Chip Manufacturing, Data Integration and Transmission

Abstract: With the wide spread application of Chip in daily life, like Smartphone, tablet PC, biochip, etc. Chip manufacturers have been raising their requirements on the Chip manufacturing data transmission. In this paper, under the concept of cloud manufacturing, the manufacturing data transmission platform is assumed established, with the application of jQuery technology, the way to realize lightweight design of Chip data interface is explored.

Keywords: Chip Manufacturing; Cloud Manufacturing; Data Transmission; jQuery Technology

1 Introduction

Due to the rapid development of science and technology, the replacement rate of smart phones, tablet PCs and other products are also growing fast, therefore, electronic products are increasingly demanding on chip, the global semiconductor market is getting more and more prosperous. At the same time, consumer electronics and mobile Internet are closely connected, which will continuously expand the application surface of network accessible terminal products like smart phones, tablet PCs, smart TVs, etc. Based on the soaring demand of electronic products, the demand for chips will continuously rising; undoubtedly, it will enhance the chip manufacturing front and rear ends' data transmission in the cloud platform.

Regarding the chip manufacturing process, concerning of varying demand of different users, faster replacement of chip is needed. In order to obtain greater profits, chip manufacturers have to introduce new technologies and equipments constantly, therefore, the cost for manufacturing will be increased [1]. During the manufacturing of chip, huge amount of date will be produced, this paper concentrates on the research of establishing a data cloud platform during the manufacturing data's transmission process, which will enables manufacturers to achieve Chip Manufacturing Front-data in a more efficient way, compared with before.

*Corresponding author: Ning GUO, School of Mechanical Engineering, Hubei University of Technology, Wuhan, China, E-mail: ningcountry@163.com
Yao-he LIU, Ming-hui YAN, School of Mechanical Engineering, Hubei University of Technology, Wuhan, China
2 Chip manufacturing data storage and retrieval

The manufacturing process of chip is divided into two parts: Front End and Back End. Front End, meaning the front process of chip manufacturing, which including Lithography, etching machines working, washing machines working, ion implantation, chemical mechanical planarization, etc. Back End, meaning the back process of chip manufacturing, it mainly contains separating the device on wafer, SMT assembling and encapsulation, etc.

Development of economic globalization has led to the development of the globalization of production, a joint production of the product value chain can be completed by different companies in different countries. The process of chip manufacturing, is also such a process. That is, the Front End manufacturing and Back End manufacturing is conducted in different places, even for Front End manufacturing, different parts can be done in different places. However, in the chip manufacturing process, the Back End manufacturing depends on the Front End manufacturing data. Without Front End Manufacturing date, it would be difficult for the Back End Manufacturers to conduct the following producing.

Nowadays, with the rapid development of manufacturing industry, Cloud Manufacturing is gradually introduced into modern manufacturing, especially semiconductor industry. Taking reference to cloud computing thinking, Cloud Manufacturing is developed based on the concept of “manufacturing as a service” [2]. The purpose of rising the idea of Cloud Manufacturing is to lower manufacturing waste of resources, make use of information technology to achieve a high degree of shared manufacturing resources. The establishment of shared manufacturing resources in the public service platform, can contribute to putting social resources in the public service platform, providing needed manufacturing services for users, in this way, business users can on the one hand saving the cost of buying processing equipment, reducing the waste of resources, on the other hand, manufacturing service is obtained. Under assumed circumstance, cloud manufacturing can achieve a product life circle’s Related Resources Integration [3]. In this way, users can easily get access to variety of manufacturing service, just like using water, electricity and gas. Thus, when Front End semiconductor manufacturers input the manufacturing date into cloud platform, Back End semiconductor manufacturers will be able to download the date according to their demands, does not need to get access into all the data. This will not only reduce the occupation of funds for enterprises on information investment, but also it will substantially help them to save cost.

As a matter of fact, the development of the semiconductor industry is relatively slow in China, though benefits from economic globalization, the export limiting of some technologies and equipments to us have been relieved, however, the key technology and equipments of chip manufacturing is still blocked. So that, the developments of China’s semiconductor industry is slow, still unable to meet the domestic demand for the chip industry. Among the manufacturing process of chip,
the Front End’s date storage is pre-recorded during overseas production environment, and the equipment to input the chip date is also produced overseas. Therefore, as most of the manufacturing equipments cannot be produced in domestic, we have to fully adopt foreign advanced countries’ equipment, while the imported equipment is extremely expensive. If not introducing overseas advanced equipments, without the Front End manufacturing data, when manufacturing chip Back End in domestic, it will cause some problems like chip size error, and electrical characteristics instability, etc. Thus, the domestic semiconductor industry’s technical level is difficult to achieve transcendence, which greatly effects the development of domestic semiconductor industry.

In order to solve the problems in Front End date transmission, a cloud manufacturing platform is called to be built up. As showing in Figure 1.

![Figure 1. The cloud platforms for chip manufacturing data](image)

### 3 Chip manufacturing data extraction size adaptation

Data transmission and Integration during the chip manufacturing process is like the current Mobile Internet date transmission. Result of the rapid development of Mobile Internet and smart mobile devices (for example, Smart Phone), the traditional network infrastructure is gradually shift in the direction of Cloud Computing. In order to realize automated on-demand, Cloud Computing needs to configure fast on Terminal Device, under the facility of Data centers, servers, storage, Lightweight design software and
operating system. Data size adaption, means the Front end and Back end data should match each other [4]. To better understand the data size adaption, here is a simple sample, see Figure 2. From Figure 2, we can find obviously, the firefighter’s gun should be connected to the hydrants, while general household faucets should not be connected to the hydrants, otherwise, it is not match. In the design of things, there is also data size adaptation problems existed among the mobile terminal and back-end. Which means, if the Cloud drive cache is oversized (data transmission fluent or bandwidth flow abundant), perhaps there will be a resource waste problem; on the contrary, if the Cloud drive cache is too small, it may cause date transmission uneasy or even blocked.

![Figure 2. Civil piped water supply adaptation](image)

The biggest challenge for Internet of Things mobile terminal design is that the hardware design cannot be completed independently, it must rely on back end software interaction model adaptation. The mobile terminal design system is huge and complicate, result in the uneasy to fine balance point in design. Besides, mobile search needs optimization, the mobile search is very different with traditional Internet search. Moreover, traditional Internet date cannot be fully displayed on a smart mobile device, there must be a conversion process to help resolving the fast refreshing by users, so as to provide better user experience. However, traditional Internet data is normally stored in relative date base, when the date base reach a huge level, it easily cause searching time consuming. Therefore, it is necessary to introduce Lightweight Database and some related technology, such as Mongodb and Restful Web Service. Foreseeable, this will lead to a challenge on technology innovation for software designers.

Nowadays, along with the rapid growing of Internet and the wide spread of 4G technology, mobile terminals have been increasingly common used in daily life. There are mainly two problems existed in mobile terminal application: firstly, due to the
need of meeting with different application logic, the exploring is very complicated; secondly, facing with verified mobile terminal application, the adaption workload is huge and facing great pressure. Thence, based on the concept of traditional middleware and mobile middleware, an mobile middleware architecture which can adapt varied of mobile terminal is designed. Also, the specific supporting method including key visual development environment, simulation running engine, application generation engine and cross-device support engine should be provided, so that the exploitation of mobile application can be more easy to handle and visible. Self adaption can be achieved depends on different model of mobile terminals, hence, the key problem of terminal support in mobile application popularizing is resolved [5].

4 The wcf framework for chip manufacturing data

4.1 Brief Introduction of WCF

SECS/GEM is the common used standard in Semiconductor Industry, also in China, this standard is adopted by our chip manufacturing enterprises. In highly automated chip manufacturing plants, the manufacturing procedure and whole process is controlled and monitored by CIM (Computer Integrated Manufacturing) system, this will help to reduce errors during the manufacturing process, further, it will lower the cost and improve products quality. However, because the manufacturing process are different, not only the equipments used for production are verified, also equipments from different manufacturers are not in the same parameter. As a result, this will make CIM Automation Management conduction even difficult and complex. Under normal circumstances, when supplying Semiconductor Equipments, equipments suppliers will also provide SECS/GEM software interface. But for Automation Software Integration, different equipments suppliers do not have communication protocol as a common principle [6]. Equipments suppliers can sometimes do not open communication protocol and interface software to semiconductor manufacturers, so semiconductor manufacturers have to build up their own software connection, leading to a huge increase on the program expense [7]. Besides, facing with different manufacturers’ equipments, only SECS/GEM can be used to comply the management of recipe as well as each different parameter. However, as the recipe format are settled verified by different suppliers, lots of equipments encryption is unable to be resolved, this will called for another exploitation by semiconductor manufacturers, referring to the SECS/GEM protocol.

WCF (Windows Communication Foundation) is an application framework exploited by Microsoft, being used to support data communication. So WCF can be translated as Windows Communication Development Platform. Integrated original Windows communication mechanism, knowing as.NET Remoting, Web Service and Socket, and merged the related technology of HTTP and FTP, WCF is the best practice to develop distributed applications on Windows platform.
The advantages of WCF are as below: Firstly, the unity of development. WCF united the technology of Enterprise Services, Messaging, .NET Remoting, Web Service, and WSE, contributed to the development and deployment, reduced development complexity. Secondly, WCF can achieve Multi interoperate. It applied the SOAP communication mechanism, which ensured the system to be interoperable, controlled, even under different development languages, cross-process and cross-machine and even cross-platform communication can be conducted. Thirdly, it can provide higher level safety and reliance. The last but not least, WCF can support multi-vessel message exchange patterns, for example, request–response, Simplex, duplex, etc. The WCF framework model shown as Figure 3.

![Figure 3. WCF frame model](image)

To sum up, WCF is a good option to comply SOA. With the adoption of WCF, Cross-platform and cross-language connection can be realized seamlessly, thus will enable Web service to be mutual transferred cross-platform and cross-language. The technology can overcome the problems encountered in chip manufacturing during cloud data transmission; it is facilitative to large application program development.

### 4.2 WCF Framework

Same as traditional distributed communication frameworks, WCF essentially provides a cross-process, cross-machine cross-network service call [8]. Here below to create a simple WCF service and users program, and use WCF to test the users program.
**Step 1:** To start the development Web server, load the WCF service information, expand the reference and click OK to add the service reference, as shown in Figure 4.

![Figure 4. Add Service Reference](image)

**Step 2:** Using WCF to test users program. See Figure 5: The request and response when using WCF to test users program.

![Figure 5. WCF Test Client](image)
Part of the code is as following:

```csharp
using System;
using System.Collections.Generic;
using System.Linq;
using System.Text;
using System.Threading.Tasks;
using Client.ServiceReference1;

namespace Client
{
    class Program
    {
        static void Main(string[] args)
        {
            string numericInput = null;
            int intParam;
            do
            {
                Console.WriteLine("Enter an integer and press enter to call the WCF service.");
                numericInput = Console.ReadLine();
            } while (!int.TryParse(numericInput, out intParam));
            Service1Client client = new Service1Client();
            Console.WriteLine(client.GetData(intParam));
            Console.WriteLine("Press an key to exit");
            Console.ReadKey();
        }
    }
}
```

This example creates a simple Web service and console users application program residing on the Web server, and use the WCF Test Client Program to inspect and invoke the service created. The default VS template was applied for WCF project, the operating defined by the default template can be used without any need to adding new code. And in the file IService1.cs to define the data agreement Composite Type which can be provided to the client application through the metadata. In IService1.cs file it also contains the service agreement and the agreement is defined as an interface with Service Contract characteristics. WCF service departs the implement classes from service interface, so that users does
not need any information about the classes, and the functions that classes may contain is far more than the function of service implementation, or even a class can implement multiple service agreements. The configuration files Web.config of the WCF service is a feature extracted from the .NET remote technology and it can handle all types of WCF services and the client program WCF serves. The test client allows input of parameters to be used, calls the method, and then displays the results, all of which do not require customers to write any code. We have also checked the XML we send and receive for obtaining the results, and find the information has very strong technicality. This is why we select WCF as an application program framework of data communications.

5 The interface design of the chip manufacturing data

5.1 jQuery Page Design

In the process of chip manufacturing, we need to extract data of former procedure from a cloud platform and display it on the terminal page. Today, jQuery has become the most popular java script library and in the world’s top 10,000 sites which are visited most, more than 55% of the users are using jQuery [9]. Compared with other page design technology, jQuery technology has the following advantages: first, jQuery is a lightweight java script library compatible with multiple browsers. It’s easy to handle and allows the application developer to get the most interface design by writing the least codes, providing the developers with different effects and features. Second, jQuery has a wide variety of document instructions and very detailed applications, and it also has a number of optional plug-ins, and the developers can select the appropriate characteristics according to different needs. Third, jQuery enables on the user’s html page that the code and html content keep separated, bringing the visitors totally different browsing experience.

Due to jQuery’s wide application and its unique advantage, to better display the chip data, hereby we use jQuery technology to proceed page design. Figure 6 shows the basic data table designed with the use of jQuery.

5.2 jQuery Mobile Interface

With smart phones, tablet PCs widely used, the mobile data terminal display has also become an important part of the front end data presentation, and this article proceed the design of mobile terminal interface by using jQuery mobile. The features of jQuery Mobile are: small frame, containing 12KB of JavaScript library, 6KB CSS and few icons, and supporting both low-end and high-end equipment at the same time.
By using the jQuery mobile framework and Restful Web Service method, chip manufacturers can query and access into real-time business in the mobile terminal (such as smart phones) anywhere and anytime, for example checking the chip's size, thickness, diameter, etc. before chip manufacturing, and sending the data to chip's production and processing center, which can greatly improve the chip production efficiency. This dynamic, real-time data acquisition can make the chip makers timely, comprehensively and accurately grasping the information of chip, and also making the workers, technical administrators and other specific executors better obtaining the chip's information.

6 Conclusion

As the demand for smaller, thinner and lighter mobile devices continues growing, and the intelligent internet-work equipment, data and video content expanding explosively, the needs of mobile data transmission promotes rapidly, which will inevitably bring for the chip makers challenges and opportunities. Data size adaption plays an important role in the data integration and transmission of chip manufacturing. With the adoption of WCF, Cross-platform and cross-language connection can be realized seamlessly. To study the data integration and transmission in chip manufacturing is of great significance for the development of China's semiconductor industry.

References


