

A Brief Analysis of Sustainable Progress of Innovative Research & Development of Chinese Copper Processing Firms—With Japanese Furukawa Electric as a Standard

Boyuan Li

Department of Operation Optimization, Chinalco, Beijing, China

Email: by_li@chalco.com.cn

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Abstract

In comparison with copper processing industrial leader Furukawa Electric Co., Ltd., Chinese copper processing industry faces many shortcomings and difficulties including but not limited to outdated equipment and technologies, low degree of specialization, and unstable product quality. The review of Furukawa Electric's development milestones reveals that Chinese copper processing industry has reached a stage in which it must rely on technological research and development (R & D) to promote sustainable productivity. Chinese copper processing firms have to invest in R & D to promote sustainable technological innovations and to improve the precisions of business practice in order to ensure the firms' improvement.

Keywords

Copper Processing, Research and Development, New Technologies

1. Introduction

Since the 1990s, to increase overall industry technical standard, the Chinese copper processing industry has gradually started to introduce and assimilate advanced foreign technologies and equipment on copper manufacturing process [1] [2]. Chinese copper processing industry has greatly improved by overall technological standard, in terms of production equipment, product quality and production output over the past twenty years of leapfrogging development. However, the challenges Chinese copper processing industry now faces include shortage of upstream resources, and lack of product diversity and technological

innovations. These drawbacks have resulted in low competitiveness, simultaneous usage of advanced and outdated process and equipment, poor degree of specialization, non-homogeneous product quality, and unsatisfactory techno-economic index. These factors have been proven to cause a severe survival crisis for Chinese copper processing industry during this period of increasingly fierce market competition [3] [4] [5]. To improve qualitatively in overall copper processing sector, to promote innovative capability of the industry, and to ensure sustainable development have become priorities for the copper processing industry.

China's neighboring country Japan has excised a huge impact on European and North American copper processing industry from the 1970s to the 1980s [6]. Relying on their technology and advantageous price, Japan has since got hold on a share of the global market. Through close examination and study on Japan's notable copper processing firm, Furukawa Electric, the large gap in technology innovations and product research between Chinese copper processing industry and world's first-class firm is evidently realized. Chinese firms could learn much by analyzing the development history of Furukawa Electric as a reference to develop their own energy efficient, environmentally friendly, modern and advanced copper processing system.

2. The Specialty of Furukawa Electric

Furukawa Electric Co. Ltd. is a firm with a long standing history. The name roots in its creator: Furukawa Ichibei. Furukawa Ichibei was an industrialist from the Meiji Restoration Era in Japan. In 1887, he started a copper resource trading business in 1877 based at Ashio copper mine in the city of Nikko, located at Tochigi Prefecture of the northern Kanto region. Mr. Ichibei extended his copper operation to many other copper mines in Japan and contributed enormously to the development of Japanese mining industry [6]. Mr. Ichibei was called "the mining tycoon" in Japan thereafter. Yamada Wire Manufacture was the predecessor of Furukawa Electric and changed its name in 1905. The goal of the new company was to modernize and to diversify the Japanese copper industry [7]. From its successful manufacture of Japan's first rubber-sheathed cable dedicated to power distribution in 1910, to the establishment of a new electrolytic copper foil manufacturing company for lithium ion battery, Furukawa Electric have come a long way in industry revolution and innovation.

Today, Furukawa Electric is a world leading industry conglomerate with a net capital of 69.395 billion JPY (5.4 billion RMB) [6]. It employs over 4000 employees and operates many subsidiaries, research laboratories, joint ventures and sales point that excel in research, design, manufacture, and sale of nonferrous metal processing [6]. Their success in sectors of metal, machinery, electrical cables, telecommunication, and electronic brings considerable revenue and worldwide reputation.

3. Experiences of Furukawa Electric Development

Japan is a country with very few metal resources. Although Furukawa Electric

started as a copper mining firm, lack of resources forced it to abandon the upstream copper industry and transformed into a copper processing company that focus on downstream manufacture and sale. Throughout this transformation, Furukawa Electric has not experienced an operational depression due to shortage of resources, instead it built an advantage with its technology and equipment to develop and grow. The three key factors that contribute to Furukawa's success can be summarized as:

3.1. Enhancing Product Development and Diversity

From super miniature fiber optic welding machine to the world's longest 500 m high temperature superconducting cable, and to ordinary copper alloy frame material to sophisticated medical stem cell separation equipment, Furukawa Electric applies its processing technology to the fullest. With various patented copper and copper alloy, Furukawa has extended its supply of copper product to almost every manufacturing industry, achieving a broad product coverage. In telecommunications, Furukawa Electric is the world leader in fiber optic manufacturing. In transportation, Furukawa Electric offers vehicle-mounted antenna equipment as well as a broad range of high-quality metal vehicle frame materials. In electronics, Furukawa Electric constantly promotes development and reform from semi-conductors to electronic component technology [7]. In engineering construction, different construction materials are created for safety and comfort.

In addition to extending from simple copper processing operation to downstream point-of-sale terminal and component manufacturing, Furukawa Electric launches personalized product made to order to satisfy consumer needs. For example, Furukawa Electric delivered the first Japanese long distance undersea DC power cable provided for Electric Power Development Co. Ltd. of Japan in 1978 to connect the power line from Honshu Island to Hokkaido [7]. With this made to order service, Furukawa Electric satisfies special needs of the market with high valued-added product, and brings considerable revenue to the firm.

3.2. Emphasizing on R & D and Sensitivity to Industrial Trend

Sustainable development of Furukawa Electric can trace its root back to the innovation-oriented management principle. The competitiveness of the firm has strengthened with constant R & D investment. Furukawa Electrics owns several research laboratories, both in Japan and abroad, to train teams with great creative capability. Advanced Technologies R & D laboratories at Yokohama in Kanagawa prefecture serves as the headquarters of the firm's R & D and specializes in the development of cutting-edge technologies as well as new materials and products [6]. The Nikko research branch mainly focuses on R & D of alloys and nonferrous metal processing, and other processes such as surface treatment. OFS laboratories in the U.S.A. have inherited the tradition of Bell laboratories and excelled in optical communications and other telecomm researches. Not only does Furukawa Electrics invest in many research laboratories, its subsidiaries are

also equipped with large R & D teams. For example, in Chiba Works, a power cable manufacturer located in Ichihara, Chiba prefecture with approximately 500 employees, only 300 of them are manufacturing workers, while the rest are all researchers working on the R & D of telecomm optical fiber and devices [7].

Innovation progress in Furukawa Electric can be viewed as an exemplary case of the world's industrial revolution of the last century. From machinery revolution to telecomm revolution, Furukawa Electric has always been in the forefront of the technological trend, closely connecting itself to each era's new industry. Furukawa Electric released countless leading products: Connector assembly for vehicle airbag during the automobile industry boom; antenna chip in mobile broad band device during the telecomm era; and dedicating to solving a diverse range of issues in the manufacturing of new-energy vehicle parts, smart power grid, and large capacity photo-communication. Furukawa has demonstrated its vast professional knowledge and powerful research capability to continuously open up new markets and operations to guarantee a sustainable future for the firm.

3.3. Focusing on High-Precision Process and High-Quality Equipment

In addition to vast research potential in product development and innovation, Furukawa Electric shows enormous potential in its process design and equipment upgrades. The copper tube division in Hyogo Prefecture mainly manufactures high precision copper and copper alloy tube, rod, and strip. Its techniques in casting, hot and cold rolling, as well as surface treatment are set the world's leading standard [7]. In order to reduce cost, the firm utilizes large quantity of recycled materials. An efficient recycling program has been put in place with strict management on recycled materials sorted according to different grade and quality [6].

The copper tube manufacturing plant is supplied with Japan's domestic equipment made in the 1970s. With ingenious equipment upgrade, these machineries are the backbone of the copper tube division even till now [6]. Throughout the years, upgrades were incorporated into the design of next-generation machinery to meet different needs. This process perfected Furukawa Electric's machinery technology and design into the world's first-class.

4. Sustainable Development of Chinese Copper Processing Industry

For Chinese copper processing firms, sustainable development cannot be expressed as a company expansion alone. Product quality improvement is a key factor to a sustainable future. The industry needs to start prioritize technology innovations and upgrades in order to keep up a strong competitiveness and healthy developmental trend. Comparing to Furukawa Electric's value toward technological evolution and striving for perfection, the Chinese copper processing

industry still has a wide gap in term of product diversity, technological innovations, and equipment utilization.

The present Chinese copper processing industry adopts an extensive but unguided industry growth. In terms of products structure, the China's domestic market focuses on mid to low-end market with products such as copper wire, tube, and rod. A distinct lack of high-end copper material manufacturing and product diversity, as well as overly excessive productivity turns normal industry competition into predatory pricing [8]. Although the Chinese copper industry has started to put more emphasis toward product R & D. Due to lack of funding, researchers, and more importantly, creative capability, Chinese copper processing firms still have a long way to go to become global technology fore-runners [9]. While large Chinese copper processing plants have started to upgrade their equipment to globally advanced standard, most small and medium enterprises, due to various constraints, are stuck to traditional process, which suffers long process flowsheet, high energy demand, outdated equipment, and poor environmental standard.

Although little probability exists for China's domestic copper industry technology to advance up to Japanese standard within a short time, experiences can be borrowed from the technology evolution of Furukawa Electric. Chinese copper processing industry needs to increase products R & D; perfect the range of available products; develop new materials and products with proprietary intellectual property rights; satisfy broader market needs and to work toward downstream operations, including marketing and sales. The industry also needs to follow the new market trend closely, grasps the forefront technology and continuously looking for new opportunities and markets. Another important aspect is to switch from a mid to low end role of "world processing plant" to an industry centralized in high technology and precision products that have much higher market value and competitiveness. This can end the awkward position of Chinese high-end copper processing products and promote products quality and foreign trade.

5. Plans and Prospects for Chinese Copper Processing Research and Development

Focus on copper products research and development fit the proposed idea of independent innovation in China's "Thirteenth five-year development plan for nonferrous metal industry" and the upcoming "Fourteenth five-year plan". Furukawa Electric demonstrates in its innovative concept of technology R & D that, for Chinese copper processing industry to further develop, research and development is the only method [10]. To lead industrial trend, firms have to continuously develop new processes and products. This development trend should reflect in:

Constant perfecting and reinforcing technology innovation system; increasing investment in technology R & D; extensively establishing industrial research

centers and laboratories and working to increase the proportion of domestically developed products.

Research trend should work toward efficiency, energy saving and environmental friendliness by emphasizing on serialization, automation, and process flow shortening in current copper processing flow. The direction of R & D will emphasize market competition, increasing products diversity, improving products quality, and reducing production cost. All issues relating to problems encountered during the production will be solved with priority. Future development of the industry will be centered on new products, new process and new technology. Transforming the current business practice and relying on innovation to progress the copper industry has become a consensus.

It is generally accepted that, although accompanied by few bumps down the road in the Chinese copper industry's revolution, such as the dispute on roll casting process and patent between Jinlong Copper Tube Group Co. Ltd. and Outokumpu of Finland, innovations is the core basis for the sustainable progress of copper processing industry [11]. R & D is the only route to a stronger copper industry as well as a more powerful nation. Continuous upgrades in the present copper processing industry, with the goal to catch up and surpass world leaders such as Furukawa Electric, should become the core concept of the "Fourteenth five years plan".

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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