Current Situation and Problem Analysis of R&D Technology Investment of Water Environmental Protection Company

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Abstract. In recent years, the importance of environmental protection and ecological civilization construction in China is increasing, the market demand of environmental protection equipment in China is increasing, and the related environmental protection equipment companies have also ushered in important development opportunities. As the primary link of innovation, increasing R&D investment has become an important measure for enterprises to enhance their core competitiveness. In environmental protection equipment companies, the competitive advantage of enterprises is the core technology, and the core technology is also the fundamental driving force for the development of environmental protection equipment companies. The most efficient R&D enterprises can usually lead the technological trend of the industry. Therefore, this paper mainly selects four representative listed environmental protection companies in the field of water environmental protection in the environmental protection equipment industry, and analyzes the R&D of the above environmental protection companies from the perspective of R&D intensity and R&D scale Technical input status and existing problems, and put forward corresponding solutions for reference.

Keywords: Environmental protection company, R&D investment, green technology.

1. Literature review

1.1. Definition and measurement of related concepts

R&D investment, also known as R&D investment, is called research and experimental funds, which refers to the expenditure on basic research, applied research and experimental development. Including the actual use of research and experimental development activities of staff wages, raw materials fees, national assets, management fees and other expenses. Basic research is an experimental and theoretical study of the basic principles of phenomena and observable facts. Applied research refers to the creative research that should be adopted in order to determine the possible use of basic research results or to explore the following year in order to achieve the predetermined goal, mainly for a specific purpose or goal. R&D investment mainly includes two indexes, one is the intensity index of R&D investment, which is expressed by the ratio of R&D investment value and operating income in the reporting period, the other is the scale of R&D investment, which is expressed by the R&D investment value, the number
of R&D personnel and the proportion of R&D personnel to the total staff of the company during the reporting period.

(2) Introduction of Case Enterprises

Beijing Originwater Technology Co., Ltd., a high-tech enterprise founded by returning scholars in Zhongguancun National Independent Innovation demonstration Zone in 2001, is committed to providing the overall solution for the country to "control the water environment, develop new water sources, ensure drinking water safety and urban ecological environment construction" through membrane technology. The company was listed on the Shenzhen Stock Exchange in 2010, now has more than 500 patent technology, and won two National Science and Technology Progress Award.

Beijing Orient Lanscape Environment Co., Ltd. (hereinafter referred to as Oriental Garden) focuses on environmental protection, ecology and circular economy three core business, through water environment treatment, mine and soil remediation, waste solid waste disposal, industrial park recycling transformation, circular economy park intelligent upgrading, improve the ecological environment. As a high-tech enterprise, Oriental Garden has more than 400 intellectual property rights of environmental protection disposal, ecological restoration and water environment management, leading the innovation and development of ecological environmental protection industry with a leading comprehensive technology system.

Guangxi Bossco Environmental Protection Technology Co., Ltd. was founded in 1999, is the national technological innovation demonstration enterprise, China Environmental Protection Industry Association backbone enterprises and national environmental protection excellent brand enterprises, and has the National Enterprise Technology Center, postdoctoral research workstation, talent small highlands and other scientific research platforms. Business areas focus on industrial environmental governance, urban and rural environment, soil environmental remediation, solid waste disposal and new energy development, intelligent sanitation, environmental services and so on.

Anhui Guozhen Environment Protection Technology Joint Stock Co., Ltd. was founded in 1997 and listed on the Shenzhen Stock Exchange in 2014 to provide project investment, technology research and development, design and construction, equipment manufacturing and integration and project operation services in the field of environmental protection. The company focuses on the layout of water environment comprehensive treatment, municipal sewage, village water environment comprehensive treatment and industrial water system integrated services. The company has water operation, environmental engineering, equipment manufacturing, pipe network, water environment, Maiwang environment, membrane science and technology, design and research institute of 8 major divisions, nearly 3000 staff professional environmental protection group. Now more than 150 municipal sewage plants, Japan Treatment of sewage is about 5.11 million tons.

1.2. Research achievements at home and abroad

At present, the research on the current situation and problems of R&D investment at home and abroad mainly has the following relevant information:

First, the research on the current situation and problems of R&D investment in Chinese companies, and puts forward some concrete suggestions on its shortcomings. For example, Zhang Chunying, Yin Lina (2018) analyzed the current situation of R&D investment in Chinese enterprises from the three angles of total R&D investment, the main body of R&D activities and the proportion of R&D expenditure areas, and concluded that the current R&D investment intensity of Chinese enterprises is low, the basic research and application research is low, and the R&D investment industry and research environment need to be optimized.

The second is to study the technological innovation of environmental protection companies in China, and put forward the corresponding solutions according to its current situation. For example, Qi Shuhan (2018) put forward the cooperation of industry, university and research to promote the technological innovation of environmental protection industry, and establish a new combination mode and operation mechanism of industry, university and research institute based on the scientific and technological strength of university and scientific research institute and standardized by modern enterprise system.
To sum up, the author selects four representative listed companies in the field of water pollution control in the environmental protection industry to analyze the existing problems of their R&D investment and put forward corresponding solutions. In order to put forward the experience of technological innovation of environmental water pollution control enterprises.

2. Analysis of R & D Investment of Environmental Protection Company

2.1. The total R&D investment of protection companies is increasing

R&D investment (R&D) is the material basis and guarantee for enterprises to carry out scientific and technological innovation activities, which is conducive to enterprises to obtain high technological advantages and build their own technological competitiveness. Especially for water environmental protection equipment enterprises, the core technology is the fundamental driving force for the development of enterprises.

**Table 1.** Companies in the past five years R&D investment amount.

| Year | Companies | Originwater | Orient Landscape | Bosco | Guozhen Environment |
|------|-----------|-------------|------------------|-------|---------------------|
| 2015 | 15400.16  | 21786.78    | 1600.5           | 2454.2|
| 2016 | 20260.39  | 24576.12    | 2793.52          | 4588.92|
| 2017 | 27841.15  | 43120.75    | 4541.16          | 5431.75|
| 2018 | 27880.74  | 37419.22    | 9075.88          | 6179.2 |
| 2019 | 24084.28  | 23725.22    | 16358.97         | 7614.52|

From the above figure, Orient Landscape spent more on R&D in 2015-2019 than the other three water environmental protection equipment companies, although investment in Orient Landscape decreased slightly in the period 2018-2019 due to government-led and risk-controlled considerations. But does not affect the above four companies in 2015-2019 R&D investment overall growth trend.

The most prominent growth rate of R&D investment is Bosco, whose total R&D investment is not dominant compared with the other three companies, but its R&D investment accounts for 5.04% of operating income, which shows that its R&D investment intensity is high. Strong awareness of R&D innovation technology. Total R&D investment increased from 16.005 million yuan in 2015 to 163.5897 million yuan in 2019, about 9.22 times that of 2015.

2.2. Increase in the total number and proportion of R&D personnel in environmental protection companies

**Table 3.** Number of R&D personnel in each company in the past five years.

| Year | Companies | Originwater | Orient Landscape | Bosco | Guozhen Environment |
|------|-----------|-------------|------------------|-------|---------------------|
| 2015 | 322       | 518         | 247              | 79    |
| 2016 | 396       | 677         | 448              | 142   |
| 2017 | 416       | 1045        | 815              | 156   |
| 2018 | 491       | 1231        | 860              | 197   |
| 2019 | 518       | 866         | 820              | 297   |
### Table 4. The proportion of R&D personnel in each company in the past five years.

| Year | Originwater | Orient Landscape | Bosco | Guozhen Environment |
|------|-------------|------------------|-------|---------------------|
| 2015 | 15.8        | 14.36            | 40.36 | 4.31                |
| 2016 | 19.06       | 17.25            | 43.28 | 6.94                |
| 2017 | 15.22       | 15.27            | 42.18 | 6.43                |
| 2018 | 15.81       | 23.47            | 42.18 | 7.01                |
| 2019 | 17.79       | 25.56            | 20.83 | 9.94                |

R&D personnel can provide intellectual support for R&D and innovation. In terms of the number of R&D personnel, the R&D personnel in the past five years overall growth trend, among which Bossco increased the fastest.

According to the proportion of R&D personnel in the company, the proportion of R&D personnel in the above four companies fell slightly in 2017, because the state reconstructed the environmental supervision and law enforcement system, promoted the supply structure reform in the name of environmental protection, eliminated high pollution and backward production capacity.

### 3. Analysis on R&D Investment of Water Environmental Protection Company

#### 3.1. The forward-looking leadership of the Water Environmental Research Corporation needs to be improved

Some researchers of water environmental protection company mainly pay attention to and pay attention to the current water pollution prevention and control work and the demand of related policies, and lack of moderate advance research on water pollution prevention and control. Sometimes the company's environmental protection technology in passive response or even limit the backward situation. In the theory and practice of water pollution prevention and control, the research on how to maximize the utilization of organic matter in sewage is insufficient, and the ability of scientific and technological guidance needs to be further strengthened.

#### 3.2. Lack of R&D innovation and low level of technology industrialization

The main body of environmental protection technology research and development in China is universities and research institutes, but the innovation of environmental protection technology in enterprises is insufficient and the strength is scattered. International water pollution control main patentee, the top 10 companies are almost all foreign enterprises, including 5 companies in Japan, 2 companies in Korea, 2 companies in the United States. There is a separation between R&D and the application and transformation of achievements in universities and enterprises, which leads to the initial or intermediate stage of some independent R&D technologies, and the level of technological industrialization lags behind that of developed countries. Some companies lack the core technology and products to support the improvement of water pollution prevention and control.

#### 3.3. Insufficient overall coordination of water environmental research

The top-level design of water environmental protection scientific research needs to be improved, some water environmental protection companies apply for the implementation and management of scientific research projects, such as fragmentation, homogenization and cross-repetition, the proportion of competitive investment in peer science and technology investment is large and there is a lack of effective communication and coordination mechanism between each other. For example, in the process of establishing or implementing some research projects, there will be insufficient analysis of the national environmental protection policy and policy and the environmental situation, so that the national environmental protection science and technology demand is not correct and the application conversion rate is low.
3.4. The high-end technology of the company needs to be improved
At present, the upstream environmental protection equipment field of water pollution prevention and control is a market approaching to full competition. A large number of small and medium-sized companies compete around the price, product, use effect and service quality of environmental protection equipment, and the industry concentration in the field of environmental protection equipment is poor and the degree of marketization is low. Small and medium-sized enterprises with water pollution prevention and control operate conventional technology products at low level, which are relatively mature and competitive, while high-end technology products have few choice types and high prices.

3.5. High demand for senior R&D talents and shortage of talents
At present, the R&D personnel of environmental protection industry in China show the characteristics of high education, high technical title, large demand for R&D management and engineering and technical personnel, which means that the technical and professional level of water environmental protection industry is high, and the dependence on related high-level talents is high. Because of the low level of attention in the past, the number of talents is on the low side, and the technical talents who can control large projects and design many water pollution projects independently are very scarce. And large environmental protection technology enterprises need to cooperate with senior technical personnel to develop products with high added value, high technology content and meet the needs of special water pollution control.

4. Countermeasures and Recommendations

4.1. Grasp the development situation of pollutants and realize the foresight of technology selection
If the enterprise lacks foresight in environmental governance, it will inevitably make the enterprise fall into the passive situation of technology and struggle to deal with the market competition. Therefore, under the current governance trend, we should study the relevant environmental protection policies and specific control indicators issued by the country and its industry, pay attention to the current environmental protection situation in China, and draw lessons from the successful treatment experience in the field of environmental protection in developed countries. Actively improve their own technical foresight, research and development of a certain period of time to meet the prevention and control of water pollution technology.

4.2. Innovating the cooperation mode of production, education and research, leading high-quality R&D technology
Production, education and research is to combine production and education, promote the education chain, innovative talent chain and industrial chain organic link. In this process of cooperation, we should pay attention to the market demand, take the talent intelligence needed for the development of the enterprise as the vane, and maximize the strength of the government, universities, enterprises, scientific research institutes and so on, so as to establish the innovation mechanism led by colleges and universities, promoted by the government and jointly built by enterprises. With the help of the training mode of industry-university-research cooperation, the new technology and new achievements developed in enterprises and industries and the new needs in the market are brought into the teaching content of colleges and universities, so that students can learn to use and understand more new ways and new theories of the development of this subject.

4.3. Research and development of innovative technologies to reduce homogeneous competition
Because of the long research and development cycle of environmental protection technology, it takes a long time for innovative technology to go from idea to market, application and market, from theoretical knowledge, patent technology, establishing technology cooperation system to transforming into market profit for at least 5~10 years. Therefore, innovative technology can be applied to many sub-industries in...
stages, the ecological circle based on core innovation technology can be established, and the competitive advantage of its own unique technical barriers of environmental protection enterprises can be formed.

Moreover, we should change the general model of "quantity input" as the criterion, take the actual transformation result of R&D personnel input science and technology output as the main concern, construct the new mechanism of judging in the field of science and technology innovation in our country, and further construct the efficient collaborative innovation platform between enterprises, scientific research institutions and universities R&D personnel input and science and technology output.

4.4. Improve the compensation system of R&D personnel at all levels and mobilize the enthusiasm of R&D personnel
We will improve the distribution and incentive system of R&D personnel at all levels linked to their job responsibilities and job performance contributions, promote scientific and technological evaluation and reward system reform, advocate multi-directional exchange of innovative talents among scientific research institutions, universities and enterprises, and implement preferential tax policies to encourage technological innovation.

4.5. Based on Symbiosis Theory to Enhance the Core Competence of Environmental Protection Company
The R&D activities of environmental protection companies are also a symbiotic structure, which requires the coordination and cooperation of various subjects. Symbiotic units include environmental companies, governments, research institutions, securities markets and investors. Symbiotic environment refers to the external environment of symbiotic structure, which has both opportunities and challenges.

The opportunity is mainly national policy support, perfect bidding mechanism, increase support for green technology innovation of private enterprises, and provide guarantee for R&D innovation and mutual benefit symbiosis of environmental protection companies. In addition, with the prosperity and development of society, the scientific and technological level of environmental protection companies is also improving. The main challenge is that there is a link between social environmental needs and environmental costs Contradictions, as well as the current social concern for environmental protection and attention still need to be improved. Therefore, we should seize the opportunity to meet the challenge, according to the market demand for efficient R&D investment, improve their core competitiveness.

References
[1] Yang Xuan ester, Luo Wei, Tang Zhen. Empirical Study on Synergy of R&D Personnel Input-Science and Technology Output Complex System from 3D Perspective [J]. Science and Technology Progress and Countermeasures, 2018, 35 (10): 9-14.
[2] Fu Xiaoyue, du Xiaorong. [J]. Environmental Uncertainty, Tax Incentives and Enterprise R&D Investment Journal of Wuhan University of Technology (Information and Management Engineering Edition), 2017, 39 (02): 186-190.
[3] Meng Qingjun, Gu Jia Le. Analysis on the Relationship between R&D Investment and Core Competitiveness of Agricultural Companies [J/OL] and Hubei Agricultural Science: 1-5 [2020-09-08]. http://kns.cnki.net/kcms/detail/42.1255.s.20200903.1731.006.html.
[4] Xu Chen. Investment in R&D and Enterprise Performance: A Review and Prospect [J] and Jiangsu Business Theory, 2020 (07): 117-121+141.
[5] Chen Yaping. Current Situation, Problems and Countermeasures of R&D Investment in Enterprises [J] and Science and Technology Economic Guide, 2020, 28 (05): 240.
[6] Zhang Chunying, Yin Lina. Analysis on Current Situation and Problems of R & D Investment in Chinese Enterprises [J] and Journal of Changchun University, 2018, 28 (09): 16-20.
[7] Wang Zhimin, Wan Ning, Sun Xiaorong, Wei Zizhang, Zhang Ji, Zhu Mingyi. Environmental Protection Science and Technology Transformation Policy Reflections China's population
Resources and Environment, 2014, 24 (S2): 172-174.

[8] Qin Jun. A Study on the Cultivation of Innovative Talents from the Perspective of Cooperation between Industry [J] and Research Heilongjiang Education (higher Education Research and Evaluation), 2013 (03): 51-52.

[9] Geng Shigang, Qi Haiyun. How to Cultivate a New Generation of Environmental Protection Personnel World Environment, 2012 (01): 78-79.

[10] Lei Yingjie. Why does Chinese Jacaranda lead other environmental protection listed companies? [J]. Environmental economy, 2020 (10): 24-25.

[11] Dylan. A Study on Optimization of R&D Cost Management in China Frame Environmental Protection Company [D]. Hunan University, 2017.