self-circulation mode of industrial design industry chain, and play a substantial role in promoting economic operation.

1. Introduction
In recent years, the industrial design industry has made a considerable progress in China, and various regions have introduced industrial design through national guiding policies, which have made positive contributions to the transformation and upgrading of industrial economies. Industrial design has become an important support for economic growth in various regions. The industrial design industry has played a positive role in promoting the technological progress and competitiveness of local enterprises in various regions.

1.1. Industrial Design Industry Chain
The term “industry” is derived from the concept of economics. In the “Design Innovation Mechanism Research of Enterprises in China”, Liu Guanzhong mentioned the concept of industrial design industry is: taking part in the process of production, circulation, as well as increasing in products value, and final realization. \cite{1}; Fan Jin also suggested that industry is a general term for economic sectors that can bring added value, and sometimes refers to all kinds of equipment that produce material of the products, and also contains the labour in this process, not just industrial design techniques \cite{2}. One of the cores for judging whether an activity has industrial attributes is depending on whether it has "closely corporate economic activities among the enterprises" \cite{3}. Therefore, the industrial design industry chain is not only a single part of designing or packaging link provided by the enterprise in the product development process. The enterprise providing the service in a certain link exists as a point of specialization in the industrial chain. The industrial design industry chain is the relationship between
the upstream and downstream links related to industrial design in the whole product development process. Therefore, the industrial design industry chain is the concept from a social perspective. From this we can see that the industrial design industry should not be simply defined as the “design” process, but rather a product development and manufacturing process.

1.2. Industrial Design Cloud Platform and Product Family
“Cloud platform” is to consider the value of public information resources (enterprise information, processing information, exchange information, etc.) in the industrial design industry chain, and to share information related to industrial design to enhance the overall level and to promote the development of industrial design industry in that local region.

The product family is a kind of modular system, which can call shared components, modules, and subsystems within the product platform and make integration through standard interfaces, then, a sort of new specific products will be created [4]. It can generate diversified product clusters and provide personalized service. It can apply a small number of standardized modules to form a large number of products, and apply product commonality in each market segmentation as much as possible. [5]. The design idea of the product platform is to use the enterprise product platform to reduce the development cost of the enterprise, shorten the period of product development, launching configurable products that can satisfy the individual demands of customers efficiently and quickly, through customized development and combination with platform modules.

2. Industrial design cloud platform construction practice

2.1. Cloud platform construction background
Objectively, there are still some restrictive factors in the development of industrial design industry. One typical performance is the disconnection between the upstream and downstream of the design and manufacturing industry chain. This problem greatly reduces the efficiency of all links in the chain. As well as, it directly affects the development of industrial design companies.

For instance, as shown in Figure 1, after the design work finished, the new products of the design enterprise (product development enterprise) will usually entrust a third-party processing enterprise to carry out the OEM work, then they will face the next question: how to find Third-party foundries? Can the materials, technical specifications, process methods, process quality and process precision of the foundries meet the design and manufacturing requirements? So, how do design companies (development companies) find processing companies that meet the needs of the process? These situations are finally summed up as a question: how to find accurate technical information of the processing company? If the phenomenon of “link breaking” in such upstream and downstream enterprises cannot be solved in one-step, the design party (or developer) is in a blind state, it’ll not only affects work efficiency but also the quality.
However, the reality is that, despite the increasing development of the Internet, the information is very few and fragmented on the important technical specifications of processing enterprises, which is completely unable to meet the needs of the design party (or developer). At present, the main carrier of technical information of processing enterprises is the enterprise website. The technical information on the website is also limited to the processing method. For sheet metal processing companies, their websites generally show the type of process (such as bending, electroplating, etc.), and some companies will display their processing equipment. For example, the plastic model company website will generally display its type of process (such as injection modelling, blow modelling, etc.), but these companies almost haven’t display of process precision, technical specifications, process equipment, but these data are very important. To further understand the detailed technical information, we can only communicate with the enterprise on the spot. But this will cost us plenty of time, furthermore, it’ll affects the design efficiency (or developer's) work efficiency and even the quality of work. In fact, it also affects the processing quality of the processing enterprise itself, which is not conducive to develop the new customer resources. Therefore, it is necessary to establish a “one-step” information service platform.

2.2. Cloud platform construction method
The development of the cloud platform can widely help companies (R&D company – design service company – OEM) in the product development process to conduct information transparent and open information to exchange. This cloud platform can design for the regional "cloud platform" service model base on each regional development specificity. For example, in the southwest region, Sichuan Province is an important manufacturing district in China. There is a huge demand for industrial design in the fields of major equipment manufacturing, consumer electronics research and development, and light chemical industry. The development of industrial design is changing from “Made in Sichuan” to “Create in Sichuan”. After experiencing the germination period and the cultivation period, the industrial design industry in Sichuan has now reached a key stage of growth and optimization.

The "SCID Platform", the basic content of the platform is to build a technical information platform based on processing enterprises of the local region, which is actually a processing The enterprise's technical information database, which collects no less than 100 processing technical information, the database contains the following information:

- Technical information of plastic mold manufacturing enterprises;
- (2) Technical information of metal processing enterprises;
- (3) Technical information of wood processing enterprises;
- (4) Technical information of ceramic processing enterprises.

Among them, the plastic mold manufacturing enterprises and metal processing enterprises are account for a great proportion in technical information, these two types of processing methods account for more than 95% of all manufacturing information. And through the following ways to make data collection and application:

(1) Data collection method: Through the network collection and data inquiry, gathering the contact information, business address, processing technology, process parameters, process quality, manufacturing cost and other related information of processing enterprises in Sichuan Province are collected in large quantities, and According to the four categories of plastic, metal, wood and ceramic lamps, to establish a detailed information database.

(2) Field investigation method: The project inspection team members have taken on-the-spot investigation to various processing enterprises that can carry out in-depth understanding. The processing scale, processing equipment, processing precision, processing quality, processing cost, and contact information of the processing enterprises are important. The information is confirmed one by one.

(3) Case study method: A small number of people in the industrial design industry and people from manufacturing companies are invited to attended seminars and survey visits to understand the actual needs related to the theme of the project.
For each processing and manufacturing enterprise, we strive to collect all relevant data, such as process methods, process precision, process specifications, process equipment (as far as possible), contact information, etc. The demand side (design or development company) can basically understand its technical information from this database, if anyone needs to know more deeply, he and can enquire it by phone or interview.

2.3. Cloud platform development significance
The construction goal of the industrial design cloud platform is to develop and build a “one-step” and “interconnected” demonstration platform based on social collaboration; and depend on the platform to participate in the innovative service system and service network. Through the close contact between online and offline, we will build an industrial design ecosystem by the process of “design resources + professional services + social collaboration”, which could effectively promote the cooperation of industry, education and research in industrial design, as well as promote cooperation and exchange of industrial design, and foster Innovative companies towards industrial design to help enterprises grow faster.

The technical information platform of the processing enterprise is built to solve the above problems. Building a platform for communication between design companies (or product development companies) and processing and manufacturing companies will be a very effective tool for connecting with design-manufacturing industry chain. This platform provides a processing (OEM) technical information database for a large number of design institutions, product development companies and design professional teachers and students, so that the can find the foundry partners easily, and also select the process methods in the design and development process. At the same time, it also provides important reference for process selection, process parameter determination, process quality verification, processing and manufacturing costs in the design and development process. In addition, the developer can also obtain important technical support and guidance from the foundry to improve design quality and design efficiency. It will also be an efficient integration of the design (development)-manufacturing industry chain for the local region, which will not only effectively promote the development of the industrial design industry, but also promote the economic development of the local region [6].

3. Industrial design cloud platform construction results

3.1. Technical goals for establishing a cloud service platform
The cloud service platform deploys software and design resources in the database. Users can select services according to their needs. According to the Information “Collection Stage” mentioned in the previous section, the cloud platform can be divided into two parts, named, “common platform” and "Lookup platform" as shown in Figure 2.
The “common platform” is mainly based on the first and second stages of the project, aiming to share the companies and technical information, so that, to open up the product development process of “R&D enterprise – design enterprise – foundry enterprise”, to form the system of industrial design industry chain. The “find platform” mainly integrates resources based on enterprise interaction information in common platform, realizes network integration of product industrial design resources, integrates various professional support technical service function modules, and develops and constructs industrial design innovation cloud service platform. At the same time, it also cooperates with universities, scientific research institutions, professional technology service organizations and local excellent design companies in the region. Developing and building “one stop” by adopting “heterogeneous data and heterogeneous database integration in cloud service network environment”, “service-oriented architecture and enterprise service bus”, and “depth integration application of Web1.0 and Web2.0”. The “interconnected and integrated” technology-based industrial design cloud service platform based on social collaboration forms an industrial design technology service innovation system and service network (including the entire platform mobile APP application). Therefore, the platform greatly gathers the resources which industrial design shared and demand, supporting the realization of industrial design services e-commerce, supporting the expansion of technical service function modules, the new service model combining online and offline provides services for product industrial design activities, and ultimately drives technology transfer and industrialization development.

3.2. Technical process of building a cloud service platform

In the process of establishing an industrial design cloud platform, the core technology of each different step will also be different. The technical key to the construction process of the industrial design cloud platform is how to accurately determine the technical indicators of each company.

There are two difficulties in obtaining accurate technical indicators. Firstly, the target of the project team is to obtain accurate technical indexes much as possible. However, from the perspective of processing enterprises, they tend to improve their technical indexes and report the fake parameters. Secondly, some companies' equipment has been used for a long time and it is impossible to confirm accurate indicators. Therefore, above this kinds of situation, the project team should know about the technical indexes on the one hand, and on the other hand, it is necessary to determine the confirmation technical parameters through various ways (such as the Internet) to confirm the information of the equipment brand and date of manufacture. This work is not too difficult, but it takes a plenty of time and requires a lot of work.

Therefore, after standardizing the construction process of the cloud product platform, it is mainly divided into the following stages, as shown in Figure 3.

![Flow Chart](image-url)

**Figure 3. Cloud platform construction flow chart.**

The first stage is the preparation stage: the goal is to sift relevant information. The main content of this phase is:
(1) Establish a project team and identify researchers;
(2) Formulating an implementation plan;
(3) Sifting material categories: first of all, to determine the direct relationship with industrial design, which will directly affect the type of process design of the product;
(4) Defining the specific direction of the type of companies which have been collected, as well as the type of materials, and the way of processing;

The second stage is the start-up stage, with the aim of identifying information of the preparation stage and sampling the information for relevant companies and technologies:
(5) Collecting a large number of relevant information in the first phase and gathering for a database, then verify and accept the acquired information;
(6) Organizing the view exchange activities between design business people and processing enterprises, inviting representatives of design companies and representatives from processing manufacturers, so that the processing factory can deeply understand the technical requirements of the design companies, also, it enables the design company to get further understanding about actual manufacturing process. This will enable both parties to get further interconnection with technical issues in the design work.
(7) Checking the survey information once again, in order to ensure the accuracy and practicability of the platform information, the members of the project team need to conduct a field visit to each processing enterprise that can have an in-depth understanding. Some companies have a strong awareness of privacy protection and are reluctant to disclose information about the company’s equipment brand and processing details. In this case, it is necessary to persuade through the multiple communication of the group members, so that, to confirm the details of the information such as processing equipment, processing accuracy, processing quality, and processing costs.

The third stage is the summary stage, which aims to eventually build an industrial design cloud platform:
(8) The small group needs to visit the relevant enterprises, and obtain the information of the processing enterprises. In order to enable the design companies, designers and other design workers to understand the relevant processing information of these companies, the propaganda group has carried out the processing enterprises. The classification is divided into four categories according to plastics, metals, wood and ceramic lamps. The promotion includes four types of materials processing technology and common surface decoration technology. Designers can search for specific enterprises on the platform according to their own needs.
(9) Timely and effective communication of platform, so that design companies, designers and other design workers can not only find the contact information of processing enterprises in the “Processing Companies Technology Information Platform” in the “Industrial Design Cloud Platform” Information such as address, processing information, etc., but also can leave a message on the platform, asking relevant requirements and problems, project members will provide timely answers and help according to relevant issues, and establish a real-time communication on the platform for the design company to processing companies, as well as design a convenient and fast communication and cooperation platform for design workers and processing enterprises.
(10) Comprehensively organize the research technical data and the information that companies demanded, and upload data for modification and addition on this basis.
(11) Information platform interaction design. Project team members need to regularly organize relevant feedback problems and also the information requirements by companies, and update the cloud platform service system, at the same time, the platform’s interface design should base on user experience, to enable consumers could quickly find the information they need.

3.3. Industrial design cloud platform builds results
In fact, the establishment of the cloud platform information is a long-term through “injection-improvement-promotion” process. After the cloud platform project team has completed finish the planned tasks, they can continue to collect some valuable processing companies’ information, such as
the new powerful emerging enterprises in plastic moulding and metal processing, as well as some minority companies focus on processing and manufacturing technology. Devoting to make it becomes a more complete database planform, and continue to link Industrial Design Industry Chain closely, enable the Industrial Design Industry Chain to operate healthily, Increasing the value of the original products, and finally realize the adjustment and upgrading of China's industrial structure.

Taking “Sichuan Industrial Design Cloud Service Platform” as an example in Figure 4.

The processing technology information platform as the bridges to communicate among the majority of design institutions and product development enterprises and processing (OEM) enterprises. In the construction of the “SCID Platform” module: a professional and effective information database is built, which includes the detailed technical information of 113 processing enterprises, and the tasks were exceeded than we planted. Among them, there are 27 plastic mold enterprises, 24 mechanical manufacturing enterprises, 22 sheet metal processing enterprises, 14 timber enterprises, 25 coating and printing enterprises. From the perspective of the type of these enterprises, that include our plants before: the 4 types of materials processing manufacturers in plastic molding (plastic production equipment), metal, wood, ceramics. Among those information, mainly in the plastic molding manufacturing enterprises and metal processing enterprises technical information, these two types of processing methods account for more than 95% of all manufacturing information. In the expected aspect of the “SCID Platform” project is: from the basic formation has been collected, the project team began to provide data to relevant enterprises and design practitioners (mainly for some industrial design enterprises in the local region and the industrial design school of universities), these groups are potential users of the database planform in the future. These data have played a very important role in the business work in related companies. In addition, after the technical information database of the processing enterprise went online, it has generated a large amount of traffic (page view) without any publicity, and gradually exerted its value. The project team plans to carry out appropriate publicity. It is believed that with the development of publicity work, the number of users will have a significant increase, and its value will be better utilized in industrial design of the local region.

Figure 4. "SCID Platform" page information.
4. Appendices
By analysing the existing "link breaking" problem in the industrial design industry chain, this paper proposes to build an industrial design cloud platform on network, which aims to make the industrial design developed to an “industrial chain”, by increasing the connection between the upstream and downstream enterprises in the industrial design industry chain, not as an independent link. Meanwhile, taking the “SCID Platform” as an example, showing that establishing the industrial design cloud platform can not only directly enhance the efficiency of product design and development, as well as enhances the quality of design and development, but also brings opportunities of market to processing enterprises and makes contribution to the entire industry chain for developing. The value of this platform is mainly reflected in:

(1) It can greatly improve the efficiency of product research and development in industrial enterprises;
(2) Efficient and convenient supporting services could promote independent innovation;
(3) Effectively reduce the cost of innovation in enterprises;
(4) Enterprises obtain the cutting-edge in industrial design and product innovation methods through platform interaction.

Acknowledgments
This research is supported by the Science and Technology Project of Sichuan Province (Grand No. 2015GZ0080).

References
[1] Liu G.Z., (2014) Shaping the design innovation of manufacturing enterprises [J]. China new time, 10: 50-55.
[2] Fan J., Zheng Q.W., Mei J., (2004) Applied industrial economics [M]. Economy and management publishing house,
[3] Li A., (2014) Design driven economic change-the rise and challenges of Chinese design industry [M]. China machine press.
[4] Luo J.Y., (2018) A modular method of adaptability-oriented product family [D]. East China Jiao Tong University.
[5] Ji H., (2012) Product platform design services based on cloud computing[D]. China academy of machinery science and technology group Co., Ltd.
[6] JS Fan, SH Yu, et. al. (2019) Multi-objective creative design evaluation method for industrial design cloud service platform[J]. Computer integrated manufacturing system, 25(01):173-181.