Chapter 12
Diversification

12.1 History Review and Status Analysis

12.1.1 Historical Stages of Development of Diversified Industries in Iron and Steel Industry

Reviewing the history of the development of diversified industries in China's iron and steel industry, we can see that it has experienced three important historical stages which can be summarized as the Enterprise-Run Society Stage, the Main Business-focused Development Stage, and the New Leap-Forward Development Stage in chronological order.

1. The Enterprise-Run Society Stage (The Beginning of the Founding of the People's Republic of China-1990)

This stage is the prototype of the development of diversified industries in China's iron and steel industry and can be subdivided into four stages:

(1) The stage of initial restoration (1951–1955). Since the founding of the People's Republic of China, the steel companies left over from 1949, represented by Ansteel, Baotou Steel, Shanghai Steel, Masteel, etc., and their supporting social service facilities were restored and after 3–5 years their own mines, hospitals, etc., all had returned to regular work. The scale of the diversified industry was very small, and the output value created was also very low at that time.
(2) The stage of scale development (1956–1965). After the restoration of the "1st Five-Year Plan", China's iron and steel industry ushered in a great development in the "2nd Five-Year Plan" period. From 1957 to 1958, China began to newly build a large number of local backbone steel enterprises, such as Hangzhou Steel, Xingang Steel (Xinyu), Nansteel (Nanchang), Jinan Steel, Qingdao Steel, Lianyuan Steel, Tong Steel, and Lanzhou Steel, and meanwhile to newly build the corresponding supporting enterprise hospitals, primary and secondary schools, guest houses, etc., as an effort to complement some social

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functions. Though the scale of diversified industries had been expanded, only mines could create production value while most of the others playing only social functions, and the value-added business was relatively simple.

(3) Business expansion stage (1965–1975). At the end of the 1960s, Chairman Mao raised the "May 7th Instruction" requiring that all walks of life across the country must be "a big school" where "the people can learn politics, military, culture, and engage in agricultural and sideline production while running some small and medium-sized factories to produce products to satisfy their own needs and exchange with the country in equal values". Accordingly, China's iron and steel enterprises had successively built new "May 7th Cadre Schools" and "May 7th Factories" to further expand the scale of industrial diversification and create a large number of new businesses to generate output value such as many new iron and steel construction teams, machine repair plants, deep steel-processing plants, guest houses, and so on.

(4) Rapid development stage (1976–1990). Since the reform and opening-up in 1978, in order to correct the mistake of the "Cultural Revolution", a large number of educated youth returned to the city and new graduates increased in large numbers, so employment problems were prominent. According to the policies at that time, the society provided part of them with a job, and the enterprises arranged employment for most of the employees' children. For this reason, iron and steel enterprises focused on offering jobs for unemployed children of the employees and production of self-help. Following the trend, a large number of iron and steel business-oriented industries had emerged, such as equipment manufacturing, construction, transportation, deep processing of steel products, guest houses, and comprehensive utilization of resources. Different from the state-owned enterprises in the past, such enterprises were basically owned by the subordinate collective (or labor service company) of iron and steel enterprise and the employees' identity also belongs to collective ownership. It was the newly created economic form of socialist collective ownership at that time.

According to the statistics of the *China Steel Yearbook*, as of the end of 1990, there were 4238 factory-running collectively owned enterprises (not including state-owned mines) belonging to the subordinated industry to iron and steel enterprises, which were later converted into diversified industries, with a total number of employees of 870,000. In 1990, it had fixed assets of about 3 billion yuan and realized an operation revenue (sales) of 10.75 billion yuan, and profits and taxes of 1.02 billion yuan. There were 4488 varieties of products and 28,091 product specifications. Between 1979 and 1990, the overall sales revenue of the subordinated industry to iron and steel enterprises has been increased by more than 20% per year, and more than 990,000 young people were employed, with an annual average of more than 80,000 people [1].

2. The Main Business-Focused Development Stage (1991–2000)

In the early 1990s, in order to implement the reform of state-owned enterprises and divest social supporting functions, China's iron and steel enterprises began to

accelerate diversified operations and proposed reform ideas of "streamlining the body and separating the subsidiary". Many affiliated industries of steel enterprises began to break away from the main body and gradually transit to socialization or withdraw in accordance with the market positioning of the development, maintenance, and shrinking.

In 1992, WISCO took the lead in implementing the reform of "streamlining the main business and separating the subsidiary" in the state-owned large-scale enterprises across China and vigorously cultivated and developed the non-steel industry. Since 1995, Ansteel had implemented the overall reform policy of "streamlining the main business and separating the subsidiary", established Anshan Iron and Steel Industry Corporation, and carried out the reform of main-supplement separation for 22 supporting units such as mine companies, construction companies, and machinery manufacturing companies.

The policy of "streamlining the main business and separating the subsidiary" had changed the organizational structure of "enterprises burdened with social responsibilities" and "large and all-inclusive enterprises". The personnel separated from the main business actively developed diversified operations and gradually embarked on the road of self-financing and self-development. With the improvement of the modern enterprise system and the competitive demand under the market-oriented economy conditions, the reform of "streamlining the main business and separating the subsidiary" had progressed rapidly. By 1996, 56 out of the state key metallurgical enterprises had implemented the reform of "streamlining the main business and separating the subsidiary" in a different extent. In the same year, the former Ministry of Metallurgical Industry held the first working conference on "streamlining the main business and separating the subsidiary" of iron and steel enterprises, and proposed a new strategy of "one main business, diversified operations, and comprehensive development" for large and medium-sized iron and steel enterprises. In 1997, the main-supplement separation work of iron and steel enterprises achieved remarkable results. According to the statistics of 51 steel enterprises, there were 786 separated supporting units and 835,000 employees, accounting for 68% and 76% of the total supporting units and their total employees, respectively. Fifty-three percentage of the separated supporting units achieved self-financing, the supporting units separated from Ansteel reduced losses by 560 million yuan, and subsidiaries separated from Baosteel made a profit of 400 million yuan. The main-supplement separation reform had effectively promoted the development of diversified operations of iron and steel enterprises. The development of diversified industries in the iron and steel industry had turned from the initial service for main business and staff living to a new stage of self-sustaining and self-development.

At this stage, steel business staff had been reduced and labor productivity had been greatly improved after the reform of "streamlining the main business and separating the supplement business from the main". By the end of 2001, the number of employees of state-owned key large and medium-sized iron and steel enterprises fell to 1.023 million, and the per capita annual output of steel is 134 tons [2]. The iron and

steel enterprises had increased their investment in non-steel industry, which significantly boosted their sales revenue. The non-steel industry had been healthily developed and profitable and became a new economic growth point. In 1999, there were 19 large and medium-sized iron and steel enterprises with non-steel industry sales revenue accounting for more than 20% of total sales revenue. Nearly 70% of non-steel industry entities realized self-management, self-financing, and self-development.

Although development of diversified industries in iron and steel enterprises had achieved new results at this stage, however, from the perspective of the overall level of the industry, diversified operation was still very unbalanced and still in its initial stage. Most iron and steel enterprises had merely separated subordinate non-steel units from the main business, namely the iron and steel business, based on the form of production, operation, and service to fulfill the main responsibility of ensuring production, reduce losses, and stabilize employment. The main problems of diversified industries are: more internal services than external development, over-reliance on the iron and steel business as the main and weak self-management; complex industry crossover, lack of pillar industries and leading products, and weak competitiveness; and lack of high-quality talents, few capital and technology investment, which were restricting the development of the industry.

3. The New Leap-Forward Development Stage (2001–Present)

After entering the twenty-first century, in order to keep close pace with the times, iron and steel enterprises vigorously developed diversified industries and achieved leap-forward development in this domain. Some enterprises' diversified industries had achieved equal success to that of the main industry. In 2002, in order to adapt to the new development trend of the industry, China Iron and Steel Association established a Diversified Operation Working Committee, which further promoted the rapid development of the diversified industries in the iron and steel industry. After that, the diversified industries entered a golden decade in which they had experienced the fastest development. The business areas gathered in high-tech and emerging industries such as electronic information, industrial automation, and real estate. The industry continued to expand, and the profitability and development level continued to improve; thus, a well-developed diversified industrial system was basically built. In 2013, China Metallurgical Industry Planning and Research Institute and the Diversified Operation Working Committee of China Iron and Steel Association organized the first conference on non-steel industries in iron and steel industry, reviewed and summarized the past development experience, and jointly discussed the future development of the diversified industries. The successful convening of this conference promoted the diversified industries to the forefront of corporate development strategy. Looking back at the rapid development in more than a decade, we can see that the diversified industries in iron and steel industry had experienced three major historical turning points.

The first turning point was the transition from exploration and development to the formation of an industrial base during the 10th Five-Year Plan period (2000–2005). During the "10th Five-Year Plan" period, the investment in diversified industries was booming. In order to disperse business risks, iron and steel enterprises had launched a development model of "develop one main business and diversified subsidiaries",

and boldly explored and tried to enter new fields and new businesses to an extensive and comprehensive extent. The main industries involved were: equipment manufacturing, logistics trade, deep processing of steel products, information, construction, chemical, tourism services, and other industries. Some enterprises such as Baosteel, WISCO, Shougang, Tianjin Tiantie, Panzhihua Steel, etc., had built competitive diversified industry bases and formed a certain industrial scale.

The second turning point was the transition from industrial scale to quality efficiency during the "11th Five-Year Plan" period (2006–2010). During the "11th Five-Year Plan" period, iron and steel enterprises repositioned the development of diversified industries, then focused on optimizing its structure, continuously improving its competitiveness and profitability, and thus significantly improved the development level. The industrial focus of this period was mainly on the high-tech industries and emerging industries such as the development and utilization of information technology, steel structure, waste resources and secondary energy utilization, as well as real estate. A number of new economic growth points in diversified industries were gradually formed. Steel enterprises such as Baosteel, WISCO, and Ansteel had already obtained successful experience. By the end of the "11th Five-Year Plan" period, the revenue, realized profits, and proportion in total revenue of the diversified industries had all increased substantially. Especially, the profits of Shougang, WISCO, and other enterprises accounted for more than 50% of the Group's total profits, and the diversified industries achieved overall profitability. In addition, the revenue and profits achieved by Baosteel, TISCO, and other enterprises accounted for more than 25% of the Group's total.

The third turning point was the transition from an economic growth point to a development strategy during the "12th Five-Year Plan" period (2011–2015). Entering the "12th Five-Year Plan", iron and steel enterprises had integrated the development of diversified industries as an important part into the overall development plan of the enterprises. The development of diversified industries had risen to the same strategic position as the main business. The development of diversified industries was boosted across the board. During the period, the quality of economic operation of diversified industries in the whole industry had been significantly improved, the investment of diversified industries had been further increased, the project structure had become more scientific and reasonable, and the industrial development ideas were more in line with relevant national policies. The revenue of diversified industries had climbed to new heights as non-steel revenue of super-large iron and steel enterprises such as Shougang, Baosteel, and WISCO had exceeded or approached the level of 100 billion yuan.

The historical stage of development of diversified industries in iron and steel industry is shown in Fig. 12.1.

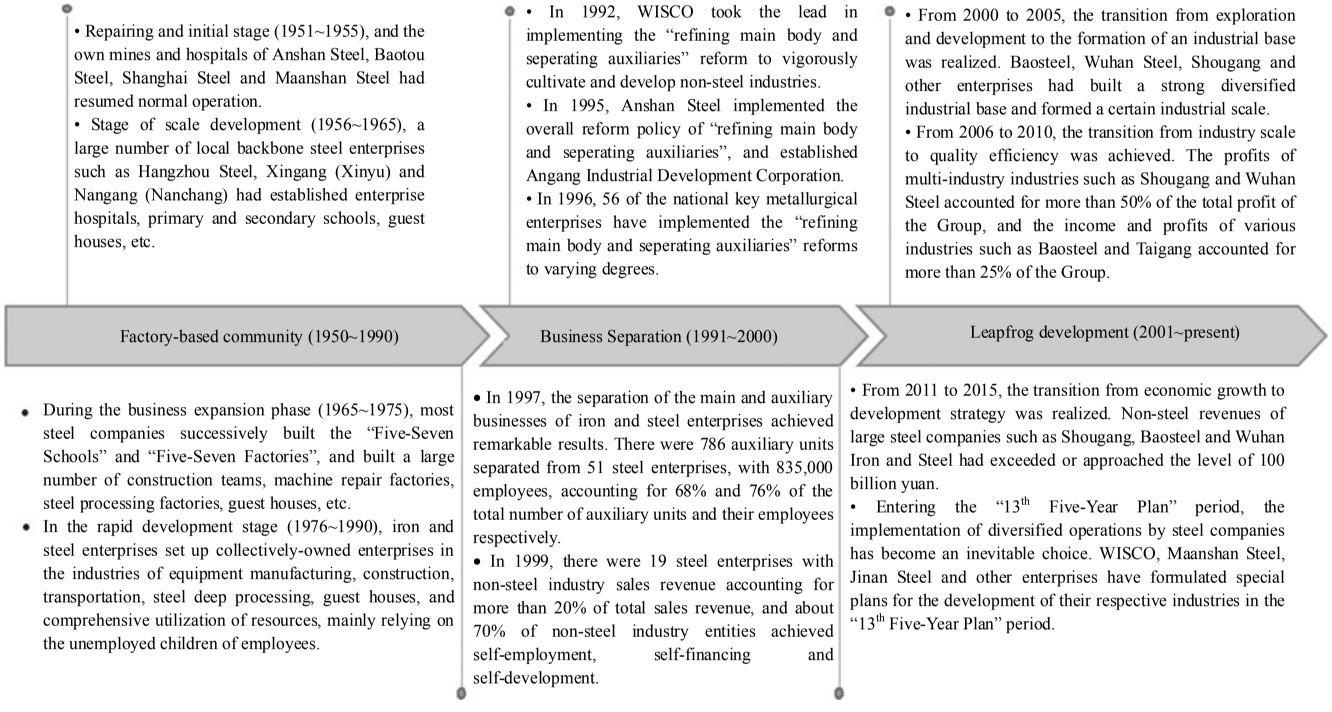

Fig. 12.1 Historical stage of diversified business in iron and steel industry

12.1.2 Development Status of Diversified Industries in Iron and Steel Industry

1. Industry Scale and Characteristics of the Times

At present, the development of diversified industries in iron and steel enterprises is no longer just a concept of "the subordinated industries", "service companies", and "relocation and re-employment". The development of specialization, scale, and industrialization is gradually taking shape, and many new industrial development modes and sub-industries have emerged. The diversified industries involved in iron and steel enterprises are divided into steel-related industries, emerging industries, and traditional industries according to the correlation with the main business. Among them, the steel-related industries mainly include resource industry, deep steel-processing industry, logistics industry, engineering technology industry, trade and business industry; the emerging industries are mainly based on strategic emerging industries that the country has strongly encouraged in recent years, including equipment manufacturing industry, energy conservation and environmental protection industry, information technology industry, new materials industry, biopharmaceutical industry, 3D printing industry, etc.; the traditional industries include financial investment, food, real estate, education, health care, tourism, and other supporting service industries.

Diversified industries have become more and more supportive and synergistic for the main business through scale and specialization development. It can not only greatly reduce the operating costs of iron and steel business, but also increase the added value of the main business products and even create value and benefits directly. According to the relevant statistics of China Iron and Steel Association, in 2014, large and medium-sized iron and steel enterprises had a profit loss of 4.4 billion yuan in steel business, diversified industries had a profit of 27 billion yuan, and thus an annual profit is 22.6 billion yuan. It was the profits created by diversified industry that made up the loss of iron and steel business; in 2015, the profit loss of steel business was 112.7 billion yuan, the profit of diversified industries was 48.1 billion yuan, so the profit loss for the whole year was 64.6 billion yuan. It can be seen that in recent years, the profit contribution of the diversified industries in iron and steel enterprises is far greater than that of the steel business. In the context of the severe overcapacity of the steel industry and the loss of iron and steel business, the diversified industries have become the pillar industry to restore the advantages of the iron and steel business, improve market competitiveness and profitability of the steel enterprises, and create value for steel enterprises.

2. Overview of Development of Typical Diversified Industries

(1) Resource Industry

1) Industry status. The iron and steel industry is closely related to the upstream iron ore, coking coal, auxiliary minerals, and other industries, with high industrial relevance and great influence. After years of development, steel enterprises have become more and more aware of

the importance of the upstream raw material and fuel industrial chain of steel to the development of the iron and steel industry itself. Since the new century, iron and steel enterprises have strengthened development of the upstream-related mining industries in order to ensure a stable supply of resources. The main measures are reflected in two aspects: First, vigorously develop their own mines and increase the production capacity and supply ratio of domestic mines; second, actively "going global" to participate in overseas mineral resources investment and increase the amount of overseas equity mineral resources.

① Iron ore. By the end of 2015, China's iron ore-identified resource reserves were 85.077 billion tons, of which the basic reserves were 20.763 billion tons [3]. The explored reserve of iron ore resource was distributed in 31 provinces (autonomous regions) and municipalities directly under the central government. The top three provinces were Liaoning, Sichuan, and Hebei. The total reserves of the three provinces were 40.18 billion tons, accounting for 47.2% of the country's total reserves.

Iron ores are the main raw material for the iron and steel industry, and almost all of them are used to produce pig iron. According to the output of pig iron, we can speculate that China's iron ore consumption in 2016 was about 1.11 billion tons.

In 2016, China's iron ore output was 1.281 billion tons (raw ore) [4], distributed in 26 provinces (autonomous regions) and municipalities directly under the central government. The top five provinces are Hebei Province, Sichuan Province, Liaoning Province, Inner Mongolia Autonomous Region, and Shanxi Province. The five provinces produced a total of 960 million tons of iron ore, accounting for 75.2% of the country's total output.

Domestic mines cannot meet the demand, so a large amount needs to be imported each year. In 2016, China imported a total of 1.024 billion tons of iron ores [5], mainly from Australia, Brazil, and South Africa. In order to cope with the huge import demand for iron ore, domestic iron and steel enterprises have increased their efforts to obtain iron ore resources from overseas. Ansteel, WISCO, Shougang, and other enterprises have invested in mining in Australia, Canada, Peru, and other places, and achieved certain results. However, in general, the iron ore resources that Chinese enterprises have obtained in recent years have not been rapidly transformed into domestic supply capacity, and the effects and profits are not optimistic. There are only a small number of projects that can form production capacity and effectively supply domestic iron and steel enterprises.

② Coal mines. In 2015, China's explored reserve of coal resource was 1566.3 billion tons [3], of which the proven recoverable reserves

were about 169 billion tons. The top three were Inner Mongolia Autonomous Region, Xinjiang Uygur Autonomous Region, and Shanxi Province. The static guarantee period of explored recoverable coal reserves is about 45 years.

In 2015, China's coal output was 3.68 billion tons, imported coal was 204 million tons, exported coal was 5.3 million tons, net imported coal was 200 million tons, and apparent coal consumption was about 3.88 billion tons. In 2016, China's coal output was 3.41 billion tons [6], imported coal was 256 million tons, exported coal was 8.78 million tons [7], net imported coal was 247 million tons, and apparent coal consumption was 3.657 billion tons.

From the perspective of coal consumption in China, fuel (mainly including power generation, boiler fuel, blast furnace injection coal, etc.) occupies the largest proportion, accounting for 74–75% of total coal consumption, followed by coking coal for coke accounting for 15–16%, coal for chemical gasification (synthesis gas, synthesis ammonia, urea, methanol, hydrocarbons, etc.) accounting for about 9.4%, and coal for gasification or liquefaction (natural gas, liquefied oil, coal water slurry, etc.) accounting for about 0.5%.

From the perspective of China's coal sub-sector consumption, the proportion of power generation and heating industry is the largest, accounting for 49–51% of total coal consumption, followed by steel industry accounting for 16–18%, chemical industry accounting for 11–13%, and other industries accounting for 20–22%.

At present, there are more than 70 state-owned key large coal enterprises (groups) in China that have mastered most of the domestic coal resources, and their coal production accounts for more than 60%. The main enterprises are Shenhua, China Coal, Yimin, Longmei, Kailuan, Jizhong, Coking Coal, Datong, Pingdingshan Coal, Panjiang, and so on.

In order to meet the demand of iron and steel enterprises for their own coal consumption, only a small number of steel enterprises in China are involved in or are preparing to enter the domestic coal industry. Typical enterprises include Kunming Steel who masters 460 million tons of coking coal equity resources through investment and stock holding, with an annual output of washed coal for coking of 4 million tons, Shougang and Baosteel who, respectively, invested in Shanxi Coking Coal Group and Yima Coal Industry to form long-term strategic cooperation. However, in general, China's iron and steel industry controls a small amount of coal resources which has not yet formed a scale and their amount is very small compared with the total consumption of the whole industry. In the long run, there are fewer newly explored coal fields of coking

coal, which is the largest consumption in the iron and steel industry, because the domestic measured resources have already been divided. Therefore, if the iron and steel enterprises want to control domestic coking coal resources, they can only procure them from the enterprises that already have coal resources or directly purchase shares of coal enterprises to control coking coal resources, but a huge investment is needed.

③ Other mineral resources. Manganese ore: As of the end of 2015, China's explored reserve of manganese ore resources was 1.38 billion tons, and there were 481 manganese ore mines nationwide, mainly distributed in Guangxi, Hebei, Hunan, Guizhou, Yunnan, Chongqing, etc. China's manganese ore production is mainly distributed in provinces (autonomous regions) like Guizhou, Guangxi, Chongqing, Hunan, Yunnan, Liaoning, Hubei, and Shaanxi. Domestic manganese ore is mainly produced from local privately operated mines, and there is no official output statistics. It was estimated that the output of manganese ore in China in 2016 was about 28 million tons (finished product ore). In 2016, China imported a total of 17.05 million tons of manganese ore from 29 countries or regions [8], mainly from South Africa, Australia, Gabon, and so on.

Chrome ore: By the end of 2015, the explored reserve of chromite ore resource in China was 12.458 million tons and there were 64 chromium ore mines nationwide which were mainly distributed in Xinjiang and Tibet. China's chrome ore resources are relatively scarce, and they are scarce resources according to the degree of demand. The main source of domestic chrome ore is from local privately operated mines. There is no complete statistics yet, but it was estimated that the domestic output of chrome ore in 2016 was about 300,000 tons. Since domestic chrome ore cannot meet domestic demand, a large amount of chrome ores need to be imported as a supplement. In 2016, China imported 10.579 million tons of chrome ore from 23 countries or regions [9], mainly from South Africa, Turkey, and other countries. In addition, some steel enterprises in China actively "go out" to invest in overseas chrome ore resources. For example, Sinosteel established Sinosteel South Africa Chromium Co., Ltd. in South Africa in 1996 to engage in the development and production of chrome ore. In addition, TISCO was also investing in chrome ore projects in Turkey.

2) Problems

① Low output of domestic iron ore cannot meet the needs of the domestic iron and steel industry, and external dependence has increased year by year, exceeding 85% in 2016.

② Domestic iron ore resources are in poor condition as they are "poor, fine, miscellaneous, and scattered", and the heavy burden of corporate taxes and fees results in high production costs and weak corporate competitiveness.

③ Iron and steel enterprises control an insufficiently small amount of coal resources, especially the amount of coking coal resources, which is not conducive to the stable production of coking in steel enterprises.

④ The distribution of domestic manganese resources is unbalanced, the scale of the deposit is small, the ore grade is low, and the mining conditions are poor. Besides, more than 80% of the manganese ores comes from local small and medium-sized mines, which determines the difficulty in boosting the productivity.

⑤ Domestic chrome ore resources are in short supply, and the deposit is small and scattered, so imported ore is heavily depended on.

(2) Resources Comprehensive Utilization Industry

1) Status of Comprehensive Utilization of Resources. The resources comprehensive utiliation industry in iron and steel industry mainly refers to the comprehensive utilization of resources such as solid wastes in the iron and steel industry. The key points include: resource utilization of industrial solid wastes such as smelting slags, coal ash, and desulfurization gypsum, efficient utilization by classification of iron-containing dusts such as iron oxide scales and zinc-containing dust, and the regeneration and recycling of waste oil, waste acid, social wastes, and so on [10].

① Output Value of Comprehensive Utilization of Resources. In 2015, the comprehensive utilization output value of "three wastes" of the members of China Steel Association was 33.95 billion yuan and the profit was 6.45 billion yuan, equivalent to 60.4 yuan and 11.5 yuan per ton of steel, respectively, which decreased, respectively, 9.6% and 24.2% compared with the comprehensive utilization output value and profit per ton of steel in 2011. From 2011 to 2015, the comprehensive utilization output value and profit of the "three wastes" of the China Steel Association members are shown in Fig. 12.2 [11–15].

As can be seen from Fig. 12.2, the overall utilization output value of resources and the profit rate of products generally fluctuate downward, mainly because of the continuous downturn in China's iron and steel and building material industries in recent years, and the product homogenization and low-value competition of comprehensive utilization of resources.

② Industrial Structure and Technical Equipment of Comprehensive Utilization of Resources. In recent years, with the promotion of ecological civilization construction and the introduction of relevant

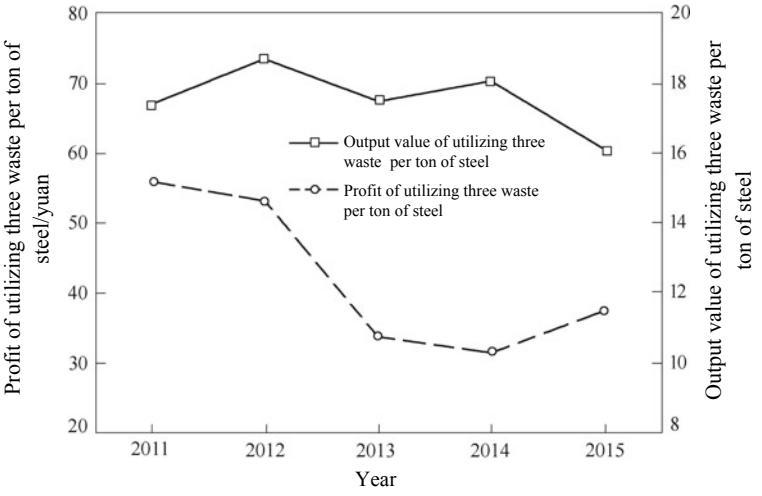

Fig. 12.2 Output value and profit per ton of steel of the "three wastes" of members of China Iron and Steel Association

incentive policies, industrial structure of comprehensive utilization of resources in China's iron and steel industry has been continuously improved, the technical level, process equipment, and value-added products of comprehensive utilization of resources in key areas have been persistently enhanced, and the overall level of comprehensive utilization of resources has been improved significantly.

At present, the enterprises engaged in comprehensive utilization of resources in China's iron and steel industry have formed an enterprise structure that combines wholly owned subsidiaries of iron and steel enterprises, joint ventures of iron and steel enterprises and specialized companies for comprehensive utilization of resources. The technical level, process equipment, and utilized added value of products of comprehensive utilization of large quantity of industrial solid wastes like iron and steel slags have been significantly improved. According to statistics, in 2016, China's blast furnace slag output was about 260 million tons. Besides, there were about 360 BF slag micro-powder production lines, with a production capacity of about 220 million tons. In 2016, China's steel slag output was about 100 million tons, and steel slag tailings were about 80 million tons. The application and popularization of technology and equipment such as steel slag hot stewing technology and steel slag rolling grinding technology have greatly improved China's overall level of comprehensive utilization of steel slags. In addition, the mature application of separation and extraction

technologies of dedusting ash containing zinc and potassium, the regeneration and recycling of waste materials such as waste refractories, waste oil, and waste acid, the development of urban mineral resources, etc., have made a great contribution to expand the comprehensive utilization of resources industry and improve the comprehensive utilization level of resources.

③ Status of Enterprises Engaged in Resources Comprehensive Utilization. In recent years, the scale, professional management level, and scientific research strength of enterprises for comprehensive resources utilization in China's iron and steel industry have been significantly enhanced. For example, Baosteel Development Co., Ltd. mainly undertakes Baosteel's resources regeneration and recycling, steel production services, and other businesses. After nearly ten years of development, its total assets and annual sales revenue have reached 10 billion yuan. The main products of its resources regeneration and recycling include: new-type construction material made from metallurgical waste slags, magnetic materials made from iron oxide, regenerated refractories, waste oil and other regenerated products made from wastes; Baosteel Development Co., Ltd. has thus been crowned the industrial leader for its scale, technological strength, and management level in the resources comprehensive utilization domain. WISCO Metal Resources Co., Ltd. is responsible for the processing and distribution of scrap steel, metallurgical slag treatment, and deep processing and utilization of oxidized scales and other businesses for WISCO, with an annual operating revenue of nearly 10 billion yuan. In addition, the specialized resources comprehensive utilization enterprises such as Huaxia Shixing Co., Ltd. and GreenNovo Co., Ltd. have continuously strengthened their influence in the field of steel slag treatment and zinc-bearing dust and sludge treatment, and the scale of enterprises and market share have been continuously increased.

2) Problems in Comprehensive Utilization of Resources. At present, although the comprehensive utilization of resources in China's iron and steel industry has achieved remarkable results, it still has the following main problems:

① There is Still Room for Improvement of Comprehensive Utilization of Resources. At present, the added value of comprehensive utilization of resources in China's iron and steel industry is relatively low, and the output value of comprehensive utilization of resources is still far behind the advanced iron and steel enterprises at home and abroad. In 2016, the members of the China Iron and Steel Association calculated that the output value of comprehensive utilization of steel resources per ton of steel in iron and steel enterprises was 49.7 yuan, while those of Liugang Group and Shagang Group have reached 139 yuan and 227 yuan, respectively. At present, China's industrial solid waste resources such as blast furnace slags, steel

slags, coal ash, and desulfurization gypsum are mainly used for construction materials in road construction, brick making, cement production, and gypsum board. The comprehensive utilization of products has low added value and poor product diversity. In some areas, the markets of applied products are even saturated, resulting in poor economic benefits and low willingness to use solid wastes of enterprises. The levels of iron recovery from steel slags of enterprises are quite different, resulting in the loss of ferrite resources; waste heat from a large amount of high-temperature steel slags has not been effectively utilized, resulting in a huge waste of resources and energy and loss of economic benefits.

② The Concentration and the Technical Level of Resources Comprehensive Utilization Industry Urgently Need to be Improved. At present, the overall level of comprehensive resources utilization industry in China's iron and steel industry has improved significantly, but there are still problems of small-scale resources utilization enterprises, scattered operations, and low level of industrialization. In particular, the research, development, and promotion of resources comprehensive utilization technology and the lack of industrialization of equipment have become important factors restricting the standardization and large-scale development of comprehensive utilization of resources. On the one hand, the products of comprehensive resources utilization are not high end in science and technology, and the entry threshold of the industry is low. That means some resource comprehensive utilization enterprises only carry out simple processing with the incoming materials. On the other hand, the industrialization capacity of equipment for resources comprehensive utilization is insufficient, some advanced technologies and equipment rely on imports, China lacks its own intellectual property rights, the degree of industrialization of equipment for comprehensive resources utilization is low, and the quality of comprehensive resources utilization products is poor.

③ The Industrial Policy and Standard System of Resources Comprehensive Utilization Are Not Well Developed. The management system is not well developed, the incentive mechanism for technology research and development and promotion is unsound, industry-university-research-application cooperation is not close, the development of related technologies, equipment standards, and product standards is relatively lagging, and the degree of industrial standardization is low. These factors are difficult to support the promotion and application of advanced technologies and equipment.

(3) Deep Steel-Processing Industry

1) Development Status of Deep Steel-Processing Industry. In 2017, China's crude steel output was 832 million tons, pig iron output was

710 million tons, and capacity of steel products (including recycled materials) was 1.048 billion tons, increasing by 0.8% on a year-on-year basis. In the same year, the import of steel was 13.297 million tons, the export of steel was 75.431 million tons, and the actual consumption of steel was 728 million tons.

In 2017, the steel industry intensified the supply-side structural reforms and achieved remarkable results in cutting overcapacity, thereby significantly improving the benefits of the enterprises and stabilizing the operation of the industry. However, the pressure of optimization and adjustment of industrial structure became increasingly prominent, and the industry was still facing many challenges.

China's iron and steel industry has experienced rapid development for more than 30 years and has achieved remarkable achievements. However, at present, serious overcapacity, overall losses, resources and environmental protection and many other problems in iron and steel industry are prominent. Most iron and steel enterprises have difficulty in survival. Finding new profit points, broadening the business field, extending the industrial chain, and developing deep steel processing have become the choice of many enterprises [16].

Deep processing of steel in China is generally classified as follows:

① Deep processing products can be classified into wire rod, plate, and pipe by classification.

② Deep processing products can be classified into semifinished products for users and the products for direct market demand by the end-user's requirements on product shapes and performance.

③ Deep processing products can be classified into production-type deep processing, marketing-type deep processing, and industrial deep processing by the division of labor in the industrial chain.

The classification of deep steel processing in China is shown in Fig. 12.3.

2) Main Problems in Deep Steel-Processing Industry. Although China is the largest steel producer, most of the steel is of primary and secondary materials. Compared with industrial developed countries, China has a smaller proportion of deep steel processing and a lower added value. Iron and steel enterprises and downstream industries have not built a mutual beneficial cooperation. Besides, most of the enterprises' sales strategy still follows the line of small profits but quick turnover, thereby leading to small benefits and even loss. Compared with the developed countries, main problems in China's deep steel-processing industry include:

① Low proportion of deep steel processing. At present, the proportion of comprehensive deep steel processing in the developed countries worldwide has reached more than 50%, while the proportion in China is only about 25%, and some high-tech deep processing products still need to be imported.

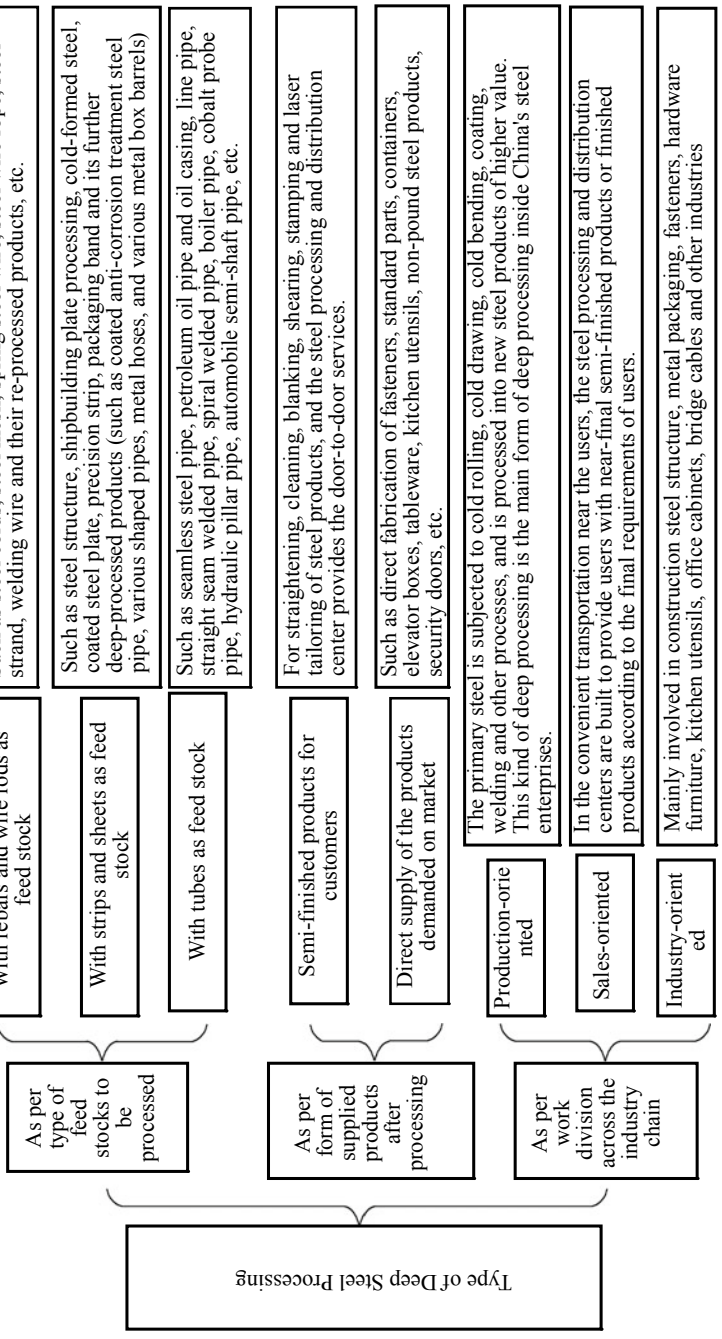

Fig. 12.3 Classification of deep steel processing

② Overall overcapacity in production-type deep processing within enterprises. Due to historical reasons, almost every enterprise's rolling mills are equipped with various types of finishing shear machine units. At present, these finishing capacities scattered within the enterprises are completely oversupplied.

③ Overlapping network of marketing-oriented deep processing has been formed, and competition has been intensified. Since the beginning of the twenty-first century, domestic steel enterprises, steel traders, and foreign-funded enterprises have continuously built steel processing and distribution centers in cities where the downstream industries are concentrated, which have been spreading everywhere and formed homogenization competition in the gathering of major downstream users.

④ A mutually beneficial and win-win marketing system has not been established between industrial deep processing and downstream market. Industrial deep processing enterprises lack cooperation with downstream industries. Without forming a win-win cooperation, their business revenue is unstable.

3) The Focus of Deep Steel-Processing Industry Concerned in the Future. Extending steel industrial chain and service chain in iron and steel industry is one of the effective ways to solve the difficulties currently faced by the iron steel enterprises. In the future, the downstream demand for deep steel processing has great potential and broad development prospects. However, on the whole, most steel enterprises in China still have not completed the transition from steel producers and suppliers to service providers and cannot meet the needs of steel production and steel trade development.

In order to adapt to this role change, enterprises must find the right market positioning. Before deciding to be engaged in deep processing, enterprises should fully conduct investigation and proofing of the project, and pinpoint the target market and customer base based on the characteristics and grades of their products; otherwise, it will be difficult to survive and develop.

In order to cope with the external environment of overcapacity and homogenization competition, enterprises should focus on refinement, specialization, individualization, and high efficiency in deep steel-processing projects. The users have to be allied in research and development of advanced material technology to ensure satisfactory services and products so as to enhance the core competitiveness of the enterprises.

(4) Mechanical Maintenance and Manufacturing Industry

1) Development Status. The mechanical maintenance and manufacturing industry are closely related to iron and steel industry. It has a stable internal market and obvious advantages in raw materials as one of the pillar industries for the diversified development of iron and steel enterprises and one of the potential industries for key development. Throughout the history of the entire mechanical maintenance and manufacturing industry, it was developed from machine repair and equipment manufacturing business such as the initial equipment repair, simple spare parts processing, and low-end complete equipment manufacturing internally for iron and steel enterprises.

At the beginning of the founding of the People's Republic of China, China's machinery industry followed the Soviet machinery and equipment management and maintenance system. Almost every iron and steel enterprise has its own "big and all-covered" or "small but all-covered" affiliated machine repair shop or machinery shop along with a large number of professional maintenance staff and equipment. By the end of 1984, the iron and steel enterprises had a total of 71 affiliated machinery shops responsible for spare parts processing, equipment repair, and self-made simple equipment for the enterprises internally. However, with a low degree of specialization and cooperation and backward process, equipment, and products, they showed obvious times characteristics of strong self-sufficiency and self-service.

With the development of China's iron and steel industry and the division of production functions, in the 1990s, the machinery maintenance and manufacturing business internally for iron steel enterprises began to be independent from the frontline production departments. Some machine repair departments still focus on new projects, equipment overhaul, and equipment technical transformation within the enterprises; some machine repair departments are independent legal entities, which while serving the enterprise were also facing the society. They implemented independent accounting and self-financing and sought survival and development in the market.

In the twenty-first century, the equipment management system and maintenance methods of iron and steel enterprises are facing new changes, and steel enterprises are beginning to move toward socialization and specialization. In 2002, the eight ministries and commissions of the State Council jointly requested the state-owned enterprises to accelerate main-supplement separation. At earlier stage, the iron and steel industry was focusing on "streamlining the body and separating the supplement business from the main" which increased the proportion of non-steel revenue, achieving initial main-supplement separation. On this basis, the steel industry striped out the machinery

maintenance and manufacturing business mainly for internal service, and started external development on the basis of fully ensuring the internal maintenance.

After more than a decade of development in the twenty-first century, the mechanical maintenance and manufacturing industry, separated from steel business, have continuously strengthened management and self-reforms to increase its market competition. Thus, the production scale and equipment technology have reached a higher level. When serving for the iron and steel business, it aims to expand the external market share, develop specialized products, and adapt to the requirements of market-oriented operations.

The machinery maintenance and manufacturing industry in the iron and steel industry follow the development philosophy of "focusing on the main business market, expanding the domestic market, and advancing into the overseas market". After experiencing three stages of self-sufficiency, market restructuring, and in-depth development, it has gradually become a modern machinery maintenance and manufacturing industry that meets the needs of market development. At this stage, most steel enterprises have formed a mechanical maintenance and manufacturing industry with capabilities including equipment maintenance and repair, spare parts processing and manufacturing, repair and remanufacturing, complete equipment manufacturing, technological innovation, and new product development, which plays an important role in the development of iron and steel business.

2) Problems. Affected by unfavorable factors such as severe overcapacity in the iron and steel industry, increased energy and environmental constraints, and slowing growth of market demand, the mechanical maintenance and manufacturing industry, which are closely related to the iron and steel industry, have shown decreased market demand, overcapacity, declining product price, rising price of raw material, and tighter supply, so the industry is clearly at a disadvantage. The main problems are as follows: over-reliance on steel business, lag in response to external markets, poor ability to develop the market; insufficient ability to conduct research and development of products, fixed business philosophy, backward management and control modes; sharp glide-down of market share, simultaneous shrink of internal and external markets; increasing threats from overseas enterprises with core technology, core equipment manufacturing capacity, and general contracting capacity; shift of the cost pressure from iron and steel enterprises to downstream suppliers and the significant increasing survival crisis; increasing competition among equipment manufacturing industries and a low profitability of mechanical products; lack of competitive products with high-tech content, high added value and strong

market influence, poor market competitiveness resulted from zero differentiation, unremarkable brand benefits, and lack of competitiveness; and restriction of key technologies and core technologies which can curb the healthy development of the machinery maintenance and manufacturing industry.

3) Characteristics of Typical Enterprises. Due to different enterprise systems and equipment levels as well as different business scopes and product structures, the competitiveness of the machinery maintenance and manufacturing industry in China's iron and steel industry is quite different. Most large iron and steel enterprises have a relatively long operating history, so their technological strength, brand, and production capacity are in a leading position in China. They lead the market because of their good background and the highest technical level in the domestic industry. The characteristics of typical enterprises are shown in Table 12.1 [17, 18].

(5) Refractory and Auxiliary Materials Industry. Refractory materials are used in various fields of the national economy such as iron and steel, nonferrous metals, glass, cement, electric power, and military industry. They are essential materials to ensure production, operation as well as technological development of the above-mentioned industries. They are irreplaceable in the production and development of high-temperature industries.

1) Industry Status and Existing Problems. From 2001 to 2010, supported by the strong driving of rapid development of high-temperature industries such as iron and steel, nonferrous metals, petrochemicals and building materials, the refractory industry maintained a good growth momentum. China has become a major producer and exporter of refractory materials in the world. During the "12th Five-Year Plan" period, China's refractory output showed a steady and declining trend. In

Table 12.1 Typical enterprises in mechanical maintenance and manufacturing industry of iron and steel industry

No.	Enterprise name	Main characteristics	Key products or technology
1	Baosteel	Supported by technological integration and innovation capabilities, Baosteel focused on high-end metallurgical equipment and high-precision spare parts, as well as the development and manufacture of the complete equipment and core components in environmental protection, chemical engineering, engineering machinery, plastic molding machinery, etc.	Professional equipment manufacturing technologies such as continuous casting machine, bearing, housing, rolling mill, payoff tension reel, gear, blast furnace cooling stave are world-class

(continued)

Table 12.1 (continued)

No.	Enterprise name	Main characteristics	Key products or technology
2	WISCO	Relying on Construction Engineering Group and Heavy Industry Group, WISCO is committed to technology-intensive and management information construction, cultivating and developing engineering contracting and advanced equipment manufacturing capabilities. Now it has formed business such as metallurgical engineering construction, municipal engineering construction, repair for maintaining production and repair, manufacturing and remanufacturing of metallurgical equipment and lifting equipment	Advantageous products include remanufacturing of blast furnace cooling stave, metallurgical slag tank, and payoff (tension) reel
3	Shougang	Shougang established a base for equipment repair, domestication of spare parts, and maintenance for the iron and steel business which was its main business, and extended such business to other iron and steel plants other than Shougang itself. Multi-approach and multi-channel cooperation platform were set up with the help of foreign high-end patent technology	Leading products include large medium and high-end metallurgical equipment such as continuous casting machine and blast furnace top equipment
4	Benxi Steel	The products of Benxi Steel fully meet the needs of the transformation and operation of the main equipment, and are sold to Baosteel, QDIS, Tonggang, and other enterprises. Moreover, the products are exported to Russia and other countries and regions. Benxi Steel promoted engineering contracting for iron and steel production lines, and implements “one-stop” service system covering manufacturing, repair, and maintenance. Besides, it undertakes projects extended from the iron and steel industrial chain	The leading products cover the manufacturing and repair of equipment and spare parts required for mining, smelting, coke, cement, petrochemical, and other industries. It is one of the bases producing spare parts for hot air stoves in China

(continued)

Table 12.1 (continued)

No.	Enterprise name	Main characteristics	Key products or technology
5	Kungang	It integrates mechanical manufacturing, repair, and installation, and has the capability of research, development, design, and manufacturing for large-scale complete equipment. Besides, its services are extended to metallurgical construction and maintenance and service to serve both the iron and steel industry and the non-steel industry	Its large cast and forged parts fill the gap in Yunnan Province. The wet overflow ball mill is the ball mill with the maximum daily processing capacity developed by the heavy equipment manufacturers in Yunnan

2016, according to the statistics of China Refractory Industry Association, the national refractory output was 23.9124 million tons, going down by 8.56% on a year-on-year basis. Among them, compact shaped refractory products were 13.5852 million tons, going down by 11.08% on a year-on-year basis; thermal insulation refractory products were 467,200 tons, going down by 1.32% on a year-on-year basis; unshaped refractory products were 9.8599 million tons, going down by 5.19% on a year-on-year basis. At present, China has become a major producer, consumer, and exporter of refractory materials, and its production and sales rank first in the world.

The structure of China's refractory products has been further adjusted to better meet the market demand and to meet the requirements of energy conservation and environmental protection. Although China's refractory industry has achieved remarkable results after years of development, there are still many problems such as severe overcapacity and disorderly market competition which should never be overlooked.

The first problem is severe overcapacity. The refractory industry is currently in a state of complete overcapacity, with a capacity utilization rate of less than 70% or even lower. The capacity in steel, cement, glass, and other refractory consuming industries is also seriously oversupplied. In the next few years, fixed asset investment, especially new construction projects, will decrease rapidly, and the demand for refractory materials will gradually decline. In addition, as refractory materials are developed and the quality is steadily improved, the refractory consumption per unit of product will be gradually reduced. This means that the overcapacity faced by the refractory industry will become increasingly serious.

The second problem is disorderly market competition. Overcapacity has led to intensifying competition in the refractory market. In

order to win the market, some refractory enterprises have adopted harmful competitive means such as low-price marketing and delivery before payment. That will directly lead to a lower market price of refractory materials, more arrears in loans, which will seriously damage the industry's business order and overall interests. At present, the refractory industry has lower production concentration and many small enterprises, which has intensified disorderly competition in the industry.

The third problem is environmental protection and resource conservation. Although China's refractory mineral resources are abundant, mineral resources have long been unreasonably allocated, the development has been paid more attention than the protection, and excessive mining, destruction, and waste are serious. As an important part of the high-temperature industry, the refractory industry not only needs to continuously reduce energy consumption, but also bears the important responsibility of providing "green refractory materials" for the downstream industries. The environmental protection, resource conservation, and national ecological construction strategy set higher requirements for chrome-free refractory materials and recycling of refractory materials.

The fourth problem is the insufficient ability of scientific research and innovation. As the profits of the refractory industry continue to decline, the R&D investment of the whole industry grows slowly, and the R&D platform construction lags behind requirements of situation; besides, the insufficiency is also represented by the lack of public welfare research institutions, the unreasonable allocation of R&D resources, the relatively weak basic research, and the insufficient innovation capability. The R&D project is not forward-looking, the connection between production and application is not smooth enough, and the problem solving or application process is not timely enough to guide and support the future development of the refractory industry.

In summary, the production and operation of the refractory industry urgently need to be transformed and upgraded to enhance the industrial competitiveness.

2) Experience in industry transformation and upgrading. The Ministry of Industry and Information Technology officially published *Several Opinions on Promoting the Healthy and Sustainable Development of the Refractory Industry* in March 2013, which has received a huge response in the industry. Local governments at all levels in Henan, Liaoning, Shandong, Shanxi, Zhejiang, and other provinces where refractory industries are relatively concentrated also attach great importance to transformation and have introduced measures to optimize product mix and spatial layout, promote intensive use of

resources, and initiate the construction of new refractory industrialization demonstration bases focusing on eliminating backward capacity, promoting joint restructuring and accelerating transformation and upgrading.

Zhejiang Province regards Changxing County where refractory enterprises are most concentrated as the focus of energy conservation and emission reduction, and puts forward the concept of "no polluted industry, only polluted enterprises", to comprehensively promote the transformation and upgrading of refractory industries. In line with industrial integration reform to promote regional economic development in Changxing County, the refractory industry introduced industry integration policies of "reorganizing, upgrading, and eliminating" and "priorities to guaranteed work items, to policy implementation, and to service and approval". Many local government departments, together with local associations, have taken active measures to put forward higher requirements for enterprises in terms of energy conservation, environmental protection, and safe production, thereby promoting the transformation, upgrading, and healthy development of the refractory industry.

Beijing Lirr is actively transforming and facing difficulties. While striving for policy support and market guarantee, Beijing Lirr focuses on cost reduction and efficiency improvement and increases efforts to contrast the standard, tap the potential, improve the management, protect the main business, expand the market, strengthen the management, and train the team. The production and operation assessment indicators are improving day by day. In addition, the enterprise has established Liaoning Lirr, Baogang Lirr, and Qingdao Sidier New Materials Co., Ltd. in recent years, acquired Ma'anshan Kaiyuan New Material Technology Co., Ltd. and Shanghai Xintaishan High Temperature Engineering Materials Co., Ltd, and reorganized Liaoning Zhongxing Group and Liaoning Jinhong Mining Co., Ltd. by issuing shares and purchasing assets. Through a series of mergers and acquisitions and restructuring, Beijing Lirr has formed three major business segments: magnesium raw material synthesis, magnesium product production, and international refractory trade. Thus, the resource allocation has been optimized, the operation and management costs have been greatly reduced, and the company's profitability has been improved significantly.

(6) New Material Industry

1) Development status. China's new material industry system mainly includes six major fields which are special metal functional materials, high-end metal structural materials, advanced polymer materials, new inorganic nonmetallic materials, high-performance fibers and composite materials, and cutting-edge new materials. The application of new materials in various fields of the national economy has

been continuously expanded, and an industrial system with a complete variety including R&D, design, production, and application has been formed. Since the beginning of the new century, some key technologies in China's new material industry have made major breakthroughs: China's self-developed technologies to produce tantalum niobium beryllium alloys, amorphous alloys, high magnetic orientation silicon steel, super-hard materials, and superconducting materials have reached or are close to international standards. The variety of new materials is also increasing; the high-end metal structural materials, new inorganic nonmetallic materials, and high-performance composite materials are significantly enhanced; the self-sufficiency of special metal functional materials is gradually improved [19].

In recent years, China's new material industry has gradually grown and expanded, with continuously improved industrialization degree and boosted technical level. According to incomplete statistics, the total production value of China's new material industry reached 2.6 trillion yuan in 2016, and the new material industry has made remarkable achievements in system construction, industrial scale, and technological progress. Among them, rare earth functional materials, advanced energy storage materials, super-hard materials, special stainless steel, and other production capacity rank forefront of the world, making significant contributions to the China's economy and national defense construction, and have a good development foundation.

2) Problems. In today's world, the scientific and technological revolution is developing rapidly, new materials and products are changing with each passing day, and industrial upgrading and material replacement are accelerating. Developed countries attach great importance to the cultivation and development of new material industry. With sound technology development and risk investment mechanism, the large multinational companies take the dominant position in high-tech and high value-added new materials relying on advantages such as their technological research and development, capital, talents, and patents, which has placed greater pressure on the development of China's new materials industry.

The overall development of China's new material industry still has a big gap with the developed countries. The industrial development faces some problems that need to be solved urgently, mainly in the following aspects: first, the weak ability of independent development of new materials, less innovative impetus of large-scale materials enterprises, and insufficient ability to guarantee the key and new materials; second, disconnection among industry, university, research institute and application, short industrial chain, difficult promotion and application of the new materials, and defective industrial development model; and

third, lack of overall planning and policy guidance of the new material industry, small and scattered R&D investment, and weak basic management [20].

3) Development opportunities. China's economic development has entered the "new normal" period. The transformation and upgrading of traditional industries and the cultivation of strategic emerging industries are the main tone of industrial transformation during the "13th Five-Year Plan" period in China. Strategic emerging industries such as new materials have a promising future as they are driven by dual power from both the industrial environment and the policy environment. The strategic adjustment of economic structure has provided important development opportunities for the new material industry: On the one hand, to accelerate the cultivation and development of strategic emerging industries such as energy conservation and environmental protection, new generation information technology, high-end equipment manufacturing, new energy and new energy vehicles, and to implement the national economy and the national defense construction projects require the support and guarantee of the new material industry, which provides a broad market space for the development of new materials industry. On the other hand, since China's raw material industry is huge and some industries are suffering from overcapacity, the limitation from resources, energy, and environment is pressing. Therefore, there is an urgent need to vigorously develop new material industries, accelerate the transformation and upgrading of the material industry, and foster new growth points.
4) Typical case analysis. With the development of high and new technology, new material and basic material industry are increasingly tied to each other, and the industrial structure is characterized by horizontal diffusion. Basic material enterprises such as iron and steel enterprises are extending businesses into new material industries. The new steel materials in high-end metal structural materials are the hot spot of R&D and innovation of China's iron and steel enterprises and scientific research units, representing the main direction of research and development of new steel materials.

   For example, pure iron materials are high-purity metallic furnace materials for modern high-end equipment manufacturing, EAF cast steel, and EAF smelting high-quality special steel, which is essential for ensuring the quality and economic efficiency of high-end and high-quality special steel. The demand for pure metallic materials is growing year by year, and even just the domestic market has a demand of as much as 30 million tons; at present, many domestic enterprises produce industrial pure iron, but not in large scale due to its complicated process and high smelting cost. Take industrial pure iron as an example: According to incomplete statistics, the annual demand for industrial pure iron materials is more than 800,000 tons, and at present,

there is still an insufficiency of about 300,000 tons in China, especially the high-quality industrial pure iron, which needs to be imported from Europe, America, Japan, and other countries every year.

TISCO is the birthplace of pure iron in China and the base for its research and development. It can produce all kinds of products except pipes. The main production equipment and lines include an 80 t and an 180 t steelmaking—external refining—continuous casting lines as well as many electroslag re-melting and vacuum smelting processes for production of special pure iron varieties. In addition to conventional products, it can also undertake the production of pure iron materials for cutting-edge engineering and scientific research, such as pure iron specially for accelerators. TISCO's pure iron has a market share of over 60% in the domestic market, and it has reached more than 95% at the highest level. The pure iron used for China's major projects, aerospace, and military purposes has always been supplied by TISCO. Some enterprises such as Angang, Great Wall Steel, and Fushun Special Steel have started to produce pure iron new materials. In addition, due to the higher cost for treating and smelting industrial pure iron with a converter and external refining process, the market competitiveness is reduced; Benxi Steel uses high-purity concentrate powder to produce sponge iron as it is cheap, and the obtained products made from pure iron material are with high purity and strong competitiveness.

In short, as the most important part of the strategic emerging industry, the basis of the transformation and upgrading of traditional industries, and the important support of the development of other strategic emerging industries, new materials will be one of the most important and most promising areas in the future. It is estimated that by 2020, the new materials industry will have become the leading industry of the national economy, and its main products can meet the needs of the national economy and national defense development. In the future, the rapid development of emerging industries supported by new materials, such as computers, communications, green energy, and nano-industries, will further increase the demand for new materials in both the variety and the quantity.

(7) Coal Chemical Industry

1) Overview. Since the coal chemical industry involved in this section refers to the diversified part of iron and steel industry, it specifically means the traditional coal chemical industry formed by the deep processing of coking by-products in the coking industry of the iron and steel industry, namely coke oven gas, crude benzene, and coal tar.
2) Main products and output
   ① Coke oven gas. During the process of high-temperature carbonization in a coke oven, coking coals produce a large amount of waste gas, which is converted into coke oven gas after being purified by blast condensate, desulfurization, de-amination, debenzolization,

and other processes. The yield and composition vary depending on the quality of coking coal and coking process conditions. Usually, one ton of dry coal can produce 290–380 m^3 of coke oven gas (under standard state).

Coke oven gas is a medium heat value gas with a calorific value of 16.3–18.8 MJ per nominal cubic meter. It is suitable fuel for high-temperature industrial furnaces and city gas. The coke oven gas can also be utilized in deep process to produce chemical products such as methanol and natural gas taking advantage of its high hydrogen content.

② Crude benzene. Crude benzene is one of the products produced by pyrolysis of coking coal. It is a benzene-based compound recovered after de-amination of raw gas. The output accounts for about 0.7–1.2% of the coal (dry coal) charged into furnace.

Crude benzene is an intermediate product and can be directly used as a solvent, a fuel, etc., but is limited in the scope of application. For this reason, the crude benzene is usually hydro-refined and separated into pure benzene (also known as refined benzene, accounting for 65–75%), toluene (12–18%), xylene (3–6%), heavy benzene (5–8%), non-aromatics (2–4%), C^{9+} (1.5–2.5%), and so on, and then applied separately to produce various derivatives.

③ Coal tar. Coal tar is also one of the crude gas products produced from coking coal in pyrolysis. It is a black or brownish black viscous liquid with irritating odor. The output accounts for about 3–4% of the coal (dry coal) charged into furnace. It is an organic mixture mainly composed of aromatic hydrocarbons with tens of thousands of components, and there are more than 500 single compounds that have been separated from it and identified.

The component of coal tar is very complex and can only be a fuel for direct use. In order to make full use of coal tar resources and maximize their value, there are two main directions for deep processing of coal tar at home and abroad.

The first is hydrogenation of coal tar which is divided into the light component hydrogenation to produce naphtha, light diesel oil, etc., and the heavy component to produce asphalt; all components are hydrogenated to produce naphtha, light diesel oil and other solvent oils, fuel oil, etc.; selective hydrogenation is to separate high-priced components for further processing or direct sale, and to hydrogenate low-priced components is to produce naphtha, light diesel oil, and other solvent oils. Hydrogenation of coal tar is a new process that has just been developed in recent years. The main advantage is that the domestic market demand for products such as naphtha and light diesel is high and the sales price is only related to the international oil market price, so the fluctuation is relatively small and the revenue is relatively stable; the shortcoming is that

the technology is not particularly mature, so the surplus profits cannot be obtained and sales revenue is not high; therefore, an industrial chain cannot be formed.

The second is the traditional separation process which separates the various components by distillation and then performs deep processing. The mainstream process for coal tar treatment in China is the traditional one whose main advantages are mature technology, more deep processes of various components, more options, long industrial chain, high sales revenue, more values and jobs, and excess profits from the right products. However, the shortcoming is that the sales price may experience a sharp market fluctuation and a frequently changing market; therefore, it is hard to predict the market condition and even harder to grasp it.

3) Industrial chain of coking by-products. At present, there are mainly three industrial chains for deep processing of coking by-products at home and abroad. One is the deep processing products produced by comprehensively utilizing coke oven gas as the raw material, the second is the chemical products produced through deep processing from crude benzene as the raw material, and the third is the chemical products produced through deep processing from coal tar as the raw material.
4) Development status of coking by-product deep processing industry. After years of development, the coal chemical industry in coking industry has reached a larger scale and a higher level. As of the end of 2015, according to preliminary statistics, the coking industry has formed a coke oven gas industry chain to produce 12.2 million tons of methanol, 3.6 billion cubic meters of natural gas, and about 2 million tons of ammonia.

   The crude benzene industry chain has a plant capacity of 5.84 million tons of benzene refining (benzene hydrogenation), of which the largest processing capacity of a single plant in China is 200,000 tons/year. In addition, there are also many subsequent deep processing devices for products such as caprolactam, adipic acid, and styrene.

   The coal tar processing industry chain has about 77 sets of traditional coal tar production facilities, with a processing capacity of 1.9 million tons. The coal tar hydrogenation units have a processing capacity of about 1 million tons and many subsequent devices capable of deep processing of products such as carbon black, scrubbing oil, anthracene oil, crude naphthalene, and medium temperature asphalt.

   According to preliminary estimates, in 2016, China's coking by-product deep processing industry achieved a sales revenue of about 161.5 billion yuan while employed about 73,000 people.
5) Typical Enterprise—Baosteel Chemical Co., Ltd.

   At present, Baosteel uses all its coke oven gas for deep steel processing and power generation, instead of deeply processing the gas

itself. It has 6 sets of coal tar processing unit with a processing capacity of 1.1 million tons/year, a unit producing carbon black through deep processing of coal tar with a capacity of 250,000 tons/year, a unit producing washing oil with a capacity of 50,000 tons/year, and a unit producing needle coke with a capacity of 100,000 tons/year. Besides, it has 3 sets of benzene refining units (benzene hydrogenation), with a processing capacity of 250,000 tons/year.

At present, Baosteel Chemical's products of naphthalene series, washing oil series, high-purity benzene, carbon black, and other products have been the leader of China and even the forerunner internationally. Among them, the tar processing capacity ranks in the forefront globally, and it has the scale advantage of developing into a world-class coal chemical enterprise.

6) Problems

First, the industrial concentration is low, and the scale economy is not reflected. According to statistics of China's coking by-product processing enterprises, the production scale of most methanol produced from coke oven gas production is 100,000 to 200,000 tons/year, that of benzene hydrogenation is 50,000 tons/year mostly, and that of most coal tar processing unit is 150,000 to 300,000 tons/year; the unit scale is generally small, and the production process and technical equipment are backward.

Second, the industrial chain is insufficiently extended, and the resources are not fully utilized. At present, China's industrial chain of coking by-product is generally insufficiently extended, and the added value of the products is low. Most of them are primary processed products, such as coke oven gas processing to methanol without deep processing; only 20% of pure benzene after benzene hydrogenation has been further processed, and there are even fewer deep processes of toluene and xylene. Besides, there are only 50 kinds of products from coal tar deep processing, which has quite a long way to go to catch up with Germany which has more than 200 kinds of industrial refined products and Japan which has more than 70 kinds.

(8) Financial Industry

1) Background. In the context of overcapacity in the iron and steel industry and increasingly fierce competition among enterprises, low benefit and even loss have become the new normal of the industry. In 2015, China's key large and medium-sized iron and steel enterprises realized a total profit of −64.534 billion yuan, which is the first loss of large and medium-sized iron and steel enterprises since 1980. Driven by profits, the capital in iron and steel industry has gradually penetrated into the finance industry which has higher profit margins and better industry development. Baosteel, Baotou Steel, and other enterprises have clearly announced to regard the finance industry as the main industry

for the future development of the enterprise, making it a new profit growth point for the group.

2) Status. At present, most of the steel enterprises entering the financial industry began with the financial companies. Since the iron and steel industry is a capital-intensive industry, iron and steel enterprises need to implement effective management and control over capital resources to enhance their competitiveness. As a fund management and control platform, the financial companies have played an important role in improving capital efficiency, liquidizing stock assets, and achieving the organic integration of the capital flow, information flow, and material flow of iron and steel enterprises to the utmost extent. As of the foreign investment in the financial sector, the equity investment of China's iron and steel enterprises in financial institutions is mainly concentrated in the financial sub-industry such as banks, securities, insurance, trusts, and funds, but most of them are in shareholding mode [21].

   In the typical enterprises' development of the financial industry, Baosteel established Hwabao Investment Co., Ltd. in 2007, a wholly owned subsidiary, as the flagship of the Group's financial investment business, and managed and controlled the existing securities, funds, and trusts of Baosteel. Through effective integration and optimization of financial resources, Hwabao Investment Co., Ltd. provides new profit points for the Group in market research, investment and financing, mergers and acquisitions, etc., and gradually is built into a financial holding company to achieve listing. In 2014, Hwabao Investment achieved an operating revenue of 1.992 billion yuan, a profit of 1.348 billion yuan, and management assets of 560 billion yuan.

   Baotou Steel is engaged in the financial industry mostly through its finance company and Huachen Trust Co., Ltd. Baotou Steel established the finance company to unify settlement, monitoring, dispatching, and operation of capital resources, and increase capital benefits and efficiency. Baotou Steel invested the trust company to carry out financing business, loan business, security investment business, bond underwriting business, equity investment business, financial leasing business, asset management, and so on, which is beneficial to the Group to achieve cost reduction, debt optimization, etc., through the financing functions of capital market and monetary market. In 2015, Baotou Steel Finance Company expected to achieve a total operating revenue of more than 200 million yuan and an operating profit of more than 150 million yuan. Huachen Trust Co., Ltd. expected to achieve a total operating revenue and a net revenue of more than 200 million yuan, respectively.

3) Problems

   ① Lack of unified management platform in financial industry and weak competitiveness. At present, the overseas financial institutions that iron and steel enterprises invest are often small in scale,

their performance is worse than their peers, and their management is relatively scattered. Therefore, they are characterized by "small, weak, and scattered". Besides, the affiliated financial institutions are not competitive, developing slowly, and cannot build a well-known brand.

The development of the financial industry lacks a unified management platform. Although some iron and steel enterprises have gradually formed the prototype of kind of financial holding companies, the layout and development still lack a unified planning. Therefore, the financial institutions under the holding company cannot bond together to fully display the synergy and implement the optimized configuration.

② Inadequate control and lack of scientific equity management. At present, the financial institutions invested and controlled by some iron steel enterprises in China are the largest shareholder, but they have little control over these financial institutions. They have a low voice in their management decisions, and the role of the largest shareholder has not been fully played. Their equity investment in these financial institutions only targets at financial investment, lacking scientific equity management. The economic benefits of enterprises are increased only by obtaining equity revenue, and support of financial services in the iron steel business and other diversified industries is weak.

③ Scarce financial talent and small talent reserve. At present, some iron and steel enterprises in China are developing financial industries, but they are generally faced with a serious shortage of talents which can restrict the development of the financial industry.

(9) Logistics Industry

1) Development Status of Logistics Industry in Chinese Iron and Steel Industry. The logistics industry is a complex service industry that integrates transportation, warehousing, freight forwarding, information services, and other industries, which is a basic and strategic industry that supports the development of the national economy. The iron and steel logistics industry is a branch of the logistics industry and is closely linked to the iron and steel industry.

According to the statistics of 2017, China's crude steel output is 832 million tons, the steel output is 1.048 billion tons, and the apparent consumption of domestic crude steel is 768 million tons. At the same time, the vast geographical distribution of iron and steel production enterprises and sales areas provide the iron and steel logistics industry a huge development space. Over the past decade or so, with the rapid economic growth, the output of crude steel and steel has been hitting new high record, and trade volume of steel has always been rising. On this basis, the demand for iron and steel logistics continues to increase, China's iron and steel logistics industry is also rapidly developing, and

the market size is expanding and its growth rate is increasing quickly. In China's steel logistics industry market, only steel sales logistics scale has rapidly been increased from 20.472 billion yuan in 2000 to 246.418 billion yuan in 2014, with a compound annual growth rate of 19.4%, and continued to maintain steady growth. Despite the decline in 2016, it is still large in scale.

As of 2016, the efficiency of iron and steel logistics industry has been steadily improved, and the logistics specialization has continued to be improved. However, in general, the cost of iron and steel logistics in China is still relatively high. According to the calculation, the total cost of the entire supply chain of iron and steel enterprises above the designated size is 790 billion yuan. The cost reduction of iron and steel logistics and the industry has great potential. The general situation of development of the iron and steel logistics industry has the following characteristics: ① improved efficiency of iron and steel logistics and ② effective control by iron and steel enterprises over logistics cost [22, 23].

2) Existing Problems in Logistics Links of Chinese Iron and Steel Industry. Based on current output, the total logistics amount of raw materials and fuel, auxiliary materials, finished steel products, and solid wastes in China's iron and steel enterprises is about 4.1 billion tons per year. In recent years, with the rapid expansion of iron and steel production capacity, China's steel logistics industry has been developed rapidly. But compared with the iron and steel powers, China still has a long way to go in modern logistics, mainly in: ① low marketization of China's iron and steel logistics industry, ② backward logistics technology and equipment, and logistics information resource management being required urgent improvement, ③ lower level of processing and distribution links in the iron and steel logistics, which cannot meet the diversified needs of customers, ④ shortage of logistics talents familiar with iron and steel industry, ⑤ various problems in the development of iron and steel logistics enterprises.
3) Development Trend of Logistics in Chinese Iron and Steel Industry. ① A special logistics management department should be set up to achieve centralized and specialized management of logistics, and gradually enter into the logistics industry. ② It has been a consensus to extend industrial chain and pursue diversified development. ③ The modern logistics management should be built with the support of information technology and network technology. ④ Third-party and fourth-party logistics have been developed rapidly.

(10) Engineering and Technology Industry

1) Status of Engineering and Technology Industry. After experiencing explosive growth, at present, the focus of construction of China's iron and steel industry has shifted from new projects to upgrading

of the existing engineering technology, energy conservation and environmental protection and structural adjustment. The iron and steel engineering industry has shifted from the traditional low-tech, low value-added industries to the emerging high-tech, high value-added and energy-saving and environmental-friendly industries, from traditional engineering design, equipment installation, and commissioning to engineering general contracting and complete equipment supply and transfer, and from the project construction to the project operation management and so on.

① Status of engineering and technology industry. In 2015, there were 20,480 engineering survey and design enterprises participating in statistics, including 1822 engineering survey enterprises, 14,982 engineering design enterprises, and 3676 engineering design and construction integration enterprises. In 2015, the operating revenue of national engineering survey and design enterprises totaled 2708.90 billion yuan, with an increase of 8.6% over the previous year. Among them, engineering surveys contributed 74.34 billion yuan, accounting for 2.7% of operating revenue; engineering design revenue contributed 336.53 billion yuan, accounting for 12.4% of operating revenue; engineering technology management services contributed 37.75 billion yuan, accounting for 1.4%; engineering general contracting contributed 1282.67 billion yuan. The total annual profit of engineering survey and design enterprises was 162.39 billion yuan, with an increase of 9.4% over the previous year; the net profit was 132.05 billion yuan, with an increase of 8.6% over the previous year. In 2015, the total expenditure on scientific and technological activities in the engineering survey and design industry was 52.64 billion yuan, with a decrease of 22.3% over the previous year; the enterprises accumulatively had a total of 93,885 patents, with an increase of 33.2% over the previous year; the enterprises accumulatively had 26,798 proprietary technologies, with a decrease 18.2% over the previous year.

There are hundreds of metallurgical engineering and technology enterprises in China, which are mainly divided into: metallurgical survey and design research units directly under the Ministry of Metallurgy after reform and transformation; metallurgical survey and design research units directly under the provincial and municipal departments and bureaus; and metallurgical survey and design research organized by various large metallurgical enterprises. The annual output value of China's metallurgical engineering design industry reaches hundreds of billions. The scale and technical strength of the enterprises are higher than the average level of the whole national survey and design industry, but it still has a long way to go compared with engineering design units with comprehensive qualifications.

② Overview of key engineering technology enterprises. In recent years, the implementation of a large number of new iron and steel projects and technological transformation projects has brought opportunities for the development of metallurgical engineering and technology industry. In this round of development, the engineering design institutes under the major iron and steel companies have significantly enhanced their comprehensive strength. Their business scope has been continuously expanded, their staff quality and technical level have been continuously improved, and their operating revenue and profitability have continued to grow. For example, Beijing Shougang International Engineering Co., Ltd., founded in 1973, is an international engineering company, with a registered capital of 150 million yuan and more than 1200 employees, established by the former Beijing Shougang Design Institute and controlled by Shougang Group as its relative shareholder. The company mainly provides technical services such as planning consultation, engineering design, complete equipment, project management, and project general contracting in metallurgy, municipal, building, energy conservation, and environmental protection industries. At present, more than 6500 projects have been completed, including over one hundred large-scale general contracting projects. The company has consistently ranked top the list as for business revenues of survey and design enterprises all over China. The undertaken project covers more than 60 iron and steel enterprises including WISCO, TISCO, Baotou Steel, Jigang, Tangsteel, CISC, Xinsteel, Xuansteel, Chenggang, and Xiangtan Steel, as well as more than 20 countries such as Brazil, Peru, India, Malaysia, Vietnam, Bangladesh, the Philippines, South Korea, Saudi Arabia, Oman, Zimbabwe, and Angola. It has undertaken the overall design of the Shougang Jingtang Iron and Steel Plant, which is the national "11th Five-Year Plan" key project and represents the development level of China's iron and steel industry in the twenty-first century. Baosteel Engineering and Technology Group Co., Ltd., established in 2010, was built as a wholly owned subsidiary of Baosteel Group and by the original Baosteel Engineering Technology Co., Ltd. which integrated Baosteel's related businesses such as engineering and steel structure, with a registered capital of 2.82 billion yuan. Baosteel Engineering and Technology Group Co., Ltd. has a complete engineering and technology industry chain and is focusing on developing energy-saving and environmental protection as well as urban building strategic businesses; consolidating and upgrading specialized services such as metallurgical engineering technology, equipment manufacturing, construction management consulting; and guaranteeing to increase competitiveness of iron and steel business as the main

business by means of industrial technical services as a regenerative business. The corporate business covers project general contracting, project management and consulting, engineering design, bidding, project supervision, equipment design and manufacturing, complete equipment supply, construction management, operation and maintenance, product inspection, etc. The service extends from metallurgy to environmental protection, energy, finance, coal chemical and municipal and other industries. In 2015, Baosteel Engineering and Technology Group Co., Ltd. achieved an operating revenue of 10.6 billion yuan. In addition, Jigang International Engineering and Technology Co., Ltd., Tang Steel International Engineering Technology Co., Ltd., and other enterprises have achieved leap-forward development as their main business has been developed from the single metallurgical field to metallurgy, construction, municipal, energy saving, and environmental protection, and transformed from engineering design to engineering design, consulting, project general contracting, and technology research and development.

2) Problems in Engineering and Technology Industry. At present, the comprehensive strength of the engineering and technology industry in China's iron and steel industry has been significantly enhanced, and the enterprise scale, business scope, and technological level have been continuously improved. However, the following problems still exist:
   ① Traditional metallurgical engineering business volume decreases. Complete overcapacity and accelerating elimination of backward capacity in China's iron and steel industry declared end of the era when a large number of large-scale projects were constructed in the iron and steel industry. The cumulative investment of the national ferrous metal smelting and rolling processing industry in 2016 was 417.74 billion yuan, decreasing by 1.1% on a year-on-year basis; a decline in the fixed investment also indicated that the volume of engineering design and project construction in China's iron and steel industry has shrunk. The decline in the business volume of traditional metallurgical engineering will increase the pressure of competition in the market of engineering and technology industry, forcing the engineering and technology enterprises to implement transformation and upgrading.
   ② High competitive pressures in new business sector. At present, the key engineering and technology enterprises in China have been continuously expanding their business scope to gradually realize the development from traditional metallurgical engineering design to new business areas such as building, municipal, energy conservation, and environmental protection; however, in the new business

fields, these enterprises still have a long way to go in market competitiveness and scientific and technological research and development strength, etc., when compared with professional design institutes and scientific research institutions, thereby facing greater pressures of competition.

(11) Other Industries. In recent years, many iron and steel enterprises have achieved some success in real estate and urban service industries such as education, health care, and catering. However, facing increasingly fierce market competition, most industries are burdening heavier operational pressures and there is room for further improvement.

1) Practice of Special Enterprises. Shougang entered the urban service industry in accordance with the requirements of adapting to the urban function of capital city. Its business scope covers traditional urban service industries such as real estate, education, tourism, and pension as well as cultural and creative industries. By promoting the development and construction of Beijing Shougang Industrial Park, Shougang closely integrates urban infrastructure construction, land development and industrial layout, park operation, and so on to create a world-class, harmonious, and livable demonstration zone, becoming the innovation-driven hosting platform for the capital and one of the most dynamic areas. Through the establishment of a special operating company to integrate Shougang TV, publishing, art performance, industrial tourism and other resources to develop cultural and creative industries, it has successfully held the two World Animation Conferences and Beijing International Animation Week, the 6th to 10th Shougang Chinese Rose Garden Flower Show, three Light and Shadow Culture Season and Shougang Lighting Festivals, the "Steel Rhythm" Steel Sculpture Art Exhibition, the Live Concert of the Three Chinese Tenors, the 5th Beijing International Electronic Music Festival, and other large-scale events. Shougang Industrial Park has become China's first national-level industrial and cultural tourism AAA scenic spot.

Operation of WISCO's urban service industry mainly relies on its wholly owned subsidiary—the City Service Group. Its core businesses can be divided into four major parts: property services, public utilities, urban services, and manufacturing and transportation, with businesses covering more than 20 varieties. Its market covers all production logistics within WISCO and expands to many social organizations such as universities, financial institutions, hospitals, enterprises, and public institutions. Among them, the City Service Group is the executive member unit of China Property Management Institution and the first enterprise in Hubei Province that has the first first-grade national property management qualification. It has the second-grade qualification for construction of building and municipal engineering projects, and

the grade C qualification for design of water supply and fuel gas engineering projects; besides, the City Service Group is the Vice President Unit of Hubei Gas Association and has established WISCO China Resources Gas Company which is a joint venture company with China Resources, serving 136,000 gas users in Qingshan District, occupying gas supply pipelines with a length of more than 600 km, and has obtained the gas franchise right of Port of Fangcheng. The City Service Group's business covers a wide range of scope such as group meals, supermarket chains, beverages, elderly care, early childhood education, hotel and tourism, landscaping, as well as food manufacturing, furniture manufacturing, kitchen equipment, automobile transportation, and ecological agriculture, thereby having a great influence in Wuhan City and even in Hubei Province.

Kunming Steel has extensive experience in real estate, health care and elderly care, hotel, tourism, and so on. The real estate developed by Kunming Steel every year has reached 500,000 to 1 million square meters. Combined with the characteristics of the earthquake-prone area in Yunnan, it promotes the buildings of steel structure which save materials and energy and are environmentally friendly and with short construction period. Based on development of the internal staff residential community of Kunming Steel, it also actively expands the business to the external market covering Kunming, Honghe, Chuxiong, Lijiang, Dali, Shilin, and other areas. The Lijiang Minority National Middle School and the Yulong Middle School projects reconstructed with all steel structures have been well appraised by all sectors of society. Kunming Steel began to explore the healthcare and elderly care service industry in 2009. First, it established the first home-based elderly care service head station in Xincun Community which has the most concentrated population of Kunming Steel. In 2013, Yunnan Kunming Steel Health and Elderly Care Co., Ltd. was established, becoming the first state-owned healthcare and elderly care enterprise in Yunnan Province. Combining Yunnan's rich and colorful tourism resources, Kunming Steel invested hot spring hotels in Yanbian of Panzhihua City which was known as the "Sunshine Flower City" of Sichuan Province. Besides, it invested to build a featured hotel in Shangri-La, Diqing Tibetan Autonomous Prefecture, Yunnan Province, and invested in the Sofitel Hotel, the tallest building in Kunming. Therefore, Kunming Steel has gained some achievements in its exploration into hotel and tourism business.

2) Major Existing Problems. First, natural deficiencies are exposed during passive transformation of industry. The initial functions of such industries are generally for the logistics support of employees and their families. As the pressure in market environment increases, the Group's development philosophy changes, and the organizational structure has

undergone many reforms. Today, such industries are mostly operating as independent units and participate in severe market competition. Because the scale of the industry is generally small, experience in external market expansion is insufficient; thus, the industrial influence is limited and the overall competitiveness is weak.

Second, the lack of human resources becomes the bottleneck of industrial development. There are many problems in real estate, health care, catering, and other traditional urban service industries such as unreasonable personnel structures, aging staff with lower education, resistance to industry standardization and marketization, lack of professional, practical, and all-round technical talents, insufficient comprehensive technical strength, and large staff mobility.

Third, insufficient investment causes equipment aging. Most of the equipment in the property management, health care, catering, and other industries has high usage rates for a long time without repairing, which gradually brought them into the phase-out period. However, as in recent years most iron and steel enterprises are suffering from losses in the iron and steel business as their main business which affects the groups' operating revenue, the investment in equipment renewal lags behind, especially for those without external business qualification who depend entirely on the internal business of the groups. These factors affect the improvement of industrial competitiveness to a certain extent.

12.2 Development Environment and Policy Orientation

12.2.1 Macroeconomic Environment for Developing Diversified Businesses

In 2017, by adhering to the general tone of making steady progress, unswervingly implemented the new development concept, upholding the principle of centering on improving quality and efficiency and taking the supply-side structural reform as the main line, economic performance has achieved stable and positive progress which is better than expectation; thus, the economy and society have maintained a steady and sound development. In 2017, the gross domestic product (GDP) for the whole year was 82.71 trillion yuan, with a year-on-year increase of 6.9%, and the growth rate increased by 0.2%. The added value of the primary industry was 6.55 trillion yuan, with an increase of 3.9%; the added value of the secondary industry was 33.46 trillion yuan, with an increase of 6.1%; the added value of the tertiary industry was 42.70 trillion yuan, with an increase of 8.0%. The proportion of the tertiary industry's added value was 51.6%, which is the same as that of 2016. The tertiary industry constitutes the main driving force for economic growth. Investment in fixed

assets with high steel consumption increased by 7.2% year on year, of which real estate development investment increased by 7.0%, with the growth rate increased by 0.1%. For the traditional steel-consuming industries like the mining industry, the automobile manufacturing industry, and the metal product industry, the added value growth rate decreased, while that of the general equipment manufacturing industry and the special equipment manufacturing industry increased. The added value of the mining industry decreased by 1.5%, with its growth rate declined by 0.5%; the added value of the automobile manufacturing industry increased by 12.2%, with its growth rate declined by 3.3%; the added value of the metal products industry increased by 6.6%, with its growth rate declined by 1.6%; the added value of the general equipment manufacturing industry increased by 10.5% and that of the special equipment manufacturing industry grew by 11.8%, with their growth rate increased by 4.6 and 5.1%, respectively, compared with 2016. Such growth has promoted the recovery of the demand in the steel product market.

As China's economic development has entered a new normal, the development environment of the iron and steel industry has been undergoing profound changes. In 2015, China's steel consumption and output both entered the peak arc and presented a downward trend. Oversupply contradiction of domestic steel products has become more prominent, and the main iron and steel industry experienced the period of overall loss from that of low profit. In addition, a number of diversified businesses suitable for the development of the iron and steel enterprises represented by the Internet, finance, logistics, deep processing, and emerging industries are maintaining a high-speed growth. The profits realized by the development of diversified businesses in iron and steel enterprises have made up for some of the losses of their main businesses, greatly improved their competitiveness, and promoted their transformation in surmounting setbacks. In 2016, the iron and steel industry deepened the supply-side structural reform and made great efforts in resolving the overcapacity. As a result, the market showed positive changes and corporate benefits got improved. However, the overall condition of overcapacity has not been changed. The foundation for rising prices and recovering returns is still weak. Steel product exports have been declining, and investment in the iron and steel industry has shrunk significantly. 2017 is a crucial year for the supply-side structural reform of the iron and steel industry. Under the premise of striving to improve the efficiency of the main business, the iron and steel enterprises need to tap new profit growth poles so that it is imperative to develop diversified businesses.

12.2.2 Policy Environment for Developing Diversified Businesses

12th Five-Year Plan for the Iron and Steel Industry ([2011] No. 480 of the Ministry of Industry and Information Technology) pointed out "transforming service

concept, enhancing service awareness, establishing a strategic cooperation mechanism between iron and steel enterprises and their downstream customers, developing steel product deep processing, and improving the logistics distribution system so as to enhance product value and corporate service function, thus promoting the transformation of steel producers to service providers".

Guiding Opinions of the State Council on Resolving the Severe Overcapacity (No. 41 [2013] by the State Council) pointed out "deepen the reform of state-owned enterprises and guide the state-owned capital to transfer from the industries with severe overcapacity to strategic emerging industries and public utilities field".

Adjustment Policies for Iron and Steel Industry (Revised in 2015) (Draft for Comment) pointed out "encourage qualified iron and steel enterprise to open up new service areas like e-commerce, Internet finance, futures, logistics, and others so as to promote deep integration of production and sales supply chains, accelerate the transformation from manufactures to service providers, maximize customers' value, and create and share the value of the industrial chain".

The State Council's Opinions on Resolving Overcapacity of the Iron and Steel Industry for Development (No. 6 [2016] by the State Council) clearly pointed out encouraging enterprises to withdraw part of the steel production capacity via transformation and other means. Commercial banks are encouraged to increase credit support for the transformation of industries with severe overcapacity in accordance with the principles of controllable risks and commercial sustainability.

In the past five years, China has successively introduced relevant policies to encourage iron and steel enterprise to promote their transformation and enhance their competitiveness by advancing the development of diversified businesses with the purpose that the iron and steel industry can resolve its overcapacity, the capital can be transferred to strategic emerging industries and public utilities field, and the process of structural adjustment can be pressed ahead. Therefore, it is in line with the national policy orientation for iron and steel enterprises to develop diversified businesses reasonably and appropriately based on their own situations.

12.2.3 Necessity of Developing Diversified Businesses

Developing diversified businesses is an inevitable choice for iron and steel enterprises to guard against systemic risks. The market economy is cyclical, while the iron and steel industry is a typical cyclical industry. As the price fluctuation of the steel products is sharp, iron and steel enterprises must have plans to cope with risks and the cycles. The world's large-scale iron and steel enterprises, such as Nippon Steel, ThyssenKrupp, ArcelorMittal, and Baosteel, all own diverse businesses related to the main iron and steel business. At present, China's economic development has entered a new normal facing greater downward pressure. Thus, rational development of diversified businesses has become a common and inevitable choice for large-scale iron and steel enterprises to avoid cycles and prevent risks. This direction is in line with the development law of the market economy and meets the needs of iron and

steel enterprises to enhance their viability, adaptability, and capability of sustainable development under the market economy.

Developing diversified businesses is a necessary choice to promote the transformation of iron and steel enterprises. Developing diversified businesses has become an unstoppable trend for iron and steel enterprises to shift from production-oriented manufacturing to service-oriented manufacturing and from product competition to industrial chain competition. On the one hand, developing diversified businesses of the iron and steel enterprises is a certain requirement for China to achieve steady growth in industrial restructuring. On the other hand, creating diversified businesses that extend the iron and steel industry chain and expand the value chain will realize synergy between diversified businesses and the main iron and steel business, which has strategic significance for reducing the additional cost of the main iron and steel business and restoring the advanced nature of the same.

Developing diversified businesses is an inevitable choice for revitalizing existing assets and improving the competitiveness of iron and steel enterprises. During the 12th Five-Year Plan, some iron and steel enterprises pursued the "big-and-complete" or "small-but-complete" model in the development process, forming a large number of non-operating assets and idle assets. By developing diversified businesses and carrying out diversified business, such stock assets will be revitalized and economic efficiency will be improved. In addition, compared to tapping more profits from the main iron and steel business through technology accumulation and innovation, the development of diversified industries such as deep processing, related finance, and new emerging industries may bring greater benefits. Meanwhile, improvement of the service level and profitability in diversified businesses is conducive to promoting the core competitive advantage of the iron and steel business [24, 25].

Developing diversified businesses is an inevitable choice for the iron and steel industry to resolve excess capacity and breach the bottleneck. *The State Council's Opinions on Resolving Overcapacity of the Iron and Steel Industry for Development* (No. 6 [2016] by the State Council) clearly states that starting from 2016, crude steel production capacity would be cut by 100 million to 150 million tons within five years. According to the rough calculation of the current per capita steel production capacity of iron and steel enterprises in China, cutting the overcapacity of iron and steel industry means that about 500,000 employees in the industry will face adjustment or re-selection of jobs. Developing diversified businesses by iron and steel enterprises can provide more job posts, divert the personnel in the main business as well as prevent large-scale laid off, and meanwhile, reducing the main business personnel is of great significance in improving productivity and cutting the production costs of the main business.

12.3 Case Analysis

12.3.1 Pohang Iron & Steel Co. Ltd. (POSCO) in South Korea

1. Overview of Developing Diversified Businesses

Pohang Iron and Steel Co., Ltd. (hereinafter referred to as "POSCO") was founded in 1968. It has established a future-oriented industrial system featuring the transformation from iron and steel to non-steel, from production to service, and from the steel-centric business structure to a balanced one between traditional and new businesses.

Crude steel output of POSCO registers more than 40 million tons. It has the Pohang Steelworks and Gwangyang Steelworks with the largest scale in the world producing hot-rolled steel products, thick plates, wire rods, titanium products, cold-rolled steel products, hot-dip galvanized products, electro-galvanized products, silicon steel sheets, materials for automobiles, stainless steel, etc. Flat products are the main part in the product structure with the cold-rolling ones constituting a large proportion. Automobile and home appliance sheets are its cutting-edge products. From 2010 to 2017, POSCO ranked the first for 8 consecutive years in the world's most competitive iron and steel enterprises released by the World Steel Dynamics (WSD). Industrial characteristics is to construct a diversified industrial structure with the iron and steel industry as the core and the industries of trade, engineering and architecture, information technology, energy and environmental protection, material and chemical engineering as the support [26–28].

2. Briefs and Reviews of Diversified Businesses

POSCO's unique strategy of development of diversified businesses is of significant characteristics. Its diversified businesses focus on five fields: trade, engineering and architecture, information technology, energy and material and chemical engineering. Profit growth in the future is attributed to diversified businesses, and its subsidiaries have shifted from the dependent type to independent development model. Expanding business scope through diversified businesses will increase revenue sources and customer base as well as reduce operational risks.

(1) Trade. In 2010, POSCO acquired Daewoo International, which is specialized in global trade and investment, which is composed by the trade departments in ferrous metal, chemical engineering, petroleum products, machinery, transportation equipment, and agricultural and livestock products, the overseas project departments responsible for overseas plants and infrastructure development, and the resource development departments responsible for the development of petroleum, fuel gas, minerals, grain, and so on. It is promoting new core businesses such as manufacturing and distribution business and the real estate development business at home and abroad. Exploration of copper, uranium, and tin mines in Africa, the Americas, Southeast Asia, and Australia is ongoing.

Expanding new business spaces such as infrastructure construction, compound real estate development, and ship leasing is also being facilitated. The development of the trade industry brings synergies, which provides the main iron and steel business with a stable supply chain.

(2) Engineering and Construction (E&C). As a representative in the construction field, POSCO E&C has been continuing to expand its fields, namely the civil engineering, architecture, energy, urban development, and others based on the construction experience of POSCO steel plants. It has also expanded its business scope to the areas of low-carbon and green growth field through new renewable energy and urban center recycling business.

It conducts the construction and development of industrial plants, civil engineering, commercial and residential projects in ROK and foreign countries and is expected to become a specialized equipment manufacturer centering on high value-added industries like offshore platforms and power generation equipment. Engineering and construction mainly serve for steel plant construction and equipment manufacturing.

(3) Energy. The energy industry includes electricity, renewable energy (waste gas, solar energy, wind energy, and energy recycling), and fuel cells. Iron and steel/environmental-friendly/energy, light rail, skyscrapers, new urban development, and new/renewable energy facilities are also involved.

POSCO is at the leading status in fuel cells. It has participated in the industries concerning waste gas power generation, photovoltaic power generation, wind power generation, fuel cell, and others domestically and globally, and created an energy value chain based on LNG combined cycle power generation. The development of the energy industry plays a role in reducing the volatility of corporate profits and building a value chain to stabilize the profit of the main business.

(4) Material and Chemical Engineering Industry. POSCO CHEMTECH was established in 1994 by the merger of Samhwa Hwasung and POSCO Shipping. The former one was mainly engaged in the production and sales of alkaline refractories, while the latter one was mainly engaged in the maintenance and installation of various industrial furnaces. As a company of comprehensive raw materials that is independently carrying out the manufacturing and construction of refractory materials, it is commissioned to conduct operation of lime sintering equipment, chemical processing plants, and sales of finished chemical products. The company is also making great efforts to leap to the world's top manufacturer of coal chemistry and carbon raw materials. POSCO CHEMTECH has also diversified its business areas by getting involved in the secondary cell cathode materials, needle coke, and other chemical fields.

(5) Information and Communication Technology (ICT). This part is mainly responsible for production automation and IT equipment. By integrating IT and engineering technologies to create synergies and achieve green growth, the concept of "creating a green ICT future" is considered as its development vision. POSCO has been working with many companies around the world to develop a solution

platform and trying to consolidate its status in nuclear energy, cloud computing, green growth, and renewable energy businesses.

It provides ICT services that lead the integration era, by taking the three major areas of engineering, process automation, and IT services as the core businesses, and it also enters the future-oriented business areas such as LED lighting, smart grid, and cloud computing. At the same time, POSCO has been continuing to strengthen the core strength of green businesses such as environmental-friendly solutions, railways and transportation, renewable energy, and nuclear power plants.

3. Summary

Extend the upstream and downstream industrial chains; develop the resource industry and product service industry that are highly related to the main iron and steel business; integrate the comprehensive utilization of steel resources and the power generation by waste energy and waste heat to develop green environmental protection industry; assist the support for the main iron and steel processes to develop the productive service industry and cross-industry and cross-area combined operation to maximize the coupling effect and synergies.

The newly involved diversified businesses are far from the main iron and steel business with large scale of investment and long investment payback period, which leads to a tight budget, worsening financial conditions and declining credit rating. Entering the diversified sector by means of acquisition and reorganizationof the steel sector is helpful to avoid the risks of higher threshold. Diversified businesses are all effective extensions and supplements to the main iron and steel business. They have the coupling effects in stabilizing the profit of the main business and building the advantage of supply chain. Integration, transformation, and separation of the various diversified industrial sectors and establishing professional joint ventures can maximize the coupling effect of the entire industrial system via building the market competitiveness of each sector.

12.3.2 ThyssenKrupp Group (ThyssenKrupp) in Germany

1. Overview of Developing Diversified Businesses

The ThyssenKrupp Group's diversified businesses are almost all oriented to the development of businesses relating to the iron and steel industry. Based on the deep processing capability of steel products, it has developed basic businesses such as the raw material processing, steel cutting and distribution, laser welding of tailored blanks, mechanical parts and components. Automobile system, shipbuilding, elevators, and other manufacturing businesses are actually the industrial extensions of the above basic businesses; it has developed the businesses like raw material service and industrial service by relying on resource integration, logistics, and warehousing management capabilities; it has developed businesses like plant technologies and project management by relying on the experience and technologies in steel plant

construction. In ThyssenKrupp's diversified system, each business requires market leadership, usually with the positioning of top three in global or regional markets.

2. Briefs and Reviews of Diversified Businesses

   (1) Technological Industry of Components and Parts. The ThyssenKrupp is a major manufacturer of large-scale pivotal bearing in the world whose components and parts have been applied in the general mechanical engineering equipment, conveyors, mining and mineral beneficiation systems, port equipment, shipbuilding, cranes, earthmoving machinery, etc. This industry also includes the production and supply of track and track assemblies for mining, forestry and agriculture, excavators, bulldozers, and tractors. In addition, the industry has developed and manufactured the steering shafts, steering columns, and steering gears that have been applied in millions of vehicles around the world for safe driving. The ThyssenKrupp Group's component technology industry is synonym of the high-tech and innovative automotive chassis products in the world. It has the ability to produce and supply shock absorbers and suspension components for all passenger cars and trucks as well as state-of-the-art solutions.

   (2) Elevator Industry. The elevator industry brings together the Group's worldwide activities in the passenger conveying system. Its range includes passenger and cargo elevators, escalators, pedestrian walkways, passenger boarding bridges, stair, and platform lifts. In addition to systems that supply products to the mass market, its portfolio products include customized solutions and services, maintenance and modern packaging tailored to customers' requirements. Thanks to the innovative, safe, and reliable technologies, as well as the energy-saving, environmentally friendly, and high-quality products, the ThyssenKrupp Group's elevator technology industry has been always able to set new market benchmarks.

   (3) Industry of Industrial Solutions. This industry offers a full range of professional engineering and construction services, and its history can be dated back to several centuries ago in shipbuilding. It is also the core strength of the ThyssenKrupp Group. High-quality engineering is a key to a company's success, and this industry provides chemical plants, refineries and other industrial facilities, industrial equipment for cement, minerals, and others, machinery and systems for ore mining, processing and treatment and raw materials and mineral transportation, as well as bodywork and final assembly equipment, including A–Z engineering services from the design to construction of related controlling and experimental equipment for automotive manufacturing plants and suppliers. New fields of the industry include solutions for automotive alternative battery and driving system, innovative automotive lightweight design solutions, and equipment and experimental systems for the aerospace industry. Built on its innovation and technical expertise, its industrial solution industry is one of the world's leading players in the shipping industry, which can provide customers with high-quality military products and services.

(4) Material Service Industry. The materials service industry has 500 branches in 40 countries. The industry is committed to the global distribution of materials and providing comprehensive technical services to the productive and manufacturing businesses. Forty percent of the Group's products are sold through these material service centers in Europe. Products of ThyssenKrupp Group's materials services industry include carbon steel, stainless steel, steel pipes, nonferrous metals, and plastics. It also offers a wide range of customized materials services extending from processing and logistics to warehousing and inventory management. Service centers and branch offices of this industry have extensive processing equipment, which are able to conduct cutting, clipping, plasma or laser cutting, sawing, drilling, milling, and coating for materials. The development of the material service industry has enabled the ThyssenKrupp Group to transform from a material manufacturer to a material service provider, thus greatly enhancing the Group's core competitiveness.

3. Summary

(1) Some diversified businesses have strong correlation with the iron and steel business. The development of diversified businesses is inseparable from the basic support by iron and steel materials.
(2) Long-term accumulation and strong technology R&D foundation and ability lead to the current high-level and strong technical innovation ability to ensure its global leadership in the diversified businesses.
(3) A clear understanding of the development of diversified businesses is acquired. It resolutely withdraws from the diversified sectors with bleak prospects or saturated market, such as the sector of selling laser tailor-welded blank. Diversified businesses with promising prospects are getting more investment to seek higher returns.

12.3.3 China Baowu Steel Group Corporation Ltd. (China Baowu)

On December 1st, 2016, the former Baosteel Group Co., Ltd. and Wuhan Iron and Steel (Group) Co., Ltd. formally got merged to form China Baowu Steel Group Co. Ltd. (hereinafter referred to as China Baowu). This case focuses on the analysis of the Baosteel Group's diversified businesses.

1. Overview of Developing Diversified Businesses

Based on practical exploration, development of Baosteel Group's diversified businesses is achieved in stages gradually via analyzing and drawing on the experiences on diversified businesses of the world's steel giants. The process can be roughly divided into five stages. The first stage (before 1995) is a start-up stage of diversified business during which the decision-making operation concept of "self-supporting and

self-digesting" was introduced; the second stage (1995–2004) is the booming stage of diversified business during which a strategic orientation of building a transnational, cross-industry, and large-scale enterprise group with one main industry and several supporting businesses was pursued; the third phase (2005–August 2007) is the adjustment stage of diversified business during which an overall strategic framework with one cutting-edge industry and appropriately developed related diversified businesses was formulated; the fourth stage (August 2007–December 2012) is the optimization and convergence stage of diversified business during which the new strategic concept featuring innovative development mode and dynamic optimization of diversified businesses' structure was determined; the fifth stage (2013–2016) is Baosteel's new round of planning period with the focus on development, transformation, and building a healthy industrial portfolio [29].

2. Briefs and Reviews of Diversified Businesses

By the end of November 2016, Baosteel Group has formed "1 + 6" development model with iron and steel business as its score business and resource development and logistics, steel extension processing, engineering and technical services, coal chemical engineering, financial investment, production services, and so on as its strategic diversified businesses. The following are the introduction for each diversified business sector:

(1) Resource development and logistics industry. The resource development and logistics industry is the upstream industry of the iron and steel industry's main supply chain. It is mainly engaged in the development and operation of iron ore, coal, and other resources to ensure the resource supply for steel production. As the main unit of this industry sector, Baosteel Resources Co., Ltd. is mainly engaged in the investment, trade, and logistics services of mineral resources. This company also strives to build resource investment, trade, and integrated logistics service platform for iron and steel industry and the relevant industrial fields. In 2015, Baosteel Resources realized operating revenue of 29.4 billion yuan.
(2) Steel Extension Processing Industry. The steel extension processing industry is the downstream industry of the iron and steel industry's main supply chain. It mainly utilized Baosteel's advantage in steel production to develop the steel extension processing industry. As the main unit of this industry sector, Baosteel Metal mainly engaged in metal packaging, industrial gases, metal products, automobile trade, etc. In 2015, Baosteel Metal achieved an operating revenue of 10.14 billion yuan with a profit of 310 million yuan.
(3) Engineering and Technical Service Industry. The engineering and technical service industry shoulders the missions of enhancing Baosteel's independent capabilities in integrated innovation, supporting the iron and steel business to keep streamlined and efficient, and promoting the industrialization of engineering technology. As the main unit of this industry sector, Baosteel Engineering Technology Group Co., Ltd. covers a business scope of EPC project, project management and engineering consulting, engineering design, engineering bidding, engineering supervision, equipment design and manufacturing, supply of

complete set of equipment, construction management, operation and maintenance, product inspection, etc. Its service range extends from metallurgy to environmental protection, energy, finance, coal chemical, municipal industries, and others. In 2015, Baosteel's Engineering Technology Company achieved an operating revenue of 10.67 billion yuan.

(4) Coal Chemical Industry. The coal chemical industry is a resource utilization industry, which is mainly engaged in the gas refining after coke oven in iron and steel enterprises and the production and sales of coal chemical products. It has achieved recycled usage and product conversion based on coking by-products. By the end of 2015, Baosteel's Chemical had an original fixed assets of 9.11 billion yuan, total assets of 5.34 billion yuan, the treatment capacity of 4.2 billion cubic meters of coke oven gas, 950,000 tons of tar and 250,000 tons of crude benzene treatment, and production capacity of 240,000 tons of carbon black. The quality of needle coke products has further improved, and it has already occupied a place in the high-end market. Its tar processing capacity has ranked among the international top level with the scale advantage of developing into a world-class coal chemical enterprise. In 2015, Baosteel Chemical achieved a total operating revenue of 7.63 billion yuan with a profit of 40 million yuan.

(5) Financial Investment Industry. The combination of the financial investment business and the main iron and steel business can effectively promote the development of the iron and steel business and enhance its comprehensive competitiveness. Hwabao Investment Co., Ltd. is committed to the equity investment business and selects outstanding leading enterprises to make direct investment. While actively seeking investment opportunities in the upstream and downstream industrial chains related to the mainstream financial industry and the iron and steel business, it has also increased its investment in anti-cyclical industries such as public facilities, large-scale consumption, and medicine and health care. Focus investment at right timing was also made in energy saving and environmental protection, new materials, high-end equipment, and some high-tech industries; in addition, with market-oriented operational advantages, it has indirectly participated in the equity investment business. In 2015, Hwabao Investment realized an operating revenue of 5.67 billion yuan with a profit of 2.83 billion yuan and management assets of 763 billion yuan.

(6) Production Service Industry. The production service industry has two strategic tasks, namely providing highly efficient services for the iron and steel business and realizing the industrialization of renewable resources. As the main undertaker of this business sector, Baosteel Development Co., Ltd.'s main business includes the service covering new building materials, magnetic materials, environmental improvement, quality life, auxiliary production, logistics and distribution, factory property, and others, which can provide systematic and integrated solutions for industrial enterprises and urban systems. By based in Baosteel and extending to the whole society, it is committed to becoming a comprehensive utilization service platform for solid waste resources, a quality life integration service platform, and an industrial collaborative service platform.

In 2015, Baosteel Development achieved an operating income of 7.25 billion yuan and a profit of 590 million yuan.

3. Summary

After development of over 30 years, China Baowu's diversification has witnessed its success and twists. Through summarizing the past and facing the future, several points are worth our pondering:

(1) Developing diversified businesses by centering on the value chain of main iron and steel business. It must be ensured that the development direction of diversified business should be insisted around the main value chain of iron and steel business, so as to select appropriate businesses to make moderate development and form the industrial development policy of the joint industrial structure. Meanwhile, improving the core competitiveness of main iron and steel business should be always taken as the first element the Group's development.
(2) Core competence is the only way for related diversified businesses to become stronger. To make the diversified businesses stronger, it is necessary to find its own position in a certain link of the iron and steel production industry chain, share the resources among the similar main businesses, and pursue the coordinated development among them. Cultivating its own core competence constitutes the key to the success of the diversified businesses.
(3) Uphold the principle of marketization in developing diversified businesses. Separation of main and supporting business and the deconstruction of the value chain releases part of the resources of iron and steel enterprises. However, to truly cultivate a strong diversified industry, the enterprise must go out of the internal market and adhere to the principle of market competition.
(4) Effectively guard against the risks of diversified operations. Entering new industries is not a simple process of "buying". After entering a new industry, enterprises need to continuously inject follow-up resources, foster their own workforce, and establish corporate brands. Meanwhile, enterprises should try not to enter areas that they are not familiar with, which means "no involvement in unfamiliar area".
(5) Improving the market exit mechanism. Due to historical reasons, the diversified businesses involved in iron and steel enterprises are scattered in many fields with large extent of overlapping business. Some of the industries have serious losses, and some do not meet the company's overall development strategy. There must be innovation, new ideas, and an effective exit mechanism.

12.3.4 HBIS Group Co. Ltd. (HBIS)

1. Overview of Developing Diversified Businesses

HBIS Group Co., Ltd. (hereinafter referred to as "HBIS") is the second largest steel group in China. It now has 20 sub-branches such as Tangshan Iron and Steel Co.,

Ltd. and Handan Iron and Steel Co., Ltd. with a total of 121,400 employees and an asset size of 324.287 billion yuan. In recent years, HBIS has been actively taking the path of diversified development, extending the industrial chain, and broadening the industrial scope. By putting equal emphasis on "creating brand-new businesses" and "making innovations in existing businesses", it has scored remarkable fruits.

The development of diversified businesses in the HBIS presents the "double-layered" pattern between the Group and its subsidiaries: The Group fully leverages its integration advantages and has established three major operating companies for procurement, sales, and its international business as well as several specialized companies in mining, international logistics, finance, and other areas. It has initially formed five industry sectors in mining resources, modern logistics, financial securities, steel trade, and equipment manufacturing; based on revitalizing stock assets and optimizing resource allocation, Tangshan Steel, Handan Steel, Xuanhua Steel, and other steel plants have promoted the market-oriented transformation to the diversified businesses and cultivated business sectors such as comprehensive resource utilization, energy conservation and environmental protection, steel extension processing, engineering technologies, and social services. Diversified businesses have become an important point for HBIS's efficiency improvement and profit supplement, and have contributed 30% of the Group's revenue as well as 50% of its employment [30].

2. Briefs and Reviews of Diversified Businesses

   (1) Mineral resources. During the 12th Five-Year Plan period, resource control of HBIS Mining Company has increased significantly from 889 million tons to 3.9 billion tons, with an increase of 338.7%; the output of iron ore concentrate increased from 5.13 million tons to 10 million tons. During the 13th Five-Year Plan period, the seven key mine projects currently under construction will also be put into operation.
   (2) Modern logistics. HBIS owns 8 companies in logistics industry. The total logistics throughput of main iron and steel business stands at 180 million tons/year, and the annual value of their logistics resources is over 20 billion. However, the logistics entities at the Group level face "limited resources and lack of strength", while the logistics business at the level of each steel plants is "separate and uneven". There is no overall integration, so that the value is scattered with great losses.
   (3) Iron and Steel trade. HBIS International Company is mainly responsible for the import of raw materials and fuels, the export of products, equipment import management and agency, overseas investment, investment introduction, and other businesses. In recent years, its ore imports accounted for about 5.0% of the national total imports, and its steel exports accounted for 7.5% of the national total exports. The main value-added services cover two major aspects: One is the implementation of a large-scale logistics strategy to carry out freight forwarding business on their own; the other

is the expansion of financing channels to optimize financing structure and realize financing value adding.

(4) Finance and securities. Currently, HBIS's institutions involving in financial business mainly include the HBIS Finance Company and Caida Securities Company. In 2014, operating revenue of HBIS's financial and securities business registered 1.910 billion yuan with a profit of 1.232 billion yuan and total assets of 28.895 billion yuan.

(5) Deep processing of steel products. The steel product deep processing of HBIS is currently carried out by the Tangshan Huaye (Tianjin) Steel Marketing Co., Ltd., Handan Iron and Steel (Linzhang) Industrial Park, and Wugang Sanhesheng Machinery Manufacturing Construction Co., Ltd. As of the end of 2014, HBIS's steel product deep processing capacity has reached about 3.6 million tons, which needs to be further strengthened.

(6) Equipment manufacturing. HBIS has 7 equipment manufacturing enterprises. Tangshan Steel Machinery (Heavy Machinery) Equipment Company, Handan Steel Equipment Manufacturing and Installation Co., Ltd., and Shijiazhuang Steel and Jingcheng Equipment Technology Co., Ltd. perform well, but the overall development of the industry is relatively weak.

(7) Comprehensive utilization of resources. The comprehensive utilization of HBIS mainly involves in industrialized gas, solid waste, and other resource utilization businesses. Its Industrial Gas Company has realized the development and utilization of high-purity gases, rare gases, and special gases. The added value and profit margin of the products have been greatly improved, and the external market has been effectively exploited with an annual output of about 1.6 billion yuan and the total profit of 300 million yuan. The overall level of solid waste comprehensive utilization needs to be improved. Most of the solid waste resources are directly sold out, and the added value of solid waste utilization is relatively low. The annual output of solid waste resources is about 30 million tons with a total value of 650 million yuan by comprehensive utilization.

(8) Engineering technologies. The engineering technology industry of HBIS is relatively scattered, which is currently mainly carried out by the Tangshan Steel International Engineering Technology Co., Ltd. and the Design Institute of Handan Iron and Steel Group. The annual revenue of this sector has achieved 300 million yuan.

(9) Medical and health. The medical and health industry of HBIS mainly includes five Grade II A affiliated staff hospitals. After years of development, it has cultivated an employee team with good comprehensive quality and strong ability, which has made prominent contribution for protecting the health and safety of the employees in steel plants and keeps the personnel stability of the same. Under the impetus of the reform of the enterprise mechanism and system in recent years, the hospitals have

been gradually facing the society. But due to the lack of flexible market-oriented operational mechanisms, most hospitals are confronted with many difficulties.

(10) Social services. The social service industry of HBIS Group mainly includes property management, vocational education, catering and accommodation, landscaping, industrial tourism and real estate, etc. During the 12th Five-Year Plan period, the Group actively promoted the market-oriented transformation of its subsidiaries' life logistics service system. By relying on internal related markets, this system fully participated in social competition, with the help of innovated management system and mechanism to revitalize the existing resources and assets.

3. Summary

Through years of development, HBIS has provided a good resource guarantee for the development of the Group's diversified businesses, including capital, land, talents, technology, and many other aspects based on its strong scale advantages, regional influence, and resource integration capabilities. The Group has initially formed five major industrial sectors, namely mining resources, modern logistics, financial securities, iron and steel trade, and equipment manufacturing. Subsidiaries like Tangshan Steel, Handan Steel, and Xuanhua Steel have focused on cultivating comprehensive resource utilization, energy conservation and environmental protection, steel product extension processing and engineering technology, social services, etc. Various subsidiaries in diversified businesses have basically formed their own leading products and have acquired certain market competitiveness in related fields. A solid foundation for the rapid rise of diversified businesses has been laid.

In addition, although HBIS has achieved outstanding results in developing its diversified businesses in recent years, such development still does not meet its goal of being a world-class steel complex. Compared to those advanced steel groups at home and abroad, HBIS lags behind in the development of diversified businesses. For example, the development of its financial industry lacks impetus, the combination of industry and finance is weak, and its contribution to the overall development of the Group is insufficient; its management mechanism needs to be further streamlined, the synergy between the various subsidiaries has not been realized, and the ability to cope with the external market is lacking; restrictions posed by talent shortage have become increasingly obvious so that the institutional mechanism guarantee for the introduction and training of talents in the diversified businesses needs to be further improved; high labor costs have seriously weakened the market competitiveness of enterprises; leading enterprises with strong influence are insufficient; problems such as insufficient exploration of external market need to be solved step by step.

12.3.5 Kunming Iron & Steel Co. Ltd.

1. Overview of Developing Diversified Businesses

Kunming Iron & Steel Co. Ltd. (hereinafter referred to as Kunming Steel) was founded in 1939 and was formerly known as China Electric Steel Plant and Yunnan Steel Plant. After years of development, Kunming Steel has been built into a huge group with the coordinated development of iron and steel business and diversified business. It is the largest state-owned enterprise in Yunnan Province and has been among the top 500 Chinese enterprises for many years. In 2007, Kunming Steel's main business and WISCO Group made a strategic restructuring and formed the WISCO Group Kunming Iron and Steel Co., Ltd., which is controlled by WISCO Group. After the reorganization, work focus of Kunming Steel has gradually been shifted to the development of diversified businesses. The related diversified businesses have seen rapid development, and a multi-industrial system with synchronous development of coal–coke chemical industry, mining exploitation, equipment manufacturing, new materials, cement building materials, and modern service industry has been established. In 2015, the revenue of Kunming Steel's diversified businesses has exceeded 50% of total operating revenue, making diversified businesses an important pillar for its development (Fig. 12.4). The characteristics of its diversified business development are: basing on the main iron and steel business, starting from the steel-related businesses, developing the resource industry necessary for steel production, enriching the steel-consuming industry and the steel service industry, and expanding the new materials, modern service industry, and others with certain relations to its iron and steel business.

2. Briefs and Reviews of Diversified Businesses

(1) Coal–coke chemical business. Through various measures such as capacity replacement, mergers and acquisitions, and technological transformation, Kunming Steel has basically established a complete industrial chain of coal–coke chemical industry, owning coal mines and coal washing plants. Its coke output capacity stands at 4.5 million tons/year, and its deep processing capacity of coal-based products registers 1 million tons/year. The product varieties in this sector have reached 24. Based on the "backdoor" restructuring of Malong Company, it has successfully been listed in the name of "Yunmei Energy". As a result, the coal–coke chemical industry has become an important one of the diversified businesses of Kunming Steel. Kunming Steel's coal–coke chemical industry is in line with the development model of being economical, clean, and recycling. It has the technical and economic conditions in coal resource control and industry integration. While satisfying the demand for coke in the main iron and steel business, it also creates new profit growth points for the enterprise.

(2) Mining exploitation business. Via strengthening the ore prospecting and resource integration, promoting the comprehensive utilization of tailings,

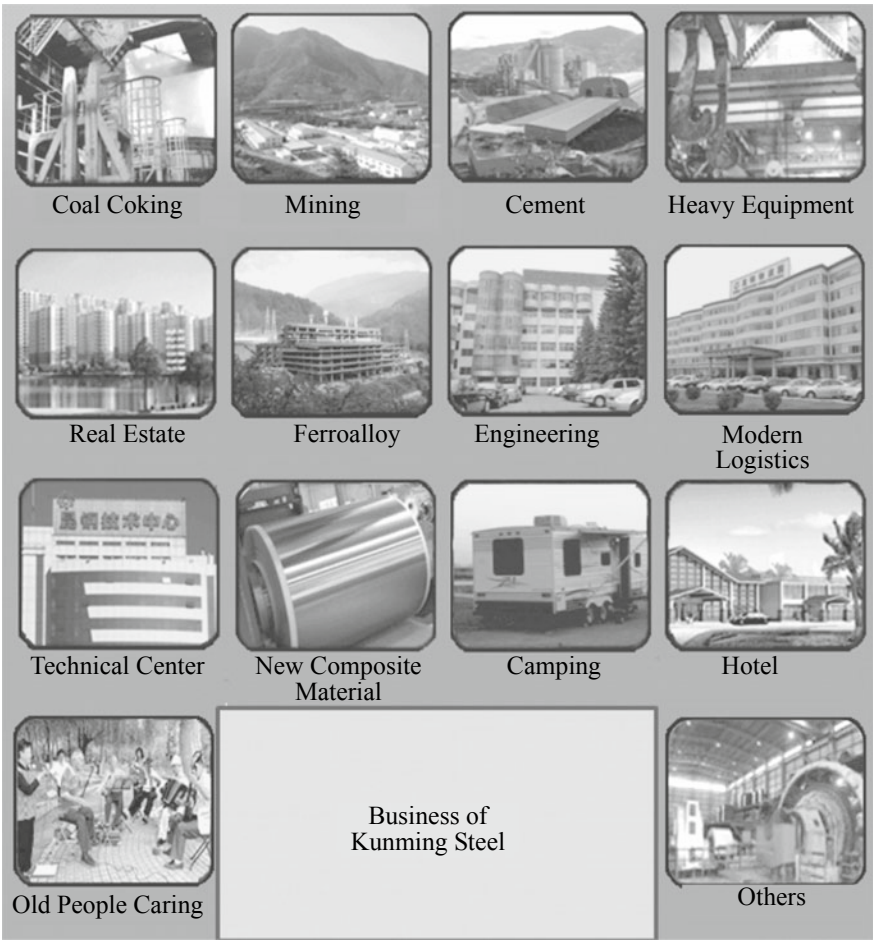

Fig. 12.4 Map of Kunming Steel's diversified businesses

focusing on the R&D and promotion of new technologies in beneficiation and smelting, and implementing such strategies and measures as going global, Kunming Steel has been continuously improving the overall level of its mining exploitation industry with nine iron ore mines being built successively. It now owns an iron ore reserve of 800 million tons and an iron ore concentrate output capacity of 6 million tons per year. The mining exploitation industry of Kunming Steel has effectively provided low-cost raw materials for its iron and steel business, broadened the resource channels, and consolidated the foundation for the company's sustainable development.

(3) Equipment manufacturing business. In 2008, the utility and auxiliary facility maintenance works and their personnel of Kunming Steel had been separated from Kunming Steel to set up a heavy equipment manufacturing group

so as to systematically upgrade its research, development, design, and manufacturing capabilities on large-scale complete sets of equipment. It gives priority to the development of heavy lifting equipment, wear-resistant materials, heavy castings and forgings to provide the equipment required for the manufacturing of large-scale equipment in Yunnan Province and promote the differential development of the equipment manufacturing business. The shield machine, ball mill, large steel castings, and other advanced products can meet the various customized needs of customers. While supporting the rapid development of the local equipment manufacturing industry, Kunming Steel's equipment manufacturing business has also created a number of regional leading technical records.

(4) New materials business. It is mainly aimed at developing high-end materials consumed by the manufacturing industry, dedicated to the R&D and production of new materials like stainless steel composite materials, iron-based powder for 3D printing, cold-rolled titanium coil, stone paper, etc. A number of its products have filled the domestic blank, and the industry has basically formed a certain scale. New materials business of Kunming Steel is aiming at the world's advanced level. As it has been continuously improving the innovative R&D capabilities and core competitiveness, this sector enjoys a promising prospect.

(5) Building materials business. Through direct investment, restructuring and merger, and joint venture holding, Kunming Steel has promoted the rapid development of the cement building materials business. It has completed 16 new dry process cement clinker production lines with a production capacity of 20 million tons/year. By rapidly developing the building materials business through multiple measures at the same time, Kunming Steel has become a leading enterprise in the cement building materials industry in Yunnan and ranked as top 500 Chinese building materials company.

(6) Modern service business. On the basis of integrating the original service business, the company has been continuously expanding the fields of modern service business and formed a modern service business system with modern logistics, real estate, health care, and social welfare services as its main business segments. Sales revenue of Kunming Steel's modern service business accounted for nearly 30% of its total revenue, which effectively accelerated its transformation and development.

3. Summary

Kunming Steel takes the extension of the industrial chain as a breakthrough, prioritizes the development of familiar businesses, integrates relevant resources and elements, and continuously expands the business system. It has soon created a sound situation where diversified businesses have generated profits and efficiency. A good result has been achieved in helping the company make transformation and surmounting difficulties. As the development model of the diversified businesses in Kunming Steel is easy to push forward and can realize scale benefits rapidly, it is worthy of reference by other iron and steel enterprises. Kunming Steel's diversified businesses

cover a wide range of fields and can achieve significant results in various areas. However, the development core is not clear enough so that it is necessary to further integrate the elements, concentrate the advantageous resources to build the core competitiveness, and form a well-known brand so as to develop the diversified businesses into a new engine in driving the transformation and development of enterprises.

12.3.6 Shagang Group

1. Overview of Developing Diversified Businesses

Under the guidance of "strengthening the main iron and steel business, building greater modern logistics, and operating well the non-steel industries", Shagang Group takes active exploration, steady advancement, and whole process risk control as the basic principles. While developing the main iron and steel business, it also actively accelerates the development of the non-steel business, effectively utilizes existing resources, and gradually implements a diversified business strategy in a moderate way. At present, the main investment areas of Shagang's non-steel business include resources and energy, trade logistics, financial investment, industrial chain extension, venture capital, and real estate with an accumulated investment amounting to tens of billions of yuan. It has formed 69 non-steel companies successively. Among them, the resource and energy sector has an annual output of nearly 40 million tons of metallurgical raw and auxiliary materials such as iron ore, coal, coke, alloy, and refractories and a processing capability of 10 million tons of solid waste resources such as steel slag and Fe-containing dust and mud. The logistics sector mainly includes trade in steel products, metallurgical raw materials and equipment as well as the business of Jiulong Steel Logistics Park. In 2016, raw materials trade volume of Shagang International Trade Co., Ltd. registered 56.117 million tons with a sales revenue of 37.09 billion yuan, while Jiulong Logistics Park realized an operating revenue of 120 billion yuan; in extension of the industrial chain, it has realized an annual output of 160,000 tons of steel strands, 300,000 tons of welded steel pipes, and 400,000 tons of coal and chemical products; by the end of July 2015, 4.1 billion yuan of petty loans and a total loans of 21.6 billion yuan have been granted in the financial sector; by the end of 2014, the venture capital investment in 23 venture capital enterprises and one private equity investment fund with a total investment of over 6 billion yuan have been made; a total construction area of 800,000 m^2 has been developed in the real estate sector. In 2015, Shagang's sales revenue was 203.8 billion yuan with a profit of 1.897 billion yuan. Among them, the non-steel businesses' profit accounted for about 20% of the total profit from January to August. In the next five years, Shagang aims to increase the profit proportion of the non-steel businesses to 50%.

2. Briefs and Reviews of Diversified Businesses

   (1) Resource and energy sector. In order to ensure the stable supply of raw materials for the main iron and steel business, Shagang Group has invested

in iron ore, coal, coke, alloy, limestone, metallurgical auxiliary materials, and other supporting resources via mergers and acquisitions, joint ventures, and other methods. Now it has formed a scale with an annual output of 14.38 million tons of iron ore, 15.5 million tons of coal, 6.3 million tons of coke, and 150,000 tons of silicomanganese. At the same time, it has the capacity to process 6 million tons of BF slag micro-powder, 3.2 million tons of steelmaking slag, and 450,000 tons of Fe-containing dust and mud annually. Apart from meeting its own demand as the metallurgical auxiliary materials, the extra BF slag micro-powder, steelmaking slag and tailings, steel slag baking-free bricks, and other products are sold to the market, which has made important contributions to the normal production and economic growth of the main iron and steel business.

(2) Trade logistics sector. The trading business mainly covers steel products, bulk raw materials (ores, coking coal, and scrap steel), import and export metallurgical equipment and others, scrap steel recycling, as well as the procurement and supply of limestone and other metallurgical auxiliary materials. In 2016, the trade volume of raw materials amounted to 56.17 million tons with a sales revenue of 37.09 billion yuan. Among them, the total export volume of steel products was 4.31 million tons, ranking the first in the country's individual steel plants for three consecutive years. The Qianlong Logistics Park focuses on becoming the "information center, trading center, settlement center, price center, processing center" for steel products logistics and establishing six supporting platforms in "warehousing and distribution, extended processing, e-commerce, bonded logistics, financing guarantee, and integrated services". At present, more than 1600 enterprises in total have settled in the park, creating an annual business revenue of over 160 billion yuan.

(3) Financial investment sector. In order to realize the effective allocation of the funds in the Group, maximize the value of funds, effectively promote the virtuous growth of the Group, and form a beneficial supplement to the main iron and steel business, Shagang Group has established several companies such as Shagang Finance Co., Ltd., which formed a certain scale in the financial investment field. As of the end of July 2015, Shagang's petty loans totaled 4.1 billion yuan; its cumulative issuance of MTN reached 10 billion yuan, short-term financing 9.6 billion yuan, and ultra-short-term financing 2 billion yuan; the bank's credit granted to Shagang totaled more than 150 billion yuan; in addition, its financial institutions like Shagang Investment Bank and Shagang Securities have all achieved a certain return on investment.

(4) Industrial chain extension. In order to extend the industrial chain of steel products, Shagang Group fully leverages its resource edge steel products and coking by-products and others as well as cooperates with the leading enterprises in the industry to jointly invest in steel product deep processing and manufacturing enterprises and fine coal chemical enterprises, which has further enhanced its product added value and economic profits. Therefore,

it has achieved resource sharing, advantages complementing, and improvement of the Group's competitiveness. Currently, it has an annual output of 160,000 tons of steel strands, 300,000 tons of welded steel pipes, and 400,000 tons of coal chemical products.

(5) Venture capital sector. In order to effectively utilize the capital advantages of the Group and to support the main iron and steel business through capital investment, Shagang Group has cooperated with several well-known domestic investment institutions such as China Science and Merchants Investment Management Group (CSC Group) and GP Capital Co., Ltd. to gradually develop the venture capital business. On April 26, 2016, Shagang Group Investment Co., Ltd., a wholly owned subsidiary of Jiangsu Shagang Group, was formally established with a registered capital of 2 billion yuan. On this basis, the Group founded a number of equity investment companies and investment management companies in Shanghai, Zhangjiagang, Shenzhen, and Hong Kong, which constitutes an investment platform for the secondary industries the Group's priority in the future. While performing well in the main iron and business, Shagang has been actively trying new investment so as to improve the profit margin of the company.

(6) Real estate sector. Adhering to the development concept of "building quality projects and creating value", Hongrun Real Estate Co., Ltd., a subsidiary of Shagang Group, has operated a number of real estate projects with a total construction area of 800,000 m^2. The company owns rich experience in real estate development. At present, projects under the company's operation include Jiyang Lake No. 1 and Jiyang Lake Crown with a total planned area of nearly 260,000 m^2, a construction area of nearly 360,000 m^2, and a saleable area of nearly 220,000 m^2. It is one of the top-level high-end communities in the Yangtze River Delta region and has won high praise for its advanced planning concept and exquisite architecture quality.

3. Summary

While maintaining the major status of the main iron and steel business, Shagang has chosen to moderately develop non-steel business which shares a relevance to its main iron and steel business. Through the developing of resources, energy, and trade logistics, it provides a stable supply of raw materials and high-quality supporting services for steel production, laying a foundation for the green, stable, and high-efficiency development. In particular, the logistics business is the strategic focus in developing the non-steel businesses by Shagang. In response to the broad development space of steel logistics, Shagang proposes the goal of "creating another world's top 500" in modern logistics. At the same time, with the core of improving economic benefits, the Group has been actively promoting the integration of industry and finance, giving full play to the respective advantages of the main iron and steel business and the financial business so as to enhance the market response rate and efficiency. In addition, cooperation around steel products and secondary resources has been carried out to extend the industrial chain and further improve the economic performance and risk resistance. The development of Shagang's non-steel businesses has cultivated and

formed a new growth point for the Group, thus increasing the overall strength and comprehensive competitiveness of the Group. However, the non-steel business' share and profit contribution rate still have a certain gap compared with those advanced iron and steel enterprises at home and abroad.

12.4 Prospects and Path Analysis of Diversification Trend

During the 12th Five-Year Plan period, the main iron and steel industry experienced the new normal of development featuring low growth, low price, low efficiency, and high pressure. The whole industry entered a state of loss. Faced with huge pressure for survival, operation with diversification of iron and steel enterprises has become a new trend for development. In the future, three major development tasks of China's large and medium-sized iron and steel enterprises are: to strengthen the main iron and steel business, enhance the extension to the upstream and downstream of the iron and steel industrial chain, and moderately develop diversified businesses. At this stage, developing diversified businesses in iron and steel enterprises will pay more attention to the transformation from related diversification to non-related diversification, and to the strategic synergy between the diversified businesses.

To this end, the following suggestions and countermeasures are proposed to help the iron and steel enterprises develop their diversified businesses.

12.4.1 Scientifically Chart the Development Road Map of Diversified Businesses and Highlight the Guiding Role of Planning

The strategy of diversified business constitutes an important part of the development strategies of most iron and steel enterprises in the future. It has a bearing on the successful realization of the overall development goals and the effective improvement of the overall competitiveness of enterprises. The development of diversified businesses requires overall planning, systematic arrangements, key highlights, and scientific implementation. Some iron and steel enterprises lack strategic coordination. They chose to develop the diversified businesses as a contingency plan when the main business was in serious loss. Such rigorous decision-making would bring about unsettled payments and new debts. Enterprises should have clear understanding of their own status and find out the weakness and advantages to scientifically chart the road map for the related sectors of diversified businesses and decide reasonable scale, specific measures, and key projects by combining with the characteristics and development trend of the target businesses. It is suggested that iron and steel enterprises should put the planning work of diversified businesses on the equal footing as that of the main business with early arrangement and scientific preparation.

12.4.2 Shape the Main Body for Market Competition and Accelerate Innovations in Institutions, Mechanisms, and Management

The main iron and steel business is the cornerstone of the development of iron and steel enterprises. The key to the development of diversified businesses lies in the system and mechanism. There are two main types of management modes for diversified businesses by iron and steel enterprises currently. Most of them adopt the parent–subsidiary operation mode where the group takes control and the subsidiaries carry out independent management, while a small number of enterprises set up specialized companies for the management of their diversified businesses to conduct centralized management and operation of all related businesses. For the time being, iron and steel enterprises face various problems in the management system and mechanism of diversified businesses. In the future, they must accelerate the innovation of management systems and mechanisms to truly establish a business management and control system that is compatible with its own strategies in developing diversified businesses and is in line with relevant development laws. At the same time, they should accelerate the establishment of a modern enterprise system, actively carry out the reform of the property rights system, promote the diversification of property rights and investment subjects in a view to stimulate the development vitality and strive to achieve the transformation from single ownership to multiple forms of ownership. Iron and steel enterprises should also speed up to shift from the "internal-oriented" mode to "market-oriented" mode and make a structural transition from an "industrial group with diversified businesses" to the "non-steel group industry". Relevant enterprises should truly become the legal entity and the body for market competition with clear property rights, clear power and responsibilities, separation of government and enterprises, and scientific management by improving corporate governance structure and standardizing enterprise operation mechanism.

12.4.3 Allocate Resources Reasonably and Highlight Development Priorities

During the 13th Five-Year Plan period, main iron and steel business faced multiple pressures on structural adjustment, and the adjustment in the structure of diversified business was also an imperative. In accordance with the principle of "doing something, and not doing something", enterprises should take market competitiveness as the criterion for judging the survival of their diversified businesses. Through comprehensive assessment of the environment for enterprise's survival and development and the trend and conditions for the development of target business, iron and steel enterprises should establish an internal elimination mechanism to optimize integration and allocate the limited resources to those businesses with their promising prospects. In particular, we must focus on seizing the historical opportunities and actively participating in the labor division of social specialization and the economic

restructuring. The large-scale enterprises, especially, should have the ability to participate in the exploration and development of emerging industries. For example, by seizing the major opportunities in which the country attaches great importance to the development of strategic emerging industries, iron and steel enterprises can accelerate the development of energy-saving and environmental protection industries. Development projects of urban mineral resources are an industry with broad prospects as another example. With the deepening of China's industrialization and urbanization, cities will become the largest mines in the future. The development of urban mineral resources should be based on scrap recycling and processing status to make further steps gradually.

12.4.4 Emphasize the Cultivation of Innovative Ability and Strengthen the Building of the Talent Team

In developing diversified businesses, iron and steel enterprises in China have their own successful experiences and profound lessons. It is an important consensus to pay attention to the cultivation of innovative ability and the building of a talent team. Insufficient innovation and talent shortage constitute a "bottleneck" restricting the rapid development of the diversified businesses in most iron and steel enterprises currently. For the time being, requirements for the rapid development of the non-steel business cannot be fully met by the technological innovation system and human resource structure in the iron and steel enterprises, especially in the cultivation and introduction of high-level talents. In formulating the development strategy for diversified businesses, it must be focused on those nurturing high-end talents with capabilities in capital operation, international management, international investment and trade, and business innovation to create a group of leading talents for diversified business development. Meanwhile, independent innovation should be put at the height of the enterprise's survival and development. It is of great significance for enterprises to constantly improve the independent innovation development strategy according to their own needs and continuously increase the independent innovation capability. This also serves as the basis for survival in the brutal market competition.

12.5 Industrial Practices of Diversification

China Metallurgical Industry Planning and Research Institute (hereinafter referred to as MPI) has a research center for the non-steel business development, which is dedicated to provide guidance and suggestions for iron and steel enterprises to improve the quality and level of development of diversified businesses. The non-steel business development research center provides services for governments at all levels, industrial associations, various enterprises and public institutions, financial

institutions, etc. It has long been engaged in studying on the development of non-steel industries at home and abroad as well as carrying out consulting services for iron and steel enterprises in areas such as diversified business planning and strategic research, comprehensive utilization of resources and special planning for circular economy, logistics park planning, e-commerce, and intelligent manufacturing.

Over the years, MPI has made a large quantity of explorations and practices in helping the iron and steel enterprises to achieve diversified development. It has provided consulting services in nearly 30 projects for Anshan Steel, Wuhan Steel, Shandong Steel, Ma Steel, and others, which has scored fruitful results. See details in Table 12.2.

Table 12.2 Practices of MPI in promoting industrial diversification

No.	Business sector	Introduction	Typical cases
1	Planning for enterprises' diversification strategy	Focusing on the development of diversified business such as industrial chain extension, recycling, energy conservation and environmental protection, financial services, logistics and e-commerce as well as functional manufacturing around the main iron and steel business, formulating the overall strategic plan and diversified development plan in *13th Five-Year Plan* period for many enterprises	*Development Plan of Guangxi Liuzhou Iron and Steel Group during 13th Five-Year Plan*
2			*Development Plan of Wuhan Iron and Steel (Group) Company during 13th Five-Year Plan*
3			*Development Plan of Baogang Group during 13th Five-Year Plan*
4			*Related Diversified Business Development Plan of Shandong Iron and Steel Group during 13th Five-Year Plan*
5			*Entity Industry Development Plan from 2015 to 2020 of Guizhou Hongbo Company*
6			*Development Plan of Masteel Group during 12th Five-Year Plan*
7	Comprehensive utilization of resources and circular economy	It undertakes researches on circular economy issues in government and industry and carries out circular economy planning of metallurgical enterprises, industrial park circular economy planning, circular economy planning for mineral development and deep processing, etc.	*Researches on the Development of Circular Economy in the Iron and Steel Industry during the "12th Five-Year Plan Period"*
8			*Planning on Building Demonstration Enterprises in Circular Economy of Anshan Iron and Steel Group*

(continued)

Table 12.2 (continued)

No.	Business sector	Introduction	Typical cases
9			*Planning on Comprehensive Utilization of Vanadium and Titanium and Industrial Restructuring of Panzhihua Iron and Steel (Group) Co., Ltd.*
10			*Circular Economy Industrial Park Planning of Mazongshan in Gansu Province*
11			*Planning on Industrial Demonstration Zone of Circular Economy in Hebei and Tianjin (Tiantie Metallurgy Group Co., Ltd. in Shexian County, Hebei)*
12			*Planning on Circular Economy in Shenyang Metal Deep Processing Industrial Park*
13	Logistics and e-commerce planning	Focusing on the cost reduction and efficiency improvement of iron and steel enterprises, researches and planning on integration and system optimization for metallurgical logistics management and logistics cost optimization have been carried out. It conducts studies on the development trend of steel-related e-commerce, industrial policies to help enterprises in building e-commerce, operation management, system development, and other e-commerce packaged designs	*Development Plan and Logistics Cost Optimization of Anhui Changjiang Steel*
14			*Diagnosis, Optimization, and Planning Scheme for the Logistics System of HBIS Tangshan Steel*
15			*Strategic Adjustment and System Optimization Plan for Masteel's Efficient Logistics*
16			*Planning for Shagang Group's Jiulong Steel Logistics Park*
17			*Overall Planning for Huaigang Logistics Industrial Park*
18			*E-commerce Planning of Nanjing Iron and Steel Group Corp.*

(continued)

Table 12.2 (continued)

No.	Business sector	Introduction	Typical cases
19			*Special Planning for Logistics Optimization of Shaanxi Iron and Steel (Group) Co., Ltd.*
20	Industrial intelligence consulting service	By closely tracking the advanced intelligent manufacturing theories, methods, and technologies, focusing on the core processes like production process, business operation, and corporate decision-making, MPI aims to create a unique platform for industry, universities, and research so as to accurately interface with the actual needs of enterprises and provide related services for enterprises	Business Intelligence System Planning of Tianjin Rockcheck Steel (Group) Co., Ltd.
21			*Feasibility Study Report of Kunming Steel's Internet Plus Collaborative Manufacturing Project*
22			*Informatization Special Plan of Guangxi Liuzhou Iron and Steel Group Company Ltd. during the 13th Five-Year Plan Period*
23			*Three-Year Action Plan on Intelligent Manufacturing of Benxi Steel Group Corporation*
24			Special plans for WISCO, Baotou Steel, CITIC Pacific, Shaanxi Steel, etc.
25	Other special businesses	Special planning services in finance, management, human resource optimization, and others have been provided	*13th Five-Year Plan and Financial Plan on Capital Operation of Shaanxi Iron and Steel (Group) Co., Ltd.*
26			*Strategic Planning and Financial Leasing of Tianjin Rockcheck Zhonghe Energy Co., Ltd.*
27			*Special Research Report (Capital Operation, Management and Control Model, Human Resource Optimization, etc.) of Ma Steel during 13th Five-Year Plan*
28			*Corporate Culture Consulting of Anhui Yuntian Metallurgical Technology Co., Ltd.*

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