EasyChair Preprint

№ 489

Design and Development of Tian-He Render Cloud Platform Considering the Background of Industrial Internet

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September 6, 2018

DESIGN AND DEVELOPMENT OF TIAN-HE RENDER CLOUD PLATFORM CONSIDERING THE BACKGROUND OF INDUSTRIAL INTERNET

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ABSTRACT

Cloud platform is the result of years of evolution since the first generation of computers. It is a natural evolution from the era of central mainframe to the age of distributed master-slave architecture and the age of the Internet where companies can connect the world via the global network of computers. In the process of rendering and simulation, many small and medium-sized companies have the problems of poor convenience and hardware performance bottlenecks. Firstly, aiming at saving time and expense, this paper presents an approach to these problems considering the background of the Industrial Internet era and then discusses how and why this service mode and characteristics of Cloud platform can solve these difficulties. In addition, through the analysis of the value chain of production activities, this paper analyses the potential of a new mode of operation which is the deep integration of traditional manufacturing industry and internet. Finally, an application case of Tian-He Render cloud platform is applied to verify the validation and feasibility of this mode of operation.

Keywords: Cloud Platform, Industrial Internet, Tian-He Render Cloud

1 INTRODUCTION

Germany has advocated “High-tech strategy 2020” as one of its top 10 future projects aiming to lead a new generation of revolution in the industrial field and create a new era of production and operation combining flexibility and individuation, namely the Industry 4.0 [1]. Industry 4.0 integrates physical manufacturing and virtual network deeply and conducts digital management of the whole lifecycle of products based on information technology. In China, many small and medium-sized manufacturing companies simulate production process by means of rendering and simulation to adjust various parameters timely and meanwhile predict production results. However, while optimizing production and discovering potential problems in time, these companies are worried about the problems as follows: 1. The expense of purchasing infrastructure, license agreements and professional software services. 2. The time cost of supplier evaluation and standard procedures for purchasing services from large suppliers. 3. Software and hardware performance bottlenecks during peak business hours and equipment aging problem during hardware idling.

To meet the challenges mentioned above, one company can log in a management platform separated from the production system via a fixed or mobile device at anytime and anywhere, starting the virtual compute nodes of the platform in a short period of time to run and finish rendering and simulation, then closing these resources. The company can also adjust the number of nodes depending on how busy the business is to achieve the purpose of cost saving. Such a management platform is Cloud platform. Based on the Tianhe-1A, which ranked as the world’s fastest supercomputer, Tian-He Render cloud platform can realize the super-scale

rendering management of thousands of nodes concurrent rendering. The platform is based on the SaaS mode and provides perfect support for mainstream application software.

This paper proposes a manufacturing mode that deeply integrates the process of rendering and simulation with the internet and Cloud platform through the analysis of the value chain of enterprises considering the background of Industrial Internet and takes the Tian-He Render cloud platform as a practical case to demonstrate the validation and feasibility of Cloud computing.

2 INDUSTRIAL INTERNET AND CLOUD COMPUTING

2.1 Industrial Internet concept

Industrial Internet [2] is the result of the integration of industrial system, advanced computing, analyzing, induction technology and the internet. At present, Chinese manufacturing industry is in a critical period of development from digitalization, informatization to intellectualization. With the convergence of manufacturing and digital economy, as well as the continuous integration with information technologies [3] such as Cloud computing and Big data analysis [4], the Industrial Internet comes into being.

According to its superiorities in equipment manufacturing and automation of production line, Germany has proposed an intelligent transformation scheme from the manufacturing side of its products with the application of the Internet of Things [5] and the Cyber Physical Production System [6] in the manufacturing process. Some main companies in the United States have begun the strategic deployment of a new generation of industrial technology. The United States treat intelligent equipment, intelligent system and intelligent decision as key elements of the Industrial Internet, establishing the Industrial Internet platform, data analysis algorithm and application software. The development and promotion of Predix software platform motivates the industry's exploration of Industrial Internet mode [7].

2.2 Exploration of Industrial Internet structure

The Industrial Internet is the integration of traditional industry, internet technology and Cloud computing. Figure 1 illustrates that the deployment planning of the Industrial Internet includes three dimensions.

2.2.1 Vertical deployment based on the enterprise informatization construction

Vertical deployment refers to the end-to-end digital integration within the company. In the manufacturing execution layer at the bottom, multi-source data of all kinds of parameters of the production equipment in the factory can be collected by the sensors. Data layer includes production equipment data and data from ERP, MES, QMS, OA and other information systems. This layer contains all kinds of information within the company. However, due to different information standards and format specifications in different information systems, although the amount of data is huge, it cannot be applied for data analysis directly. All kinds of data in the data layer should be pre-processed such as data flatting, feature extraction and convention and then data extraction, transformation and loading, finally stored into the ODS, Data Warehouse and Data Market [8]. In the data processing layer, data format is standard and unified, so the data can be used for extensive analysis. Next, the user, production process, production line, equipment, product and the whole factory need to be modeled in the data modelling layer. In the data analysis layer, various kinds of data inside the company can be analyzed with the help of professional data mining algorithms [9]. Finally, the results are applied in the top layer, the decision and control application layer to realize intelligent production, cooperative organization, personalized customization and service manufacturing

2.2.2 *Horizontal deployment across the companies*

Horizontal deployment refers to the integration of information and services between different companies besides upstream and downstream of the industrial chain. The information of external suppliers, competitors, outsourcing enterprises, users, products and other industrial service platforms is integrated into the data layer of the company structure through the application interface to realize horizontal expansion of the Industrial Internet and value integration and collaborative optimization of the whole industrial chain.

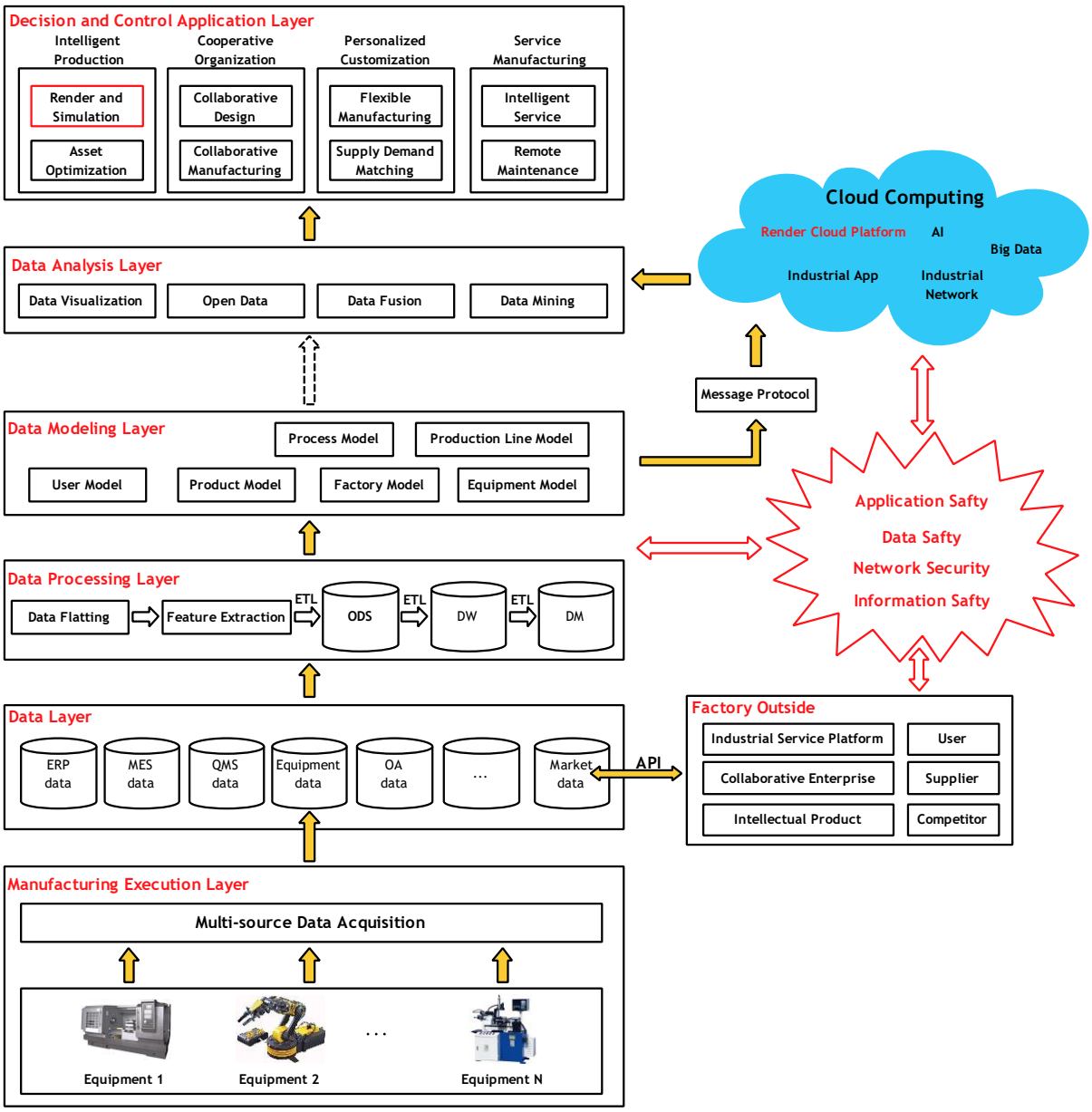

Figure 1: Industrial Internet Architecture

2.2.3 *Cloud deployment based on industrial big data and artificial intelligence*

Vertical deployment helps company complete single point informatization construction, while horizontal deployment helps the linear expansion of the whole industrial chain including this company itself. With the help of large-scale Cloud platform, various companies can be connected, thus achieving the three-dimensional expansion between enterprises.

The Industrial Internet can supply information connection between each link of the production process to the company and help the company realize the optimization and transparency

management including equipment, manufacturing, BOM, production plans, design and production scheduling, human resource management, supply chain, inventory, marketing and company asset management. One company can deploy Private cloud platform, Public cloud platform as well as Mixed Cloud platform which may depend on different degree of data sharing. Cloud platform can provide companies with Big data analysis, artificial intelligence or other applications, which means a kind of information and service integration [10].

2.3 Cloud service mode and Cloud computing features

2.3.1 Cloud service mode

The Figure 2 shows that there are three Cloud service modes: Software-as-a-Service (SaaS), Platform-as-a-Service (PaaS) and Infrastructure-as-a-Service (IaaS) [11]. Each pattern reduces the complexity of the consumer building and deploying the system through different degree of resource abstraction.

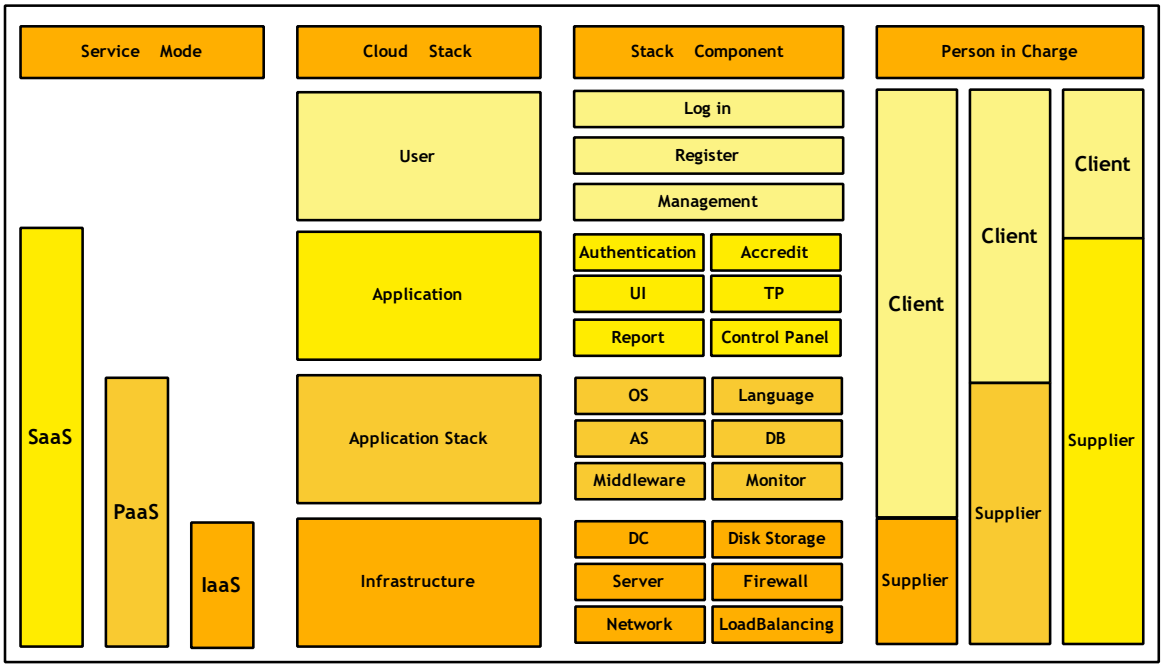

Figure 2: Cloud Stack

1. Software-as-a-Service (SaaS)

SaaS delivers complete applications to the consumer as a service. What the customer needs to do are configure some specific application parameters and manage the users. The service vendor is responsible for all infrastructure issues, application logic, software deployment and all the matters that related to the delivery of the product or service.

2. Platform-as-a-Service (PaaS)

PaaS provides services to the consumer in the form of platform service. The service vendor provides the customer with a management application platform and a set of tools to accelerate the development speed of the target software. The developers can integrate many reliable third-party solutions with simple API.

3. Infrastructure-as-a-Service (IaaS)

IaaS provides services to the consumer in the form of infrastructure service. The service vendor encapsulates the management and maintenance of the physical data centers or other infrastructures into a series of services so that the customers can deploy and run in several minutes depending on their actual needs by calling the API or logging into the web administration console.

2.3.2 Cloud computing features

1. Broadband network access

Cloud platform provides API for RESTful style, enabling easy connection and coordination between various of services. It can build web pages, mobile phone pages, tablet PC pages and keep them synchronous all the time. Users can access the Cloud platform via the network and switch between different devices or browsers flexibly. The platform will translate the code into different user interfaces that worked well on different devices to achieve the purpose of convenient.

2. Rapid elasticity

Cloud platform has an almost endless pool of resources for customers to dynamically increase or decrease the amount of computing resources to set up their rendering or simulation solutions. This allows the real-time response during peak business hours, which can solve the problem of software and hardware performance bottlenecks and equipment aging problem during hardware idling.

3. Quantifiable on-demand self-service

Customers only pay for the resources they consumed and enable or shut down Cloud services whenever they need to expand or reduce their business. They do not need to purchase physical hardware any more so that they can save much time and expense.

3 DEEP INTEGRATION OF TRADITIONAL MANUFACTURING AND INTERNET

As shown in Figure 3, the value elements in production activities [12] from top to bottom in order are: idea innovation and demand creation; raw material, technological process and fundamental S&T; key equipment and components; manufacturing system and process; products and service.

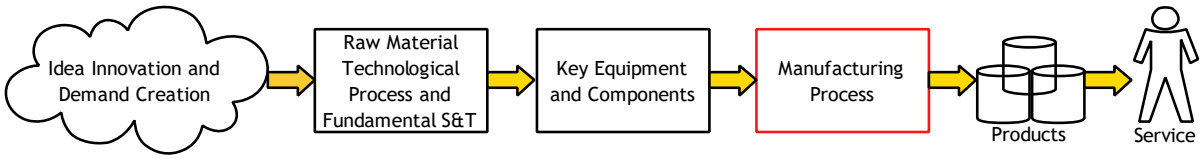

Figure 3: Distribution of Value Elements in Production Activities

The core value elements of the production activities are the innovation of ideas, demand creation and the value-added services lying in the upstream and downstream of the value chain. These are the two things that America is best at and cares most about. Two major manufacturing powers, Germany and Japan, have obvious advantages in materials, processing technology, enabling technology, key equipment and components. Compared with the three developed countries above, China has certain advantages in production process and manufacturing system but in other parts are at a disadvantage.

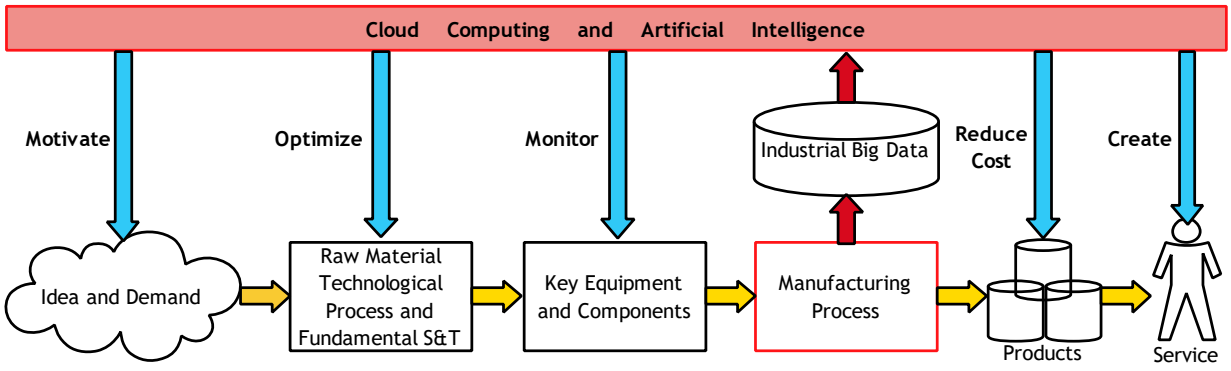

Figure 4: Reverse Definition with the Use of Industrial Big Data

However, China has the world's largest customer bases and the most abundant application scenarios. If combining industrial Big data and internet technology, China will consolidate its advantage in the value chain while making reverse definition with the usage of information technologies such as industrial Big data [13], artificial intelligence and data mining by means of Cloud platform. In this way, China can capture customers' potential demands, optimize production process, monitor key equipment to discover problems and seek new space for customer value-added services as Figure 4 shows.

4 APPLICATION CASE OF TIAN-HE RENDER CLOUD PLATFORM

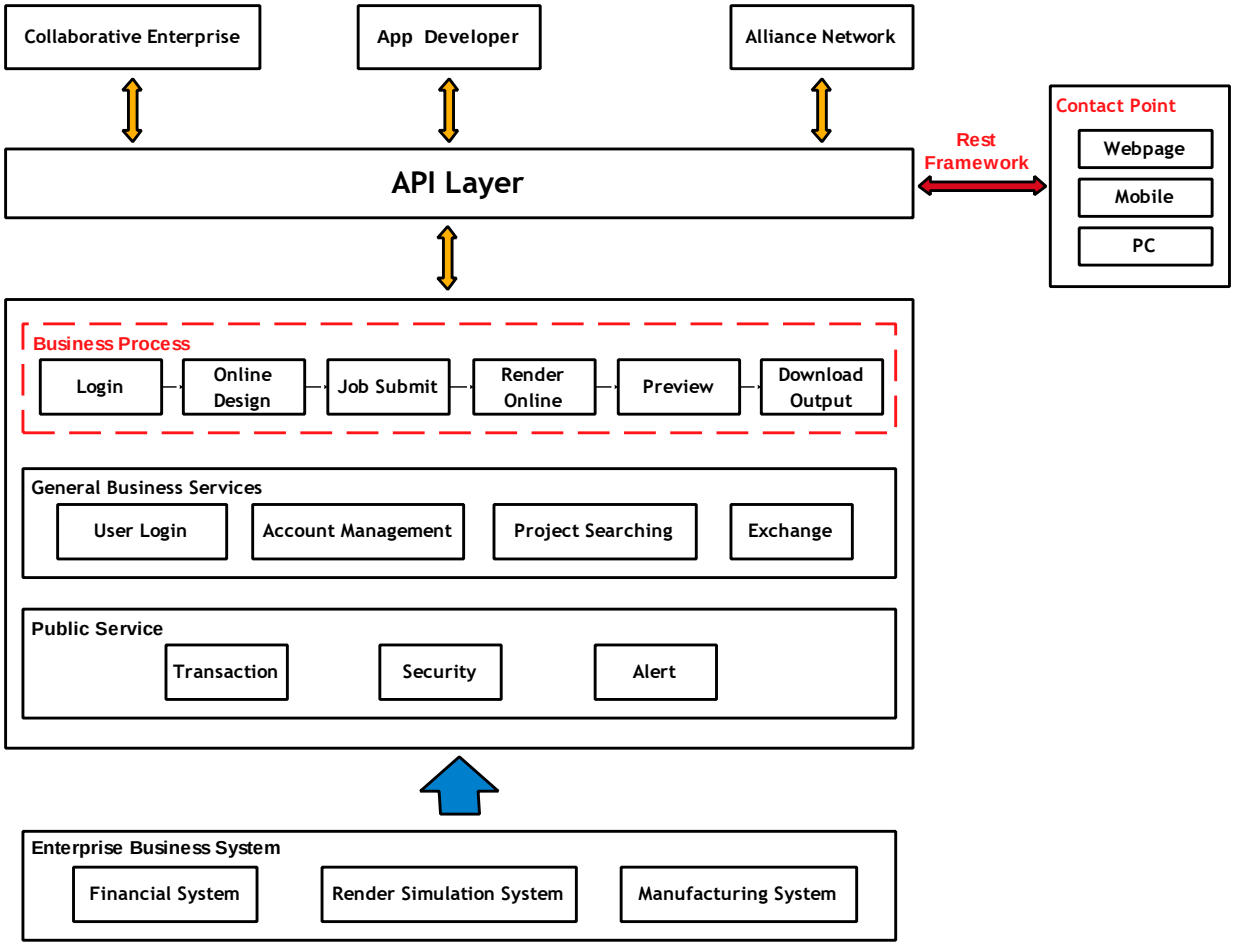

Figure 5: Business Structure of Tian-He Render Cloud Platform

The user inputs username, password and verification code from the client-side to login the Tian-He Render cloud platform. One can choose to design online or upload his project file locally. The Render cloud platform uploads the project files to the Cloud storage via the Render API and daemon and update the status information in the database at set intervals. During the rendering process, the user can check the task progress in real time and preview the rendering effect frame by frame. If problems are found during the rendering process, the user can suspend the job or task at any time and modify the project file until it meets the user's expectations. Finally, the user pays the bill and downloads the output sequence to the specified file.

Tian-He Render cloud platform mainly includes business overview, online design and online rendering functions. Business overview includes task statistics, machine time statistics and node management functions. Online rendering includes operations and query functions for jobs and tasks respectively.

Tian-He Render cloud can help company complete rendering and simulation functions and provide convenient services for enterprise while saving time and costs. It is a successful application case of the integration of traditional manufacturing industry with the internet and Cloud platform.

5 CONCLUSION

Through the Tian-He Render cloud platform, this paper has solved the problems of poor convenience, software and hardware performance bottlenecks during the peak business of rendering and simulation for small and medium-sized companies and accomplished the goal of saving time and expense for the enterprises. Through the study of Industrial Internet and Cloud computing, this paper explored how and why they could solve these problems and through the analysis of the enterprise value chain, this paper discussed the potential advantages of a new business mode which integrates the traditional manufacturing industry with the internet.

Generally, intelligent manufacturing mainly refers to the automation production line, the application of robots and "black lamp" factory. However, the concept of intelligent manufacturing should be far from that. From the external customer demand creating, raw material procurement, value-added services to the internal product design, research, development, production and sales of the whole company, everything should be seamlessly connected and well controlled. On this basis, with the help of industrial Big data, artificial intelligence and Cloud platform, it is possible to achieve the overall optimization of the whole business activity.

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