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Financial Risk Analysis of the Desalination Industry Based on the Z-score Model—Take Safbon Water Service, Shanghai Electric Company as an Example

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Abstract: Given that China's desalination industry is still in its nascent stage of development, there exist overall small-scale operations, a deficiency in innovation capabilities, and other issues that result in increasingly severe financial risks. To achieve the sustainable and efficient development of the desalination industry, this paper conducts an in-depth investigation on how to effectively prevent the financial risks of the desalination industry. This paper selects Safbon Water Service and Shanghai Electric as the research subjects, employs traditional financial indicators to conduct a preliminary analysis of financial risk, and subsequently utilizes the Z-score model for in-depth research. The results reveal that both companies have a high financial risk. Based on this, this paper offers the control measures for the financial risk of the two companies from the perspectives of reducing financing risk, strengthening operational capacity, and mitigating revenue risk. The findings of the study fill the gap in the research on individual desalination enterprises and provide a certain theoretical foundation for the subsequent study of financial risk in the domestic desalination industry.

1. Background analysis

In 2021, the United Nations Environment Programme convened two significant conventions: the 26th Conference of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC COP 26) and the 15th Conference of the Parties to the United Nations Convention on Biological Diversity (CBD COP 15). These meetings emphasized urging countries to reduce greenhouse gas emissions, safeguard water resources, and combat water pollution.

Safbon Water Service and Shanghai Electric are at the forefront of desalination technology in China. Both companies possess core manufacturing capabilities for seawater desalination equipment. Safbon Water Service primarily focuses on reverse osmosis seawater desalination, leveraging China's leading technology in this field. Meanwhile, Shanghai Electric is involved in both reverse osmosis seawater desalination and multi-effect distillation processes, holding a substantial market share of approximately 60% in localized multi-effect distillation seawater desalination.

Despite these advancements, China's desalination industry remains in its early stages of development and faces several challenges. The overall scale is relatively small; there exists a

technological gap compared to international standards; obstacles hinder the integration of desalinated water into existing networks across various regions; relevant standards and norms are not well-defined; and incentives for growth remain insufficient. Given this complex and evolving environment, financial risks within the desalination sector are an objective reality. Therefore, achieving sustainable and efficient development within this industry necessitates focused research on financial risk management strategies aimed at mitigating such risks.

In light of these considerations, this paper proposes specific control measures designed to reduce financial risks by examining financial risk management practices employed by Safbon Water Service and Shanghai Electric.

Wang Tao (2024) conducts an analysis of the financial risk associated with F enterprises utilizing the hierarchical analysis method. This approach facilitates a detailed examination of both the causes and characteristics of financial risk within these enterprises [1]. Similarly, Wang Bangyue (2024) investigates the financial risk of enterprise F through hierarchical analysis. Furthermore, Wang Bangyue (2024) evaluates the financial risk of state-owned enterprise X using the AHP-ECM model and establishes a financial risk early warning system based on this framework [2]. Liu Jian et al. (2024) employ the entropy weight-MABAC method to analyze enterprise financial risks, thereby offering innovative insights into assessing such risks [3]. In summary, domestic research methods for analyzing financial risk predominantly rely on multivariate assessment models and univariate assessment models. These models are often enhanced and expanded by integrating modern technologies. However, there is a notable scarcity of studies focusing specifically on financial risks in China's desalination industry, particularly regarding comprehensive assessments for specific enterprises within this sector. Additionally, there is limited application of these assessments in conjunction with actual operational practices. To address this gap, this paper examines Safbon Water Service and Shanghai Electric Group Co., Ltd., two leading firms in China's desalination industry. It analyzes their respective financial risks while proposing relevant measures tailored to their operational realities.

This study examines the financial risks associated with prominent entities in China's desalination sector, specifically focusing on Shanghai Safbon Water Service and Shanghai Electric Group Co., Ltd., both of which have faced scrutiny from environmental protection organizations. Utilizing the Z-score model, this paper analyzes the financial risks inherent to these companies, investigates the underlying causes of such risks, and offers recommendations for mitigation[4].The factors are examined, and corresponding recommendations are proposed.

2. Relevant concepts and theoretical models

2.1 Concept of financial risk

Financial risk pertains to the uncertainties faced by an enterprise in its diverse financial operations, which arise from a multitude of unpredictable and uncontrollable factors. Consequently, within a specified timeframe and scope, the actual financial outcomes may deviate from the anticipated business objectives, thereby creating the potential for the enterprise to incur economic losses or achieve greater profits. Such risks can emerge throughout the entirety of an enterprise's production and operational processes, including activities related to capital acquisition, both short-term and long-term investments, and profit distribution.

2.2 Z-score model

Edward Altman, a professor and financial economist at the Stern School of Business at New York University, conducted a study in 1968 examining both bankrupt and non-bankrupt U.S.

manufacturing firms. Utilizing 22 financial ratios and employing mathematical statistical methods, he developed the renowned 5-variable Z-score model. This statistical framework was constructed based on a sample of bankrupt firms, and it involved extensive experimentation on the operational conditions of these firms to analyze and assess the likelihood of bankruptcy[5] and determining the financial status of the enterprise, specifically its solvency or insolvency.

The Z-Score model is grounded in extensive empirical research and analytical studies derived from the financial reports of publicly listed companies. This model computes a series of financial ratios that serve to indicate the level of financial distress experienced by these companies. Each ratio is assigned a distinct weight based on its predictive capacity regarding financial crises. Subsequently, these weighted ratios are aggregated to produce a composite risk score, referred to as the Z-value. This Z-value is then compared against a predetermined critical threshold to assess the severity of the financial crisis faced by the firm. The discriminant function of the Z-Score model is as follows:

$$Z = 1.2X_1 + 1.4X_2 + 3.3X_3 + 0.6X_4 + 0.999X_5 \tag{1}$$

The equations utilized for the computation of each index within the Z-score model, along with the corresponding cut-off values for z-scores, are presented in Tables 1 and 2 below.

Table 1: Calculation of Z-Score Model Indicators and Meaning of Indicators

notation	formula	symbolic meaning
X_1	X_1= Working capital/total assets	Reflects the short-term solvency of the enterprise
X_2	X_2= Retained earnings/total assets	Reflects liquid cash held by the enterprise
X_3	X_3= EBIT/total assets	Reflects the profitability of the enterprise
X_4	X_4= Total market value of shareholders' equity/total liabilities	Reflects the long-term solvency of the enterprise
X_5	X_5= Sales revenue/total assets	Reflecting the enterprise's product sales

Table 2: Discriminative criteria for the Z-score model

Z-value	Discriminatory results	Probability of business insolvency
$Z < 1.81$	Significant financial risk	High insolvency risk area
$1.81 \le Z < 2.67$	Higher financial risk	grey area
$2.67 \le Z$	Less financial risk	low insolvency risk area

3. Identifying and analysing financial data based on desalination companies

To enhance the analysis of the financial risk associated with the two enterprises, Baan Water and Shanghai Electric, this study establishes a benchmark for financial risk evaluation within the desalination sector. The benchmark proposed herein is primarily informed by the "Enterprise Performance Evaluation Standard" for the desalination industry, as issued by the State Council's State-owned Assets Supervision and Administration Commission (SASAC) for the period of 2019-2023. This standard serves as a reference point for the enterprise performance evaluation criteria established by the Bureau of Examination and Distribution of SASAC, in accordance with the "Interim Measures for the Management of the Central Enterprises' Comprehensive Performance Evaluation" and other pertinent regulations. By utilizing this benchmark, the study aims to provide a more accurate representation of the operational and financial risk conditions of Baan Water and

Shanghai Electric.

3.1 Solvency analysis

The solvency of an enterprise refers to its capacity to utilize its assets to fulfill long-term obligations while managing short-term liabilities. The capability of a business to generate cash and meet its debt obligations is crucial for its sustainable survival and growth. Consequently, this study employs two financial metrics, specifically the quick ratio and the gearing ratio, to assess the solvency of enterprises.

3.1.1 Quick ratio

The quick ratio is an indicator of a firm's short-term solvency[6]. The quick ratio is an indicator of a company's short-term solvency.

This study utilizes the Oriental Wealth Network to gather relevant financial data for Safbon Water Service and Shanghai Electric from 2019 to 2023. Employing Excel, the research efficiently calculates specific financial indicators that reflect the solvency of Safbon Water Service during this period, with the resulting values presented in Table 3 below. Additionally, the paper establishes the benchmark for the quick ratio indicator within the desalination industry, as outlined in the "Enterprise Performance Evaluation Standards" issued by the State Council's State-owned Assets Supervision and Administration Commission for the years 2019 to 2023[7]. The specific values of these benchmarks are also displayed in Table 3 below.

Table 3: Indicator values of quick ratio for desalination companies, 2019-2023

vintages	2019	2020	2021	2022	2023
Safbon Water Service (%)	141	139	103	93	90
Shanghai Electric (%)	105	108	105	104	95
Industry standard value (%)	97.2	97.6	98.8	100	100.8

*Source of data: SASAC, Oriental Wealth Net

As illustrated in Table 3, Safbon Water Service exhibited a quick ratio exceeding 130% during the years 2019-2020, significantly surpassing the industry average of 97.4%. This suggests a robust short-term solvency for the company during this timeframe. However, from 2021 to 2023, Safbon Water Service's quick ratio declined from 103% to 90%, indicating a gradual deterioration in its short-term solvency. Notably, between 2022 and 2023, the quick ratio fell to 93%, which is below the industry standard of 100%. This decline is attributed to a significant reduction in short-term solvency resulting from a debt default and a crisis of confidence in 2022.

Similarly, Table 3 indicates that Shanghai Electric maintained a quick ratio of approximately 105% from 2019 to 2022, which is above the industry standard of 98.4%. This reflects a strong capacity for short-term debt servicing during this period. However, by 2023, the quick ratio decreased to 95%, falling below the industry standard of 100.8%. This decline suggests a weakening of Shanghai Electric's short-term debt servicing ability, potentially leading to a debt crisis.

3.1.2 Gearing ratio

The gearing ratio serves as an indicator of a company's capital strength, the effectiveness of its internal management, and the safeguarding of creditors' rights and interests[8]. The standardized values of the gearing ratios for Safbon Water Service, Shanghai Electric, and the desalination industry are presented in Table 4 below.

Table 4: Indicator values of gearing for desalination companies, 2019-2023

vintages	2019	2020	2021	2022	2023
Safbon Water Service (%)	60	66	87	97	100
Shanghai Electric (%)	67	66	67	67	73
Desalination industry standard value (%)	58.6	58.6	58.3	58.3	58.17

*Source: SASAC, guru focus value guru

As illustrated in Table 4, the gearing ratio of Safbon Water Service has exhibited a consistent upward trend from 2019 to 2023, with a notable increase of 31% in 2021. Throughout this period, Safbon Water Service's gearing ratio has consistently surpassed the industry standard of 58% for the desalination sector. An analysis of the years 2019 to 2023 reveals that the company has faced significant challenges, including elevated levels of borrowing, substantial investments, operational inefficiencies, declining credit ratings, and internal conflicts among personnel. These factors have collectively contributed to an escalation in the financial risk associated with the business, particularly pronounced in 2021, with no complete recovery observed by 2023.

Conversely, Table 4 indicates that Shanghai Electric has maintained a relatively stable gearing ratio of approximately 67% from 2019 to 2023, which remains above the desalination industry standard of 58%. This stability suggests that Shanghai Electric's financial risk is elevated compared to the industry average. Notably, between 2022 and 2023, the company's gearing ratio increased to 73%, reflecting a 6% rise that signifies a substantial increase in liabilities and, consequently, an escalation in financial risk.

In conclusion, the solvency of both Safbon Water Service and Shanghai Electric falls below the industry standard, with Safbon Water Service exhibiting a higher level of financial risk in comparison to Shanghai Electric.

3.2 Operational capacity analysis

3.2.1 Inventory turnover ratio

The inventory turnover ratio serves as an indicator of a company's efficiency in selling and replenishing its inventory within a specified timeframe. Specifically, Table 5 below presents the inventory turnover ratios for Safbon Water Service and Shanghai Electric, alongside the standardized inventory turnover ratios pertinent to the desalination industry.

Table 5: Inventory turnover indicator values for desalination companies, 2019-2023

vintages	2019	2020	2021	2022	2023
Safbon Water Service (times)	1.55	1.48	3.43	2.53	2.57
Shanghai Electric (times)	3.73	4.14	3.57	2.95	2.91
Desalination industry standard values (times)	9.70	12.10	15.20	12.20	13.34

*Source: SASAC, guru focus value guru

As illustrated in Table 5, Safbon Water Service's inventory turnover ratio from 2019 to 2023 has consistently remained above 1.5, with a peak value of 3.43 recorded in 2021. However, this figure is significantly lower than the seawater industry's benchmark of 15.20 for the same year, resulting in a substantial discrepancy of 11.77. This suggests that over the past five years, Safbon Water Service may be experiencing issues such as excessive inventory or a credit crisis, which have adversely affected its operational efficiency, placing its performance well below the industry average and increasing its financial risk relative to industry standards.

In contrast, as indicated in Table 5, Shanghai Electric's annual inventory turnover ratio during the period from 2019 to 2023 has consistently surpassed that of Safbon Water Service. Nevertheless, it still falls short of the desalination industry's average value of 12.508. Since 2020, there has been a slight decline in Shanghai Electric's annual inventory turnover ratio, suggesting a gradual deterioration in its operational capacity over the past four years, which remains below the average standard within the same industry.

3.2.2 Total asset turnover

The total asset turnover ratio serves as an indicator of a company's effectiveness in leveraging its total assets for production and operational activities. Specifically, Table 6 below presents the total asset turnover ratios for Safbon Water Service, Shanghai Electric, as well as the standardized total asset turnover ratio for the desalination industry.

Table 6: Indicator values of total asset turnover for desalination companies, 2019-2023

Total asset turnover ratio (unit: times)	2019	2020	2021	2022	2023
Safbon Water Service	0.17	0.08	0.03	0.07	0.08
Shanghai Electric	0.51	0.48	0.43	0.38	0.40
Desalination industry standard values	0.30	0.30	0.30	0.30	0.30

*Source: SASAC, guru focus value guru

As illustrated in Table 6, the total asset turnover ratio of Safbon Water Service exhibited a continuous decline from 2019 to 2021, ultimately reaching a nadir of 0.03 in 2021. This ratio consistently fell below the industry standard of 0.3 for the desalination sector, indicating a gradual deterioration in the company's operational efficiency over this three-year period. The significantly lower ratio compared to the industry average suggests a heightened financial risk for Safbon Water Service. Although there was a modest increase in the total asset turnover ratio from 2021 to 2023, it remained substantially below the desalination industry standard of 0.3. This indicates that, despite some improvement in operational capacity over these three years, Safbon Water Service's performance continues to lag behind the industry average.

In contrast, as presented in Table 6, the total asset turnover ratio for Shanghai Electric demonstrated a slight increase in 2023; however, the overall trend from 2019 to 2023 was one of decline, with the ratio reaching its lowest point of 0.38 in 2022. Notably, this figure still exceeds the desalination industry standard of 0.3, suggesting that while the operational capacity of Shanghai Electric has weakened over the five-year period, it remains above the average level within the same industry.

3.3 Profitability analysis

3.3.1 Net sales margin

The net sales margin, defined as net profit expressed as a percentage of sales revenue, serves as a key indicator of a business's profitability. Typically, a higher net sales margin signifies enhanced sales profitability and indicates a more robust financial performance of the enterprise.

As illustrated in Table 7, Safbon Water Service experienced a substantial decline in its net sales margin from 2019 to 2021, consistently falling below the desalination industry standard of 9.93%. By 2021, the net sales margin plummeted to -956.96%, signifying a considerable financial loss for the company and indicating extremely poor profitability. However, since 2021, there has been a notable improvement in Safbon Water Service's net sales margin, which rose to -146.47% in 2022, reflecting

an increase of 810.49%. Despite this improvement, the net sales margin remained negative as of 2023, suggesting that while the severe losses experienced from 2019 to 2021 have been alleviated, the company has yet to achieve a turnaround from losses to profitability, thereby continuing to face significant financial risks.

Table 7: Indicator values of desalination companies' net sales margins, 2019-2023

vintages	2019	2020	2021	2022	2023
Safbon Water Service (%)	8.40	-109.60	-956.96	-146.47	-40.25
Shanghai Electric (%)	2.75	2.74	-7.67	-3.03	0.25
Desalination industry standard value (%)	9.10	10.10	10.60	6.40	5.97

*Source: SASAC, guru focus value guru

In contrast, Shanghai Electric's net sales margin exhibited relative stability from 2019 to 2022, maintaining an approximate value of 2.75. However, beginning in 2021, the company experienced a slight decline in its net sales margin, which even turned negative in both 2021 and 2022, indicating a loss and a gradual weakening of profitability. By 2023, the net sales margin recovered to a positive value of 0.25%, yet this figure remains substantially below the industry standard of 5.97% for the desalination sector. This suggests that, although there has been an improvement in profitability, Shanghai Electric's performance remains weak in comparison to the majority of companies within the desalination industry, thereby continuing to pose significant financial risks.

4. Financial risk analysis of the desalination industry based on the Z-score model

This study examines the pertinent indicators of Safbon Water Service and Shanghai Electric, utilizing data sourced from the Oriental Fortune website. The outcomes for each indicator within the Z-score model are computed using an Excel spreadsheet, as presented in Tables .8. and .9.

Table 8: Calculation results of the values of the variables X_1-X_5 and Z for Safbon Water Service under the Z-score model

vintages	2019	2020	2021	2022	2023
X_1	0.0013	-0.2492	-0.5247	-0.5801	-0.6592
X_2	0.31	0.16	-1.32	-2.99	-3.57
X_3	0.0235	-0.1609	-0.6787	-0.1836	-0.0246
X_4	0.6467	0.5146	0.1635	0.0507	0.0232
X_5	0.1354	0.0819	0.03504	0.0735	0.08480
Z	0.89	0	-1.62	-1.14	-0.98

Table 9: Calculation results of the values of the variables X_1-X_5 and Z for Shanghai Electric under the Z-score model

vintages	2019	2020	2021	2022	2023
X_1	0.1251	0.1407	0.1359	0.1309	0.0850
X_2	0.1017	0.10 22	0.0702	0.0601	0.0620
X_3	0.0045	0.0081	0.0138	0.0178	0.0043
X_4	0.2689	0.2526	0.2182	0.2153	0.1930
X_5	0.0754	0.1675	0.2591	0.3965	0.0721
Z	1.03	1.01	0.78	0.79	0.79

As illustrated in Table 8, the Z-values for Safbon Water Service from 2019 to 2023 consistently fall below 1.8, accompanied by a significant overall downward trend. This trend suggests that Safbon

Water Service has remained within the bankruptcy zone throughout this five-year period, indicating a substantial likelihood of encountering a financial crisis.

Similarly, Table 9 presents the Z-values for Shanghai Electric for the same period, which also remain below 1.8, albeit with a less pronounced downward trend. This observation implies that Shanghai Electric has likewise been situated within the bankruptcy zone over the past five years, with a considerable probability of facing a financial crisis.

In conclusion, both Safbon Water Service and Shanghai Electric exhibit Z-values below 1.8 from 2019 to 2023, alongside an overall declining trend, which signifies an elevated financial risk for both entities during this timeframe. Notably, Safbon Water Service's Z-values are lower than those of Shanghai Electric, demonstrating a more pronounced downward trajectory, with Z-values recorded as negative from 2021 to 2023. In contrast, while Shanghai Electric's Z-values are declining, they have remained above 0.79 overall. This indicates that Safbon Water Service faces a greater risk of bankruptcy and financial instability compared to Shanghai Electric.

5. Control measures for financial risk in Safbon Water Service and Shanghai Electric enterprises

5.1 Reducing funding risks

An analysis of the quick ratio and gearing ratio for Safbon Water Service and Shanghai Electric reveals a projected decline in the quick ratio and an increase in the gearing ratio for the period from 2019 to 2023. This trend suggests a deterioration in the solvency of both Safbon Water Service and Shanghai Electric over these five years, potentially exposing the companies to heightened financial risks. To mitigate the financial risks associated with the anticipated decline in solvency, this paper proposes strategic measures aimed at expanding financing channels[8]. The specifics of these recommendations are outlined below.

5.1.1 Keeping an eye on national policies

The vulnerability to external shocks is a prevalent issue across the desalination sector. Consequently, Safbon Water Service and Shanghai Electric, both operating within this industry, must remain vigilant regarding fluctuations in national policies. Additionally, it is imperative for these companies to proactively pursue national incentives for seawater desalination. Such efforts aim to minimize costs, broaden financing avenues, and mitigate the financial risks associated with the potential inability of enterprises to service substantial debt obligations.

5.1.2 Rationalise the amount of funding planned

Safbon Water Service and Shanghai Electric frequently require substantial fundraising efforts to secure the necessary capital for their projects during the research and development phase. It is imperative for these organizations to develop a comprehensive fundraising strategy prior to the fundraising process to ensure the acquisition of an appropriate amount of funding. Additionally, the implementation of diversified financing methods is essential to mitigate financing costs and minimize the associated financial risks.

5.2 Strengthening operational capacity

An analysis of the inventory turnover ratio and total asset turnover ratio for Safbon Water Service and Shanghai Electric from 2019 to 2023 reveals that both companies exhibit ratios significantly below the industry standard for seawater desalination. This finding suggests that the operational

efficiency of these firms is inferior to the industry average over the specified five-year period. To mitigate the financial risks associated with their inadequate operational capacity, this paper proposes strategic measures aimed at enhancing asset management practices.

5.2.1 Develop a refined production plan

The inadequate inventory management practices of Safbon Water Service and Shanghai Electric significantly contribute to their operating capacity falling below the industry standard. In light of this, it is advisable for both companies to develop more precise production plans prior to manufacturing. These plans should be informed by anticipated sales orders for the upcoming month or quarter, while also considering potential order defaults that may result in a decrease in sales orders. By implementing such refined production strategies, the companies can effectively minimize their inventory levels.

5.2.2 Increased utilization of fixed assets

The total asset turnover ratio for Safbon Water Service and Shanghai Electric is notably low, suggesting that both companies exhibit insufficient sales performance and have not effectively optimized the utilization of their assets. In light of this assessment, it is recommended that Safbon Water Service and Shanghai Electric enhance their investment in research and development, adopt advanced equipment and technology, and implement improvements aimed at boosting productivity and product quality while simultaneously reducing costs. Such measures are essential for increasing the output derived from their assets.

5.3 Reducing revenue risk

The total asset turnover ratio for Safbon Water Service and Shanghai Electric is notably low, suggesting that both companies exhibit insufficient sales performance and have not effectively optimized the utilization of their assets. In light of this assessment, it is recommended that Safbon Water Service and Shanghai Electric enhance their investment in research and development, adopt advanced equipment and technology, and implement improvements aimed at boosting productivity and product quality while simultaneously reducing costs. Such measures are essential for increasing the output derived from their assets [9], which are as follows.

5.3.1 Enhancing competitiveness

Safbon Water Service and Shanghai Electric, as prominent entities within the desalination sector, are confronted with intensifying competition in the industry. This necessitates an augmented investment in research and development pertaining to products and technologies. It is imperative to bolster the independent innovation capabilities across various segments of the seawater desalination industry chain. Furthermore, there is a critical need to enhance the dissemination and application of scientific and technological advancements in seawater desalination. Additionally, exploring synergistic innovations between the upstream and downstream components of the seawater desalination industry chain is essential for improving overall competitiveness.

5.3.2 Optimising the product portfolio

The net sales margins of Safbon Water Service and Shanghai Electric are insufficient, primarily attributable to the limited profitability associated with their product offerings. In light of this situation, it is advisable for Safbon Water Service and Shanghai Electric to optimize their product mix by either discontinuing or minimizing the production of low-margin products while simultaneously enhancing

the production of higher-margin products. This strategic adjustment is intended to improve their net sales margins.

6. Conclusion

This study employs the Z-score model to analyze Safbon Water Service and Shanghai Electric, which are prominent entities within the desalination sector. The findings indicate that both companies exhibit solvency, operational capacity, and profitability metrics that fall below the industry standard, with an overall declining trend and an increased likelihood of experiencing a financial crisis. Specifically, the Z-scores for both companies are below 1.81, placing them within the bankruptcy zone. To mitigate financial risks, it is recommended that these companies closely monitor national policies, strategically plan their fundraising efforts, develop detailed production strategies, enhance the utilization of fixed assets, improve their competitive positioning, and optimize their product offerings.

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