

Research on Internet Helping Traditional Manufacturing Industry: A Case Study of Sany Heavy Industry and Rootcloud

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ABSTRACT

Industry 4.0 brings not only opportunities but also great challenges for enterprises. It is hard for those industries and companies who could not grasp opportunities and make good use of emerging technologies especially the industrial Internet of things to transform from traditional manufacturers to intelligent ones. More seriously, chances are that the traditional manufacturers could no longer exist. All the companies are trying their best to find solutions but in vain. As such, this paper presents a case study about Sany Heavy Industry (Hereafter referred to as SANY) and Rootcloud which is hatched by SANY through analyzing the process of cultivating Rootcloud with Kaiser IDEO analysis-synthesis bridge model and discussing the advantages of Rootcloud with radar model. SANY overcame the pain point of excess production capacity by exploring foreign markets. As for the dominant pain point of discrete manufacturing, SANY tried to apply to IIOT and established a platform named Enterprise Control Centre and No.18 plant. Then SANY kept building up its own cloud platform and established Rootcloud to provide intelligent manufacturing solutions.

Keywords: *Intelligent manufacturing, Industrial Internet of things, Internet of things, Cloud computing, Big data*

1. INTRODUCTION

It is challenging for traditional manufacturing industries to keep pace with the industry 4.0 because of the inabilities of using modern technology, and they could suffer insufficiency enterprise vitality and downsizing profits that should be solved quickly. Whereas SANY sets a successful example. COVID-19 outbreak in Wuhan, China, and SANY played a key role in constructing Huoshenshan hospital in the short ten days. Rootcloud platform provided strong background support for all struggling engineering equipment to ensure the efficient operation of equipment in the construction site in addition to real-time monitoring of equipment data changes.

SANY is the first enterprise that applies a GPS system in construction machinery industry in China. It makes efforts to make use of cloud computing, big data, Internet of things and other cutting-edge technologies and has already set a new benchmark for machinery manufacturers. So this article tries to explore the ways for traditional manufacturing factories to intelligent

manufacturing ones by analyzing SANY and tries to find out the concrete solutions for the traditional manufacturers.

The analysis part would apply innovation process, which implements the Kaiser IDEO analysis-synthesis bridge model, as analysis part structure with the following steps. Firstly, identify initial problems of SANY before applied Rootcloud. Second part provides specific issues with secondary research as an observation step. Next, the situation analysis would select related issues, and lead general innovation abstract, which is the web of things solution. The fourth step would provide multiple potential ideas by secondary research with previous solutions as a brainstorm process. The last step would focus on selecting suitable innovation ideas based on innovation strategy, which measures from innovation radar dimensions with priorities sequence analysis, and provides the final innovation solution, the Rootcloud. Next, the advantages of Rootcloud will also be discussed according to the radar model. Finally, the

solutions and advice for the traditional manufacturers will also be analyzed and displayed.

2. CONCRETE

Industry 4.0 is a new industrial stage to integrate manufacturing processes and product connectivity both vertically and horizontally. Whereas, few industries find the potential contributions of the Industry 4.0. Emerging countries such as Brazil haven't made use of advanced technologies like big data and industrial Internet of things (IIOT) [1]. So it is important to use advanced technologies in industry 4.0 to achieve higher profits.

SANY has been investing large amounts of money to apply science and technology and trying to research new technologies since its establishment, especially paying attention to the development and applications of IIOT. Every industry has periodicity, since the second half of 2011, the construction machinery industry has stepped into a downward channel. The year-on-year growth rate of total profit of construction machinery industry continued to drop from 90.70% in 2010 to -739.38% in 2016. So all enterprises in this industry are in urgent need of breakthroughs, SANY is no exception. Analyses of pain points of SANY will be discussed below.



Figure 1. The year growth rate of construction machinery industry in China [2]

A stable decline was witnessed in the construction machinery industry between 2011 and 2015, and a sharp drop existed in 2016 before the industry boomed again in 2017. So it is important for construction machinery industry like SANY to avoid the risks in the industry recession and find an opportunity such as applying for IIOT to maintain and develop.

3. ISSUE ANALYSIS

Discrete manufacture is easy to have chaos even though the assembly line is completely deterministic [3]. First of all, SANY is a representative highly-discrete manufacturing enterprise, thus, its products need to enter loads of different production departments and go through multiple processing steps before becoming final products. All the steps are discrete and managers have to maintain the coordination between the steps, and the quality of each step of the product also needs to be stricter to ensure the quality of the final product. Moreover, each process is scattered in different areas, and the transportation between them not only consumes a lot of manpower and material resources, wastes time, but also weakens its production capacity.

Secondly, the insufficiency of capital is really a big problem. If a company wants to be sustainable, its capital must be sufficient enough to support its existing business and R&D [4]. Although SANY has paid great attention to the investment in production and R&D, the amount of investment in enterprise informatization is still limited. After all, the production and maintenance of large machinery cost a lot, and the investment in informatization will cost more. Additionally, IIOT is a kind of unknown unknowns and it involves high-risks [5]. It means that all the investments could be wasted.

Thirdly, a long cycle from investment to income is needed in machinery manufacturing industry. The cycle is not only influenced by a large quantity of macro-factors like the whole economy but by a larger number of micro-factors such as cost. Each company or the industry will undergo a cycle from the stage of product development to the stage of decline. When the company booms, more employees need result from the sharp rise in sales. However, the fixed cost of employees is not easy to be handled because of workers protection act in the declining stage.

It is worth mentioning that the market is changeable. With the rapid development of Internet technology, user

behavior patterns change a lot, leading to new changes in the industry's production system, supply system, sales system, service system and payment system. Customers have an increasing number of personalized requirements which are hard to be reached by discrete manufacturing.

What's more, we have to admit that Chinese companies no longer have enough relative labor cost advantage over other countries'. The science and technology involved in the production of products require employees to have high-education. Consequently, it is really a large expense for SANY who belongs to heavy industry and employs a large number of workers.

Last but not the least, excess production capacity is a serious problem. With the adjustment of China's economic structure, the construction machinery industry entered a downturn stage between 2011 and 2016. The utilization rate of equipment and the sales volume declined, and the sales volume and growth rate of excavators have dropped to the lowest point in 2015 according to Wind [6]. More serious for SANY, the overcapacity and expenses brought by blind expansion make SANY difficult. It was high time for SANY to find out an effective solution to maintain the sustainability and stimulate itself to grow further.

4. INNOVATION ABSTRACT

SANY suffered two main problems that are excess production capacity and discrete manufacturing. According to Xiang Wenbo, president of SANY, SANY dealt with overcapacity and increased profitability through two international strategies. One of the strategies was cultivating close relationships with the countries along the one belt, one road. Another direct strategy was to try its best to sell products to other countries as many as possible. Furthermore, SANY developed the width of its product line and converted itself from the traditional manufacturing company to a one that has more businesses. According to Off-Highway Research, SANY excavator sales volume was 98705 in 2020, accounting for 15% of the global share, and won the sales champion for the first time [7].

There were not right and ready-made solutions which could deal with discrete manufacturing efficiently, so SANY had to develop intelligent service and management system by itself. Finally, the Rootcloud was born successfully after gigantic efforts. As Rootcloud not only provides a system to achieve collaborative manufacturing of various departments but also delivers real time information to customers by IIOT and cloud computing.

5. SYNTHESIS

The following part would rely on historical information about SANY's development blueprint and data from the article "If you don't turn over, you will turn over" -- how Sany goes through the cycle and conquers the future through "digital transformation"—Jianjun Zhang, Xiaolong Wang (2020) to show the procures of SANY's IIOT. Since 2005, SANY has beginning exploring the zone of Internet of things (IOT). In 2007, SANY started to develop and establish an M2M remote data platform that could help acquire data efficiently and monitor equipment and data conveniently in cooperation with the largest wireless carrier in China, namely, China Mobile. And this project helped SANY handle unstable collective collection and develop monitoring information platforms to some extent. As a result, SANY kept moving on in this way. The M2M remote data acquisition and monitoring platform was enlarged to a large-scale platform in 2009 rather than the small one in 2007. Then SANY created several sub platforms to differentiate functions to deal with production more efficiently and in order [8]. Then SANY tried to practice by establishing a platform named Enterprise Control Centre (ECC) to apply industrial Internet. The No.18 plant which was applied with the most advanced equipment was also created and established. After the implementation of intelligent transformation, in 2014, the No.18 plant saved around US \$15 million of manufacturing cost, increased more than 2000 sets of production annually, and increased more than US \$1 billion of output value annually [9]. In addition, the high-precision processing zone is also one of the characteristics of No. 18 plant. The whole machining area integrates intelligence, flexibility and less people, which can meet the requirements of multi variety and small batch production.

SANY realized that it is the right way for the enterprise to develop and it is not enough to just open a concrete factory, and IIOT should be widely used in the whole production of SANY products. In order to make full use of IIOT, it decided to create Rootcloud which is an independent company to help SANY produce products more efficiently and personalized. The predecessor of Rootcloud is SANY's Internet of things division (ECC). In 2008, SANY connected all equipment products, providing IOT based after market intelligent services, big data R&D and IOT financial services. Briefly, Rootcloud has accumulated more than 11 years of practice.

6. THE COMPREHENSIVE SOLUTION – ROOTCLOUD

SANY has already displayed its advantages and success in the 5 years since it was born. According to dongdong He, the CEO of Rootcloud, Rootcloud has developed

well both horizontally and vertically due to the help of big data, cloud computing and other advanced technologies. Big data helps deal with massive industrial data and make manufacturing industries achieve success [10]. Vertically, Rootcloud makes the most use of cloud computing and links all the parts of the factory and company to achieve high-collaboration. Rootcloud makes use of IAAS level to provide customers with access to cloud storage, network, servers and other computing resources. It also uses PASS to provide big data factory platform as well as developer platform to enable organizations to focus on development without worrying about the underlying infrastructure. Then it

utilizes SAAS to provide software and applications, and conducts service managements and predictions of the conditions of the machines. Horizontally, it tries its best to make balance between the whole product line that from suppliers to distributors to customers and partnerships. Its attempts have made effect. The root cloud platform of Rootcloud helps coordinate all the departments in the company successfully and ensures the real time transmission of information between customers and suppliers. The most important thing is that Rootcloud could offer the whole life cycle closed loop feedbacks.

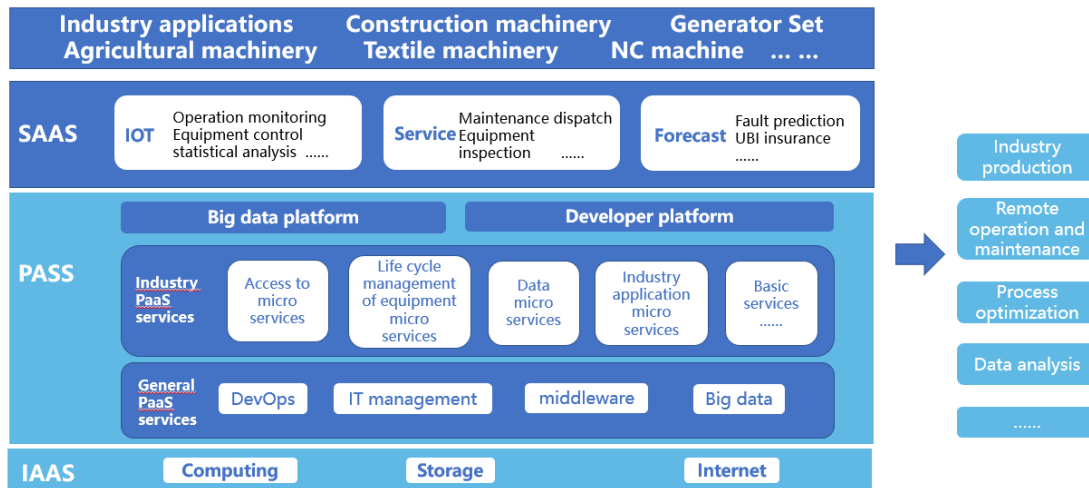


Figure 2. The technical atlas of Rootcloud [11]

The technical atlas of Rootcloud shows the concrete technology of IIOT of its system, including IAAS which deals with computing and storage by Internet, PASS which forms big data platform and developer platform to provide all kinds of services and SAAS which displays the detail services of Rootcloud such as service management and forecasts of the equipment. Then industry production and data analysis and so on could be realized at last.

7. ROOTCLOUD INNOVATION DIMENSIONS BASED ON INNOVATION RADAR

The following part will depict the advantages of Rootcloud depend on the radar model. The overall advantages will be shown first and the detailed advantages will be displayed. The radar model has four parent latitudes and each of the parent latitude has two sub latitudes. The more valuable latitudes of offerings and customers would be extracted and explained in highlight. The latitudes of process and presence would also be discussed briefly. Overall, Rootcloud gathers wide-connection, strong platform, high-safety, high-intelligence and variety-applications together to

provide five dominant service scenarios. It could achieve digital manufacturing, the ability of research and create digital services, business model innovations, aftermarket service and life cycle management of equipment.

8. OFFERINGS DIMENSION (PLATFORM AND SOLUTIONS)

In the latitude of offerings, Rootcloud provides an excellent digital-information platform and good solutions to all kinds of industries and concrete companies. According to the official website of Rootcloud, its platform focuses on building end-to-end deep value solutions from device access and IOT presentation to industry applications. It enables industrial enterprises to implement industrial Internet value solutions with the lowest end-to-end cost, the best efficiency and the strongest reliability. Rootcloud makes the whole process from R&D to production be connected to the Internet to ensure the visual management and control of project overview, remote control, fault diagnosis, positioning and tracking and so on. So open style, collaboration and security are completed and guaranteed at the same time and a

win-win mechanism with ecological partners and equipment manufacturers could be achieved.

In addition, Rootcloud also offers solutions. More than US \$300 million has been invested to develop Rootcloud since 2009. So far, Rootcloud already has 850 thousand pieces of connection equipment and has been able to enable 81 industry segments [12]. Take the textile industry chain as an example, its pain points such as equipment's abnormal monitoring, customers' unable to update the jacquard patterns remotely could be tackled by Rootcloud through Internet box. Online monitoring, real-time remote view of equipment parameters and distribution and after-sales service based on IOT are guaranteed by Rootcloud. The digital Internet platform of Rootcloud makes a big difference to the textile industry.

9. CUSTOMERS DIMENSION

In the customers dimension, customer experience would be improved a lot due to the intelligent manufacturing platform of Rootcloud. In the past, customers were not able to know about the steps of the production of their products from time to time due to the short of technology and convenient platform.

At present, Rootcloud could use its self-developed satellite remote monitoring system to track the use data of each product. In case of failure, it can quickly achieve

accurate positioning through GPS, and find the nearest warehouse for the nearest service car and required parts, so as to provide maintenance services for customers at the first time. Rootcloud makes use of big data storage and analysis platform and is able to achieve two-way interaction and remote control of the equipment. Users can master the status of all aspects of the machine anytime and anywhere through the web page or mobile app. Furthermore, after-sale service has also become more user-friendly and convenient for customers, since the basic status of the device are accessible and workers of Rootcloud could match its service history. Rootcloud would predict the requirements of customers and prepare spare parts in advance. Rootcloud also apply public cloud, private cloud and hybrid cloud to service companies in different sizes. Thus, the customer satisfactions even customer delights could be attained.

10. PROCESS AND PRESENCE DIMENSIONS

Rootcloud develops its supply chain and interact and cooperate with its suppliers more efficiently in accordance to the digital platform, too. And the concrete management organization has been improving. The whole networking has already been promoted a lot and the brand of Roorcloud is now known by an increasing number of industries and companies.



Figure 3. The concept of Radar model [13]

This picture shows the concept of Radar model and the points of the wide between the two circles could be defined differently in concrete surveys.

11. CONCLUSION

This paper analyses the pain points of SANY with Kaiser IDEO analysis-synthesis bridge model and finds two major pain points. SANY explored foreign markets and successfully handles overcapacity. Faced with

discrete manufacturing, it cultivated ECC and the successful NO.18 factory. And it realized that it was indeed to develop Rootcloud to serve not only SANY but other industries and companies. The technology and advantages of Rootcloud platform are discussed with radar model.

Currently, the transformation of the traditional manufacturing industry to intelligent manufacturing industry is a common and serious problem. The

dominant pain points are labor shortage, insufficient domestic demand, low R&D investment and low added value of products. After achieving R&D collaboration and process automation, traditional manufacturing factories need to walk further by using 5G, IOT, cloud computing, blockchain and so on to achieve intelligent manufacturing and intelligent operation and make continuous innovations in the digital time.

SANY saw that in the future, the development of China's industrial Internet will bring tremendous treasure. According to IDC, China's IOT market expenditure is expected to reach US \$255.23 billion, accounting for 24.3% of the global total expenditure in the same period, ranking second in the world by 2022 [14]. SANY has opened up the industrial Internet platform with a continuous investment of US \$150 million and has set up Rootcloud to fill the lack of domestic industrial Internet platform construction, help manufacturing enterprises to apply and implement the IOT [15].

It fully inherits the digital transformation ability of the world-famous high-end equipment manufacturing enterprises. According to the official website of Rootcloud, Rootcloud has covered 61 sub industries, more than 200 industrial enterprise customers, covering most regions in China, and customers from 45 overseas countries conduct online business operations based on the rootcloud platform currently. The rootcloud platform has completed the access of more than 560 thousand high-value equipment [16].

Whereas, here are some uncertainties about the success that SANY already has. For example, 5G that has a high transmission rate, wide connection and low delay has just been formally researched since 2019 in China. One of 5G's three applications, the interconnection of all things (IOT) just begins, the technologies of 5G and IIOT are not mature. Moreover, Rootcloud is a new product whose life is just around five years until now, so it is not serious to conclude its success with such little data. It is likely that SANY fails to find another way that could create a win-win situation. In the future, more data should be collected to ensure the usefulness of Rootcloud. All the companies ought to keep researching 5G and IIOT and try to create new advanced products.

REFERENCES

- [1] Dalenogare, Lucas Santos, et al. "The expected contribution of Industry 4.0 technologies for industrial performance." *International Journal of Production Economics* 204.OCT. (2018):383-394.
- [2] Figure 1. The year growth rate of construction machinery industry in China. Data from Wind.
- [3] Bartholdi, J. J., D. D. Eisenstein, and F. L. Yun. "Deterministic chaos in a model of discrete manufacturing." *Naval Research Logistics (NRL)* 56(2009).
- [4] Figge, F., and T. Hahn. "The Cost of Sustainability Capital and the Creation of Sustainable Value by Companies." *MIT Press* 9.4(2005):47-58.
- [5] Ramasesh, R. V., and T. R. Browning. "A conceptual framework for tackling knowable unknown unknowns in project management." *Journal of Operations Management* 32.4(2014):190-204.
- [6] Data from Wind.
- [7] Data from Off-Highway Research.
- [8] Shan, S., et al. "Intelligent manufacturing in industry 4.0: A case study of Sany heavy industry." *Systems Research and Behavioral Science* 1(2020).
- [9] Data from the report of SANY.
- [10] Jwab, C, et al. "Big data analytics for intelligent manufacturing systems: A review." *Journal of Manufacturing Systems* (2021).
- [11] Figure 2. The technical atlas of Rootcloud. Data from Rootcloud and the Internet.
- [12] Data from Rootcloud official website.
- [13] Sawhney, M., R. C. Wolcott , and I. Arroniz . "The 12 Different Ways for Companies to Innovate." *MIT Sloan Management Review* (2006).
- [14] Data from IDC.
- [15] Data from the report of SANY.
- [16] Data from Rootcloud official website.