

Analysis on the Development of Wanhua Chemical

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Abstract. With the development of the chemical industry, the traditional chemical enterprise model of relying on high energy consumption and high input has not adapted to the requirements of high-quality development. At present, chemical enterprises have problems such as low product performance, single product and excessive energy consumption. Wanhua Chemical Co., Ltd. is a technology-intensive high-end chemical enterprise, and its high-end chemical products (e.g., MDI) occupy an important position in the world. However, while investigating and analyzing Wanhua Chemical, it is found that the current enterprise also has a large gap compared with the world's top chemical enterprises. This paper uses SWOT strategic analysis and financial analysis compared with BASF to find that Wanhua Chemical has a single product structure, high repayment pressure, and low research expenditure. On this basis, this study provides a suitable development strategy for Wanhua Chemical, aiming to provide a reference implementation path for Chinese chemical companies to go international.

Keywords: Development strategy; chemical enterprise; Wanhua Chemical; BASF.

1. Introduction

Polyurethanes were first developed by Otto Bayer and his colleagues in 1937 in the laboratory of I. G. Farben (formerly Bayer) in Vorkusen, Germany. Using the principle of addition polymerization, they experimentally condensed liquid isocyanates with liquid polyethers or diol polyesters to produce a new material, polyurethane (PU), that was distinct from the polyolefins that had been discovered at the time. Since 1951, when TDI-type polyurethane coatings were made from dry oil and its derivatives in the United States, polyurethane-based adhesive, foam and elastomer manufacturing technologies have been introduced one after another, and the polyurethane-related industries have been developing rapidly [1]. At present, the global polyurethane market is mainly concentrated in North America, Western Europe, Asia Pacific (Japan, Korea) and China, accounting for about 85% of the global total. Among them, China alone accounts for about 38% of the total global consumption [2]. The main raw materials of polyurethane, MDI, TDI and PPG, have become internationalized commodities. Polyurethane rigid foam with polymerized MDI as the main raw material is globally recognized as a building energy-saving material with superior performance. Since its production and equipment are more complex and the manufacturing threshold is high, only a few companies in the world have mastered its production technology, e.g., BASF, Huntsman, and Wanhua Chemical.

Wanhua Chemical Group Corporation (the company) is headquartered in Yantai City, Shandong Province. Its main products are high-end chemical products (e.g., MDI and TDI). It has developed into the most competitive polyurethane manufacturer with advanced technology, leading production capacity and excellent quality in the world, and its products are sold both at home and abroad [3]. At present, the main production bases of the enterprise are concentrated in Yantai, Zhuhai and Ningbo, and it has one production base abroad, which is located in Hungary. The company's R&D centers are mainly located in Yantai, Ningbo, Beijing and Shanghai, and one R&D center has been established in Houston, USA. Wanhua Chemical's fully-owned or majority-owned subsidiaries mainly include Wanhua Chemical (Ningbo) Co., Wanhua Chemical (Ningbo) Hotspot Co., Wanhua Chemical (Beijing) Co. (Ltd. and Wanhua Chemical (Yantai) Chlor-alkali Cogeneration Co.

BASF is one of the world's largest multinational chemical companies and the most innovative company in the global chemical industry, headquartered in Ludwigshafen, Germany. According to BASF's 2020 annual report, it invests €2.216 billion in research and development, has more than 110,000 researchers and 240 production sites, and applies for nearly a thousand new patents

worldwide [4]. Its product portfolio covers chemicals, plastics, specialty products, crop protection products, and crude oil and natural gas. Its uniquely integrated sites are the company's strengths, which enable BASF to achieve a low-cost advantage and thus ensure a great competitive advantage. As a leading global chemical company, it combines economic success, social responsibility and environmental protection. Through scientific innovation, it helps customers in a wide range of industries to meet the needs of society today and tomorrow. Its products and solutions contribute to the protection of resources, the provision of nutrition and the improvement of quality of life [5].

According to Hu and Jean, the cost management of domestic chemical enterprises is different from the previous cost management of chemical enterprises, both in terms of cost management mode and management concept have been greatly changed, and cost management has changed from the scope of material cost management to the scope of non-material cost management. Differently, the cost management now includes enterprise capital cost management, enterprise target cost management, enterprise quality cost management and enterprise information cost management. So far, the cost management methods of domestic chemical enterprises are relatively backward, and the quality of cost management work cannot be improved. Hence, it is difficult to improve the economic benefits of chemical enterprises [6]. Liao and Wang constructed LEAF and LE models to digitally link lean manufacturing and sustainability, and provided a short roadmap for creating a vision of the future and corresponding growth strategies for the chemical industry [7]. Zhao argues that economic growth drivers can be found both on the demand side and on the supply side [8]. Chinese chemical companies should follow the chemical-driven development path and look for economic growth drivers from the supply side. Buddelmeyer argues that aggressive innovation investments represent a new high-risk behavior for companies in the long run [9]. The aggressive innovation investments can make companies more financially vulnerable over time. This suggests that such risky investments should only be made by financially secure companies. Küçükoglu believes that green innovation can significantly improve a company's competitive advantage [10].

In order to analyze the advantages and disadvantages of Wanhua Chemical and put forward the development strategy for it, this paper uses SWOT strategic analysis and financial analysis. To be specific, the author compares Wanhua Chemical with BASF (a world-class chemical company whose products are similar to the target), and analyzes the shortcomings of Wanhua Chemical. The rest part of the paper is organized as follows. The Sec. 2 will describe the current status and future trends of the chemical industry. The Sec. 3 will use SWOT analysis to Wanhua Chemical. The Sec. 4 will compare the financial date of Wanhua Chemical and BASF. The Sec. 5 will conduct prospective analysis on Wanhua Chemical. The Sec. 6 will put development suggestions for Wanhua Chemical.

2. Description of the Industry

Chemical companies aim at safe, stable, long-cycle, full-load, optimized production. Nowadays, the development space of traditional chemistry has become saturated, and refinement and deep processing have become the new development direction of chemical enterprises, and the research direction has become more and more focused on market demand [11]. In today's increasingly competitive chemical industry, the importance of high efficiency, safety and reliability is becoming more and more prominent. In addition, from the perspective of social development, the chemical process must meet the requirements of energy and environmental aspects. The fundamental purpose is to improve efficiency, ensure product quality and quality stability, reduce the operating costs of products, and take the new chemical road of high technological content, good economic efficiency, low resource consumption, low environmental pollution, and full advantage of human resources [12]. The chemical enterprises seek breakthroughs in the following aspects Chemical enterprises mainly seek breakthroughs from the chemical science and technology competition, the production process optimization and production cost reduction as well as the sustainable development.

3. SWOT Analysis of Wanhua Chemical

The SWOT analysis method was selected to conduct a strategic analysis of Wanhua Chemical, which organically combines the company's strategy with internal resources and external environment, clearly identifies the company's resource strengths and weaknesses, and understands the opportunities and challenges faced by the company, which is of vital importance to the formulation of the company's future strategy.

3.1 Strength

Wanhua Chemical possesses independent intellectual property rights of MDI and pays attention to the introduction and cultivation of technical talents, forming a research team with international level. The investment in R&D in 2021 is as high as 3.168 billion yuan, which differs greatly from the international chemical giant BASF, but also has the advantage of leading R&D in the industry. Wanhua Chemical has a professional system. Good system construction is the guarantee of stable development of the enterprise. Secondly, Wanhua Chemical has a large domestic and foreign market, even compared with BASF and other giant enterprises also have a fighting power.

3.2 Weakness

Wanhua Chemical's profit-making product structure is relatively single, and the main source of profit is polyurethane business, while the oil business and fine chemicals business are relatively weak. At the same time, Wanhua Chemical's financing is huge and mostly debt financing, and the pressure of repayment is high, and the company will be in trouble if the capital chain breaks.

3.3 Opportunity

MDI industry is very important in the strategic position of China's economy, and the policy greatly supports the development of MDI. The MDI industry has high technical barriers and is an oligopoly global enterprise, currently only seven companies in the United States, Germany, Japan and China produce MDI, and Wanhua is one of them [12]. Contemporarily, it seems to be very difficult for new competitors to join. Secondly, MDI is widely used and still has strong irreplaceability.

3.4 Threat

Firstly, the raw material procurement of MDI is risky, and the price of upstream raw materials is volatile, which will increase the difficulty of raw material procurement for enterprises. Second, the industry competition is intensified. Globally, there are not many companies producing MDI but all of them are large in scale. As Wanhua and its competitors continue to expand their assets, the competitive pressure of the industry is bound to intensify. However, in general, the biggest threat to Wanhua Chemical is its product monolithic disadvantage and the risk of product substitution in the long run. Therefore, Wanhua Chemical should focus on the research and development of new technologies and products to enrich the product structure and find new profit points.

Table 1. Total Asset Size of BASF (unit in EUR) and Wanhua (unit in yuan)

BASF	2018	2019	2020	2021
Current Assets	43221000000	30990000000	29868000000	35051000000
Total non-current assets	43335000000	55960000000	50424000000	52332000000
Total Assets	86556000000	86950000000	80292000000	87383000000
Wanhua	2018	2019	2020	2021
Current Assets	30890000000	23480000000	40530000000	72290000000
Total non-current assets	56170000000	73380000000	93230000000	118000000000
Total Assets	87060000000	96860000000	133760000000	190290000000

4. Comparison of Two Chemical Enterprises

4.1 Analysis of the Statement of Assets and Liabilities

The financial statements are summarized in Table 1 and visualize in Fig 1, 2 and 3. Seen from the results, inventory accounts for most BASF's current assets while Wanhua's Inventory accounts for less, which indicates that Wanhua's inventory turnover is higher. Moreover, Wanhua's monetary assets have grown significantly and accounted for nearly fifty percent of current assets in 2021, indicating that Wanhua has abundant liquidity, no financial risk, and strong short-term debt repayment ability. According to Table 1, BASF's total assets are higher than Wanhua's and its current assets and shareholders' assets are more evenly distributed, with fixed assets accounting for about 60 percent of total assets, indicating strong and stable production capacity and good capital turnover. On the contrary, Wanhua Chemical's current assets account for less than BASF in 2018-2020, which means that the corporate wealth is less stable than BASF. However, in 2021, the current assets account for nearly 40%, which means that the corporate wealth is relatively more stable. Besides, the trend of asset growth of Wanhua Chemical's assets is very obvious (steady growth year by year), which has very considerable development prospects.

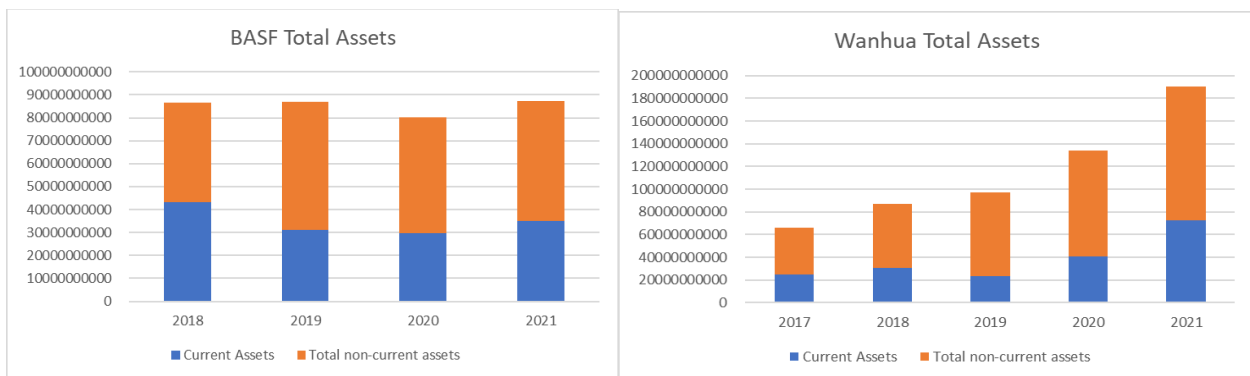


Figure 1. Current assets and non-current assets of BASF (unit in EUR) and Wanhua (unit in yuan)

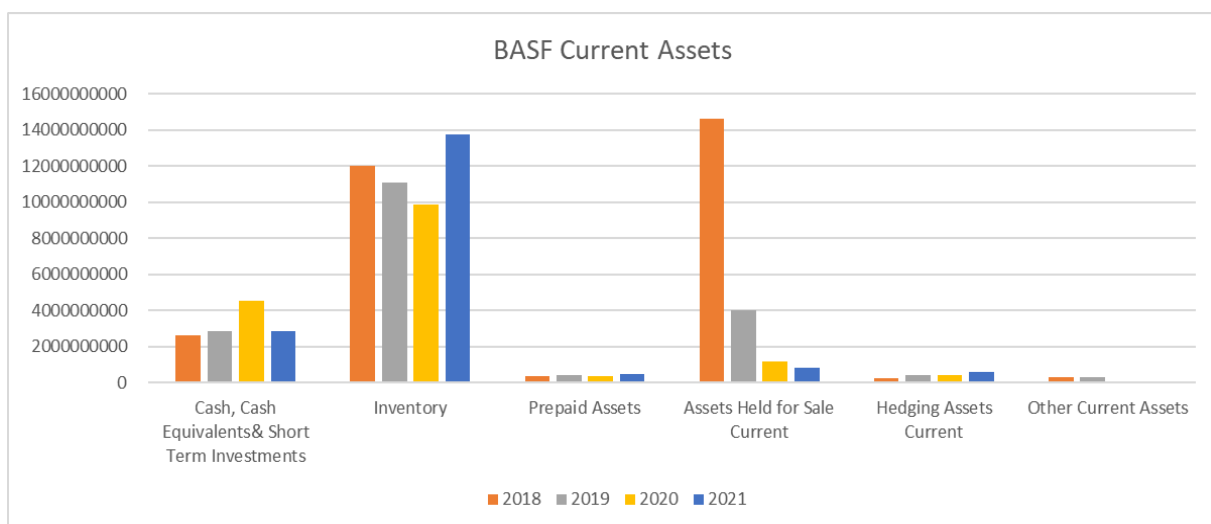


Figure 2. Classification of current assets of BASF (unit in EUR)

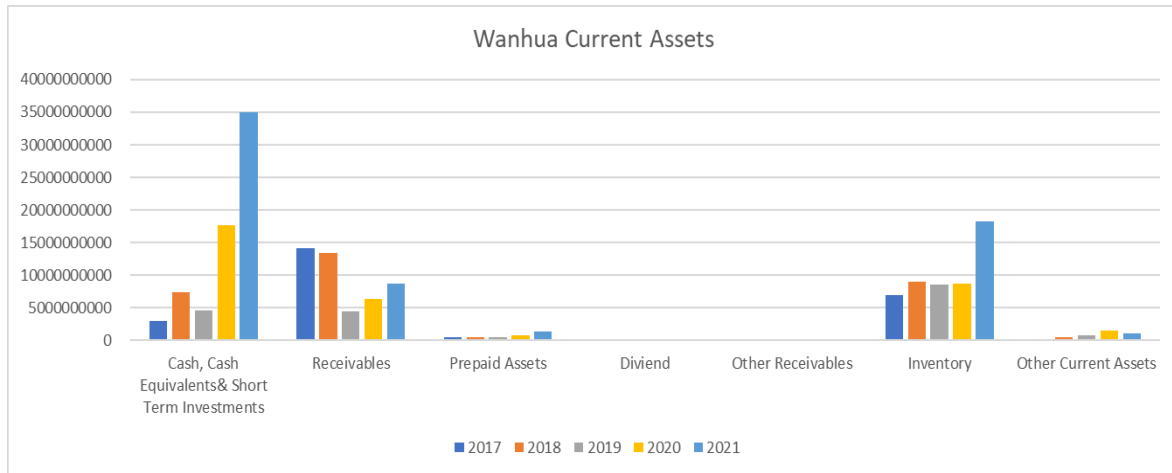


Figure 3. Classification of current assets of Wanhua (unit in yuan)

According to Fig. 4 and Fig. 5, both BASF and Wanhua's liquidity liabilities are mainly derived from short-term borrowings and accounts payable, but the difference is that BASF's short-term borrowings are smaller or closer to accounts payable; while Wanhua's short-term borrowings are much higher than accounts payable. Wanhua's short-term borrowings and accounts payable have been increasing significantly from year to year.

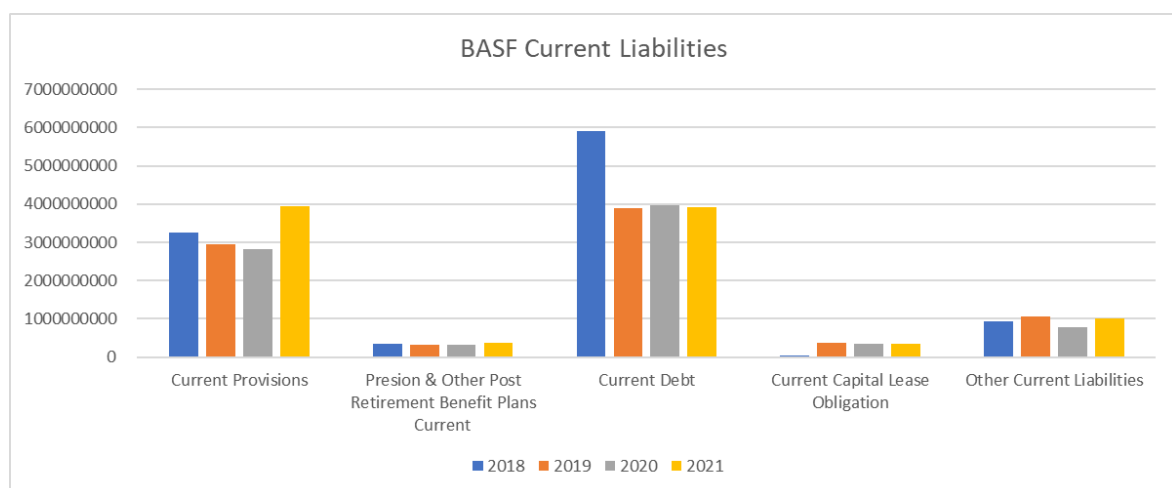


Figure 4. Classification of current liabilities of BASF (unit in EUR)

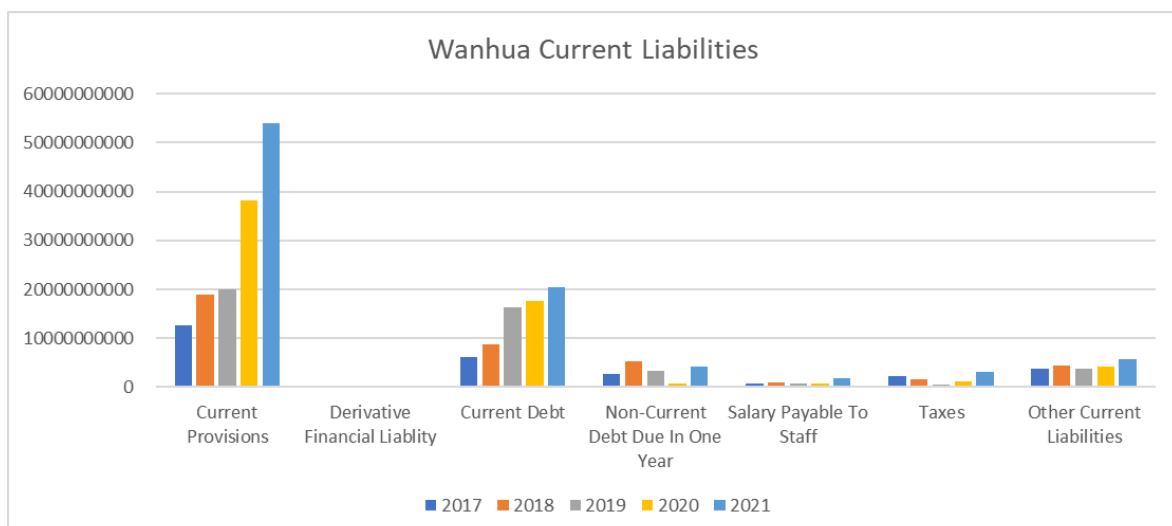


Figure 5. Classification of current liabilities of Wanhua (unit in yuan)

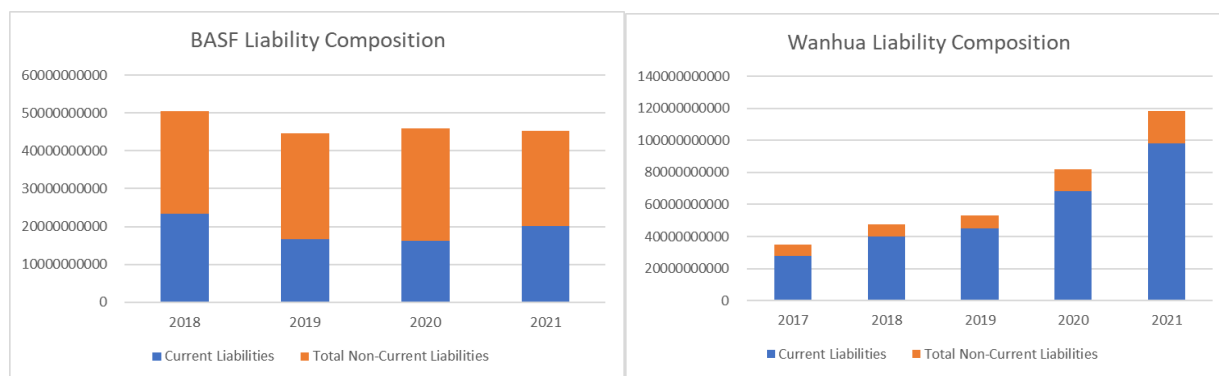


Figure 6. Liability composition of BASF (unit in EUR) and Wanhua (unit of yuan)

Table 2. Gross revenue and net profit margin of Wanhua (unit in yuan)

Expiration Date	Gross Revenue				Net Profit Margin			
	Operating Receipt	Same period	Year-On-Year	Quarter on	Net Margin	Same period	Year-On-Year	Quarter on
		Last Year	Growth	Quarter Growth		Last Year	Growth	Quarter Growth
2021/12/31	145.5 B	73.43B	98.19	-3.64	24.65B	10.04B	145.47	-15.04
2020/12/31	73.430B	68.05B	7.91	32.07	10.04B	10.13B	-0.87	86.65
2018/12/31	60.62 B	53.12B	14.11	-71.66	10.61B	11.13B	-4.71	-196.53
2017/12/31	53.12B	30.10B	76.49	-2.57	11.13B	3.679B	202.62	12.67

According to Fig. 6, Wanhua's current liabilities are too high compared to BASF in the above chart, which indicates that Wanhua may have a shortage of funds. Wanhua's asset structure is risky. Wanhua's liabilities have been growing steadily for several years, indicating that the company is in a period of expansion and needs more capital. In 2019-2021, Wanhua's non-current liabilities tend to rise, and Wanhua's financial pressure may gradually ease in the future.

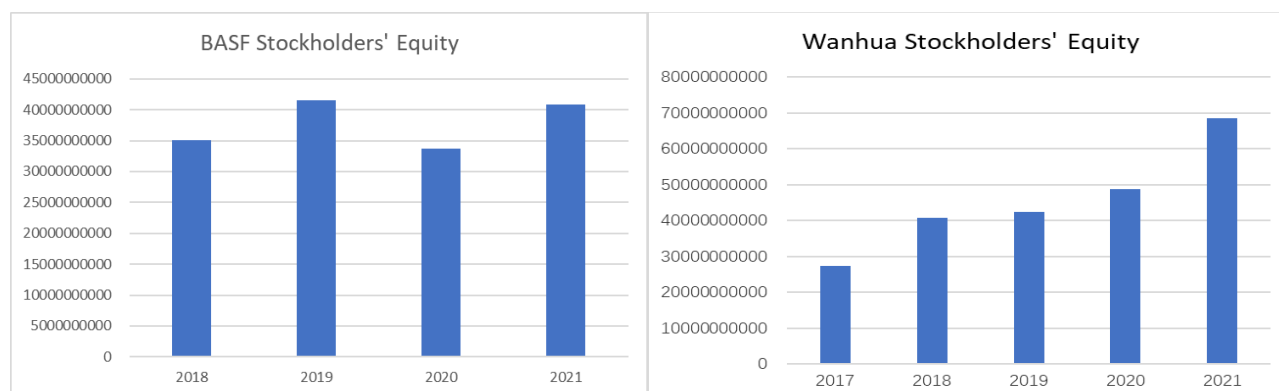


Figure 7. Stockholders' equity of BASF (unit in EUR) and Wanhua (unit in yuan)

According to Table 2, Wanhua's earnings reports in recent years show that Wanhua has made significant net profits in each of the last five years, with a significant near-doubling in 2021, which shows that Wanhua can repay its debts, and that the banks have given Wanhua full trust from the fact that most of Wanhua's current liabilities come from credit borrowings, which gives Wanhua some security to expand its industry in the future. Seen from Fig. 7, the amount of Wanhua's owner's equity has been on the rise in the last five years, indicating that Wanhua has been profit-oriented in its operations in recent years and has achieved capital appreciation and preservation. The increase in owner's equity represents the company's full capital flexibility for future strategic development planning and gives the company a certain level of defense against risk.

4.2 Analysis of the Income Statement

According to Fig. 8, Wanhua's operating income, costs, and net profit are more volatile and fluctuate. However, there is an overall upward trend, especially in 2020 to 2021 net profit has a substantial increase, which is likely to be related to the reform of enterprise production methods, production equipment renewal, and production technology innovation.

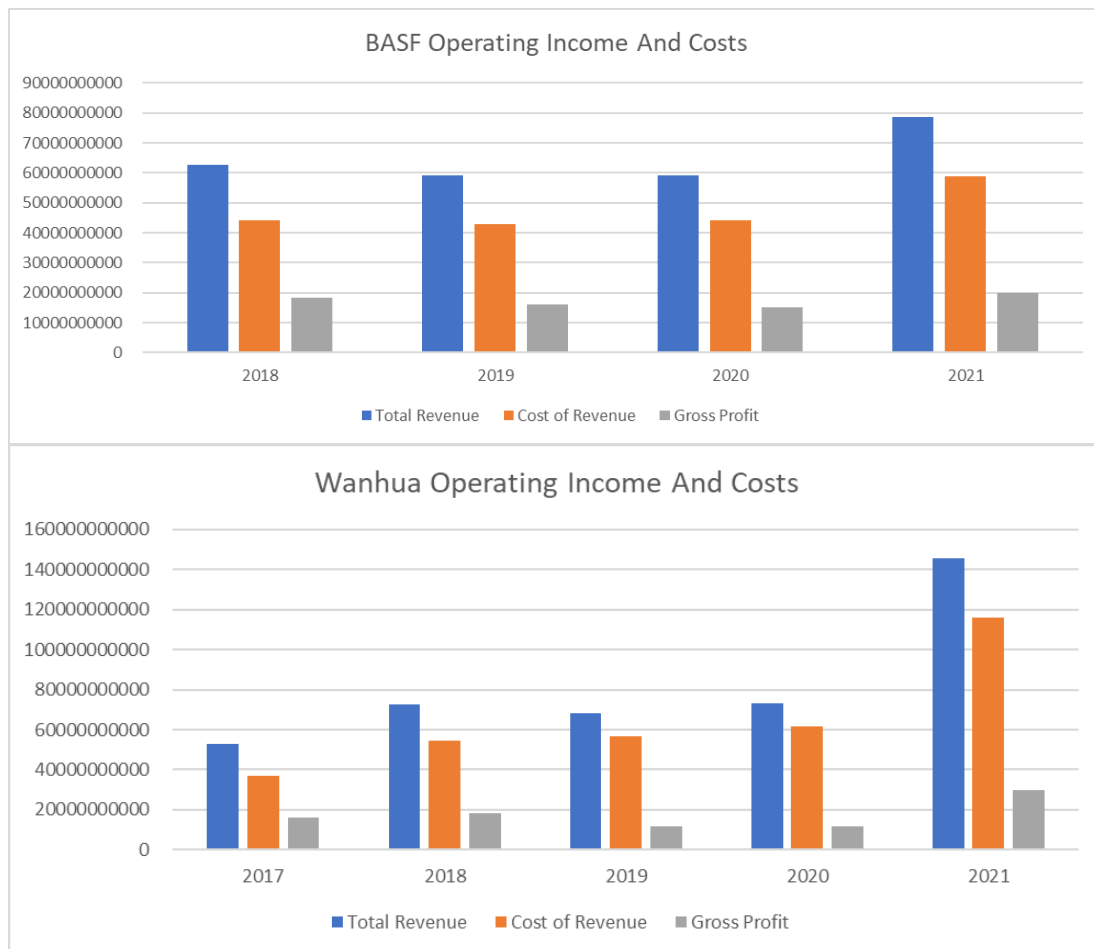


Figure 8. Operating income and costs of BASF (unit in EUR) and Wanhua (unit in yuan)

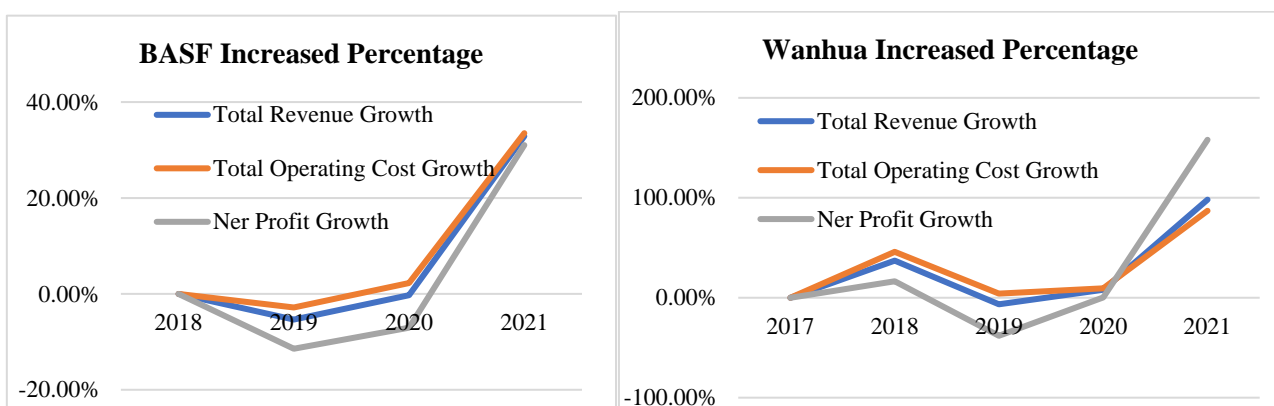


Figure 9. Increased percentages of BASF and Wanhua

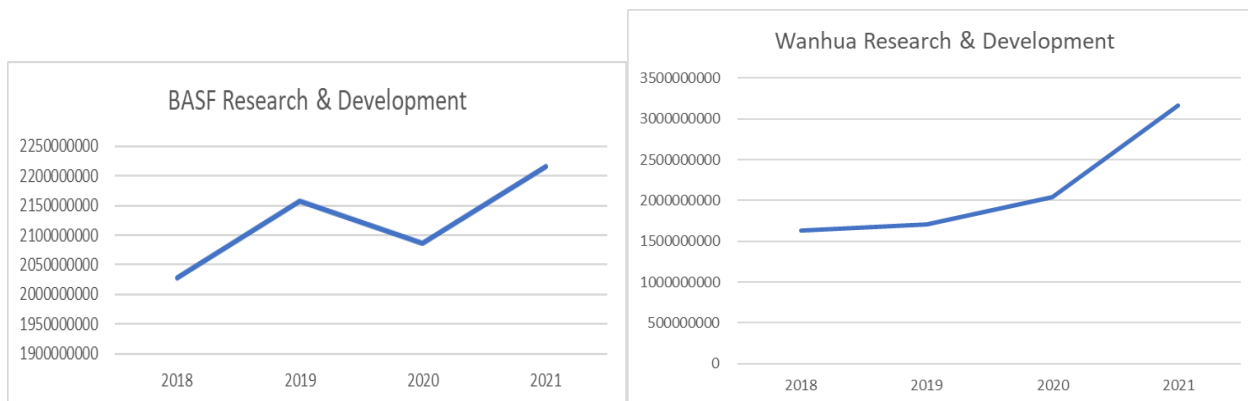


Figure 10. R&D costs of BASF (unit in EUR) and Wanhua (unit in yuan)

As illustrated in Fig. 10, Wanhua has been focusing on investment in R&D funds, and the amount invested shows a steady increase from 2018 to 2021, and a greater increase from 2020 to 2021. However, the ratio of R&D investment to total corporate revenue is still lower than that of BASF and tends to decrease from 2020 to 2021. Wanhua's core products are polyurethane products such as MDI and TDI, and the share of MDI products in the global MDI market is comparable to that of BASF. However, the large gap between the total investment in R&D and BASF shows that the lack of investment in R&D is an important factor limiting Wanhua's technological innovation, which deserves high attention.

Table 3. BASF and Wanhua’s R&D expenses as a percentage of revenue

	BASF				WANHUA			
	2018	2019	2020	2021	2018	2019	2020	2021
R&D Expenses as A Percentage of Revenue	3.24%	3.64%	3.53%	2.82%	2.24%	2.51%	2.78%	2.18%

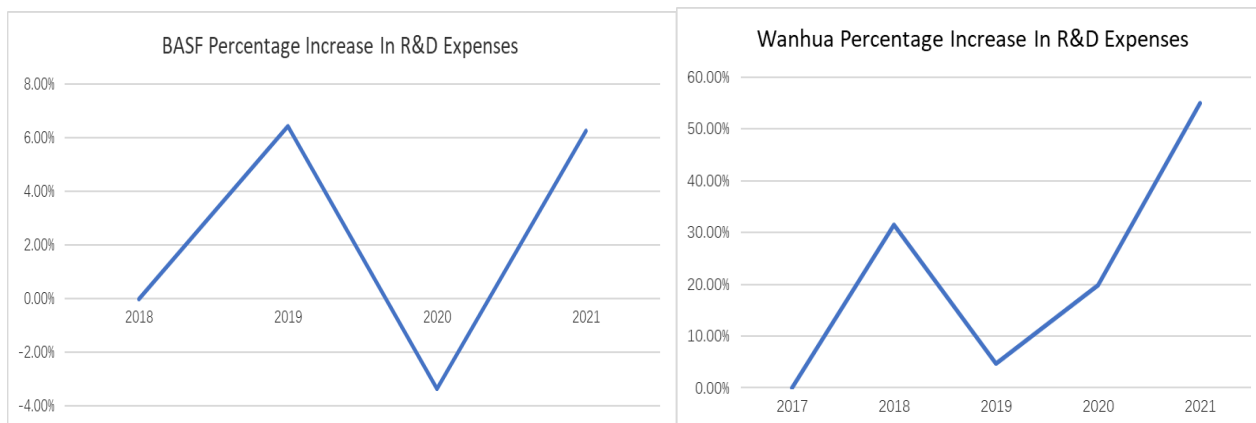


Figure 11. BASF and Wanhua’s percentage increase in R&D expenses

4.3 Analysis of Short-term Debt Capacity

Short-term solvency measures a company's ability to repay its current liabilities. The strength of short-term solvency depends on the liquidity of assets, that is, how quickly a company's assets can be converted into cash. The easier a company's assets are to liquidate, the more liquid its liquidity is and the stronger its short-term solvency. The following measures the short-term solvency of the two companies from 2018-2021 in terms of current ratio, quick ratio and cash flow ratio. Current ratio is the ratio of current assets to current liabilities, which is calculated as follows: Current ratio = Current assets ÷ Current liabilities. As an important financial indicator to measure the short-term solvency of an enterprise, the higher the current ratio, the stronger the enterprise's ability to repay current liabilities and the greater the guarantee that current liabilities will be repaid. However, a high current ratio is not a good sign. The higher the current ratio is, the more money the company has left in its

current assets, which is not effectively utilized and may affect the company's ability to obtain. Experience shows that a current ratio of about 2:1 is appropriate. According to Table 4, BASF's current ratio has been stable and close to 2:1 in the past four years, indicating that BASF has a strong ability to repay its current liabilities. In contrast, the current ratio of Wanhua Chemical is much smaller than 2:1 and varies widely, which indicates that the management level of Wanhua Chemical still needs to be improved and should increase current assets or reduce current liabilities in order to improve its short-term solvency.

Table 4. Short-term debt capacity of BASF (unit in EUR) and Wanhua (unit in yuan)

BASF	2018	2019	2020	2021
Current Ratio	1.853	1.866	1.835	1.745
Quick Ratio	1.336	1.197	1.227	1.061
Cash Flow Ratio	34.031%	45.134%	33.299%	36.044%
WANHUA	2018	2019	2020	2021
Current Ratio	0.774	0.524	0.595	0.738
Quick Ratio	0.550	0.332	0.467	0.551
Cash Flow Ratio	57.353%	57.895%	24.726%	28.460%

Quick ratio is the ratio of quick assets to current liabilities. The current ratio has certain limitations in evaluating the short-term solvency of an enterprise. If the current ratio is high but the liquidity of current assets is poor, the short-term solvency of an enterprise is still not strong. Among current assets, inventories need to be sold before they can be converted into cash. If the inventories lag in sales, their realization becomes a problem. Generally, current assets net of inventory is called quick assets. The formula for calculating the quick ratio is: Quick ratio = Quick assets ÷ Current liabilities = (Current assets - Inventory) ÷ Current liabilities. A normal quick ratio is usually considered to be 1. A quick ratio below 1 is a low short-term solvency. BASF's quick ratio has been steadily higher than 1 in the past four years, while Wanhua's quick ratio hovers around 0.5. It seems that Wanhua Chemical is much worse than BASF in terms of short-term solvency. The cash flow ratio of BASF is relatively stable in the past four years, compared to Wanhua Chemical's cash flow ratio which is much higher than BASF in 2018 and 2019, but lower than BASF in 2020 after a significant decline, indicating that Wanhua Chemical's industrial short-term solvency decreases significantly between 2020 and 2021, probably due to the rapid expansion period of Wanhua Chemical. This is probably because Wanhua Chemical is entering a period of rapid expansion and needs to borrow money to meet its needs.

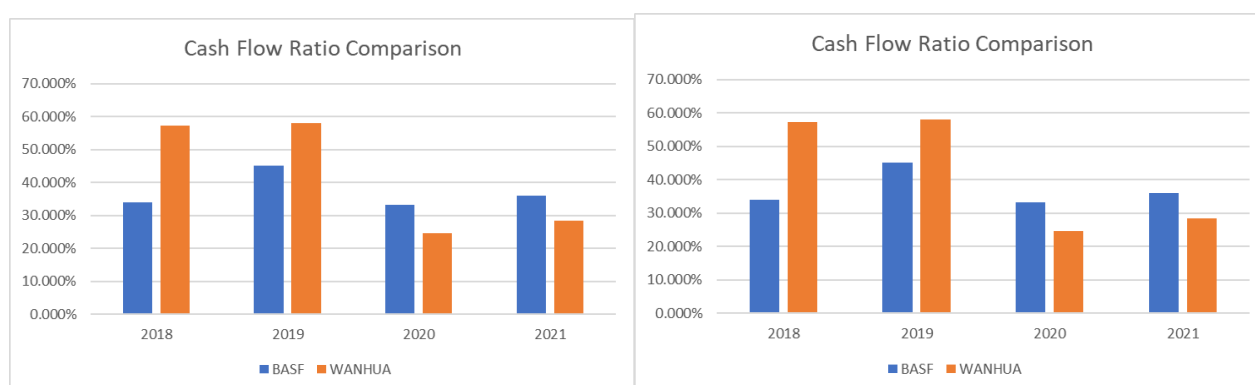


Figure 12. Cash flow ratio of BASF and Wanhua

4.4 Analysis of Long-term Solvency

Long-term solvency is a company's ability to repay long-term debt, and its strength is an important indicator of a company's financial security and stability. A company's solvency is not only influenced by its capital structure, but also depends on the future profitability of the company. The long-term solvency of BASF and Wanhua are measured by the gearing ratio, shareholders' equity ratio, equity

ratio and equity multiplier in Table 5. The gearing ratio is the ratio of total liabilities to total assets, which indicates the proportion of funds provided by creditors to the total assets of the enterprise and reveals the extent to which the contributors of the enterprise guarantee the debts of creditors, so this indicator is an important indicator for analyzing the long-term solvency of the enterprise. The higher the gearing ratio, the greater the financial risk of the company. Apparently, Wanhua Chemical's gearing ratio approximates to BASF from 2018 to 2019, but increases significantly from 2020 onward, which indicates that its financial risk increases and its long-term debt capacity decreases.

The equity multiplier is the total assets to equity ratio, or the leverage ratio in financial analysis, which is the ratio of total assets to owner's equity, i.e., $\text{Equity multiplier} = \text{total assets} \div \text{owner's equity}$. The larger the equity multiplier is, the smaller the proportion of capital invested by owners in the enterprise. Besides, the more fully the enterprise utilizes the debt operation; conversely, the smaller the ratio is, the larger the proportion of capital invested by owners in the enterprise in total assets, the higher the degree of protection of creditors' rights and interests, and the stronger the enterprise's solvency. With the gearing ratio and shareholders' equity ratio, Wanhua Chemical's equity multiplier has increased substantially since 2020, which indicates that its ability to service its debt starts to be much lower than BASF from 2020 onwards.

Table 5. Long-term solvency of BASF and Wanhua

BASF	2018	2019	2020	2021
Gearing ratio	58.28%	51.29%	57.16%	51.84%
Shareholder equity ratio	40.50%	47.73%	42.01%	46.68%
Ownership Ratio	1.44	1.07	1.36	1.11
Equity multipliers	2.47	2.10	2.38	2.14
WANHUA	2018	2019	2020	2021
Gearing ratio	54.53%	54.65%	61.38%	62.33%
Shareholder equity ratio	46.71%	43.74%	36.47%	36.00%
Ownership Ratio	1.17	1.25	1.68	1.73
Equity multipliers	2.14	2.29	2.74	2.78

5. Prospect Analysis

Polyurethane series products are the main profitable production series of Wanhua Chemical, and MDI, as the raw material for producing polyurethane, is currently the only one that Wanhua Chemical can produce in the whole China, and Wanhua Chemical has been able to achieve economic growth from the supply side, which is very favorable to Wanhua Chemical. Although the development of polyurethane industry in China started later than developed countries, China has now become the largest producer and consumer of polyurethane in the world. Polyurethane can be found in all aspects of production and life, and there is still a lot of room for future development of polyurethane-related industries. In addition, Wanhua Chemical's key products include petrochemical products, which are not as profitable as polyurethane products. Nevertheless, the global demand for petrochemical products is also very large. Therefore, Wanhua can focus on developing the market of petrochemical products in the next few years, which can not only increase the profit but also solve the problem of Wanhua Chemical's single profit. If Wanhua Chemical can grasp the opportunity to optimize the production structure, develop new products, expand sales and further increase the market share, it is believed that Wanhua will have more promising development prospects in the future.

6. Development Proposals

The investment in R&D is a key factor in determining an enterprise's R&D improvement. Compared with BASF, Wanhua Chemical's R&D capital investment still has a certain gap. It is recommended that Wanhua Chemical actively benchmark itself against high-end chemical companies in the industry and gradually raise its R&D investment to the top level in the industry, so as to

maximize its innovative R&D capability. Besides, Wanhua Chemical should make full use of the innovation experience established by MDI technology development to actively develop new products in the petrochemical product category, actively broaden the research content and increase the types of profitable products. In addition, based on the existing products, it should actively extend the existing industrial chain and strive to improve the added value of products in order to make efforts to strengthen horizontal integration and horizontal diversification. Moreover, it should also strengthen technical cooperation with universities and research institutes and actively seek cooperation with universities and research institutes at home and abroad, e.g., strengthen the cooperative relationship with universities at home and abroad, rely on universities to introduce high-end talents and teams, build joint laboratories and make full use of scientific research resources. Furthermore, it should also establish a reasonable internal talent selection and promotion mechanism. It is necessary to discover the excellent talents within the enterprise and provide them with reasonable promotion channels, so that they can go to higher positions for training and upgrading. To set up a scientific assessment and evaluation system, combined with the actual situation of the enterprise internal staff assessment and evaluation. Last but not least, the road of sustainable development should also be considered.

7. Conclusion

In summary, Wanhua Chemical is studied and analyzed by SWOT analysis, financial analysis and company comparison. The strengths and weaknesses of Wanhua Chemical and the gap between Wanhua Chemical and international first-class chemical companies are analyzed. It is concluded that Wanhua Chemical has problems such as low investment in scientific research, lack of systematic R&D concept, single product, and unstable debt structure. A series of specific measures are proposed. However, there are some limitations and shortcomings in this study. Firstly, not all the data used is primary data. Secondly, the theoretical knowledge and practical experience are not sufficient in this study to achieve a global grasp of corporate strategy implementation. Finally, this paper is a comparison study of two companies, Wanhua Chemical and BASF, and the guidance for other companies in the chemical industry needs to be improved. These need to be improved and enhanced in future study and research. Further studies ought to collect some first-hand information and add some quantitative analysis to the future forecast. Overall, these results offer a guideline for Wanhua Chemical development analysis.

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