Chapter 3

Research Methodology

This research adopted both quantitative and qualitative research methods to thoroughly explore the application of X technology in improving silver powder products. Qualitative research helped us gain a deep understanding of how X technology is applied in enhancing silver powder products and how to improve Xincailiao Enterprise's products through document study and case analysis. Quantitative research assessed the impact of X technology on the improvement of silver powder products through experiments and data analysis. This led to achieving a sales revenue of over 100 million RMB, thus enhancing the company's overall gross profit level and comprehensive competitiveness. Detailed information on the research methods is provided below:

1. Research design
2. Population and sample size
3. Research instruments
4. Data collection
5. Data analysis

Research Design

The research design for this study encompassed a multifaceted approach that combined literature research, case studies, experiments, and the analysis of production data to provide a comprehensive view of the subject matter.

1. Document study

The document study phase involved an in-depth examination of a wide range of existing documents pertaining to the ABC Company. This included a meticulous review of documents related to key performance indicators for silver powder quality, the utilization of X technology to enhance product quality while reducing production costs, and the advantageous impact of applying X technology to customer product systems, market share, and overall competitiveness. Through this process, a wealth of knowledge was gathered from the documented history of the ABC Company's endeavors in these critical areas.

2. Case studies

This research delved into the intricate world of case studies. ABC Company, which operated within the silver powder industry and had embraced and integrated X technology, was identified and selected. The primary objective was to conduct a comprehensive examination of their experiences, encompassing various facets such as product quality, production costs, profit margins, market share, and competitiveness. This entailed a detailed analysis of specific instances where X technology had been implemented in practice, aiming to illuminate the tangible results and benefits achieved. This exploration included a thorough examination of the strategies, implementations, and outcomes that could offer valuable insights for the broader industry.

Population and Sample Size

The key informants for the interviews were selected through a purposive sampling method, comprising employees, managers, and other relevant personnel of the ABC Company who were directly involved in the implementation of X technology. A total of 12 individuals were interviewed, following the criteria for selecting key informants as outlined in Table 3.1

Table 3.1 Criteria for selecting key informants

Criteria	Details
Direct Involvement	Key informants should be individuals within the ABC Company who are directly involved in the implementation of X technology. This ensures that they have firsthand knowledge and experience related to the technology's impact.
Diverse Roles and Departments	Select informants from various roles and departments within the company. This can include production, quality control, finance, marketing, and management. This diversity will provide a comprehensive perspective on the research objectives.
Experience	Choose informants with varying levels of experience with X technology. This can include both long-term employees who have witnessed its implementation and newer employees who may offer fresh insights.

Table 3.1 Criteria for selecting key informants (Cont.)

Criteria	Details
Responsibility Levels	Include individuals with different responsibility levels, from frontline employees to managers. This ensures a holistic view of the technology's effects on various organizational levels.
Knowledge of Silver Powder Production	Prior knowledge or experience in the production of silver powder is valuable, especially for objectives related to quality and production costs.

Furthermore, the researcher also took into consideration 'availability' to ensure that the selected informants were available and willing to participate in interviews. This involved coordinating schedules and obtaining necessary permissions. Additionally, the selection process involved choosing individuals who could effectively communicate their experiences and insights. Good communication skills were essential for productive interviews. It was also essential to ensure that the chosen informants had insights that directly related to the research objectives. Their input should have contributed effectively to addressing the research questions.

Research Instruments

Interview Guideline as shown in Table 3.2

Table 3.2 Interview guideline

Research Objective	Questions
1. To compare the quality of silver powder before and after the implementation of X technology.	1. Can you explain the significance of specific surface area, particle size distribution, and ignition loss in assessing the quality of silver powder? 2. How do these key performance indicators affect the properties and characteristics of silver powder? 3. What specific techniques or methodologies are used to measure and analyze the specific surface area, particle size distribution, and ignition loss of silver powder?

Table 3.2 Interview guideline (Cont.)

Research Objective	Questions
	4. Can you discuss any previous research or studies that have explored the relationship between these key performance indicators and the quality of silver powder? 5. Are there any industry standards or guidelines that define acceptable ranges or specifications for specific surface area, particle size distribution, and ignition loss in silver powder?
2. To examine the production cost and profit margin of silver powder products after the application of X technology by the ABC Company.	1. How has the implementation of X technology impacted the production cost of silver powder products? 2. Can you explain the key factors or components that contribute to the production cost of silver powder products? 3. Has there been any noticeable change in the profit margin of silver powder products since the adoption of X technology? 4. Are there any challenges or obstacles faced by the ABC Company in terms of cost management and profitability after implementing X technology? 5. Are there any challenges or obstacles faced by the ABC Company in terms of cost management and profitability after implementing X technology?
3. To evaluate the benefits of applying X technology to ABC Company competitiveness, in terms of customer product system, production cost, profit margin and market share.	1. How has the application of X technology affected the customer product system of silver powder products? 2. Have there been any changes in customer satisfaction or feedback since the implementation of X technology? 3. Can you discuss any specific improvements or enhancements in silver powder products that have resulted from the application of X technology?

Table 3.2 Interview guideline (Cont.)

Research Objective	Questions
	4. Has the market share of the ABC Company in the silver powder industry seen any changes after adopting X technology? 5. In what ways has the competitiveness of the ABC Company been influenced by the application of X technology in the silver powder market?

Data Collection

1. Document study

For the document study, existing sources of information were analyzed and synthesized using a data collection method known as secondary research or literature review. The focus was on reviewing the available literature related to the key performance indicators for silver powder quality, the use of X technology to enhance product quality and decrease production costs, and the benefits of applying X technology to customer product systems, market share, and competitiveness. Various sources of data such as academic journals, research articles, conference proceedings, technical reports, industry publications, and company publications were used.

2. Case study

Data was collected through case study by selecting an ABC Company that had implemented X technology in the silver powder industry. In addition, the researcher collected production data from the ABC Company before and after the application of X technology to silver powder products for production data analysis. The researcher gathered additional data from interviews with employees, managers, and other relevant personnel of the company, as well as from financial reports and other relevant documents.

In the interviews, the researcher employed a semi-structured interview method, a research approach commonly utilized in the social sciences and qualitative research. In this type of interview, the researcher posed a set of open-ended questions but also allowed for flexibility and probing to delve deeper into the participants' responses. Unlike structured interviews, where the questions were fixed and standardized, semi-structured interviews offered a degree of flexibility in the conversation, enabling the researcher to adapt and follow up on emerging themes and insights.

Semi-structured interviews were widely recognized as a valuable tool for gathering rich, in-depth qualitative data. Researchers such as Flinders (1997, pp. 267-270) and Turner (2010, pp. 754-760) emphasized the importance of open-ended questions and the interactive nature of the interview process. According to Gubrium & Holstein (2002, p. 981), semi-structured interviews allowed for a dynamic interaction between the researcher and the participant, promoting a deeper understanding of the participants' experiences, perspectives, and meanings. Semi-structured interviews held a pivotal role in this research, serving as a valuable tool for gathering rich, in-depth qualitative data to fulfill the stated research objectives.

One of the primary research objectives was to compare the quality of silver powder before and after the implementation of X technology. Semi-structured interviews proved to be an invaluable asset in this regard. Researchers such as Ruslin, et al. (2022, pp. 22-29) highlighted the significance of open-ended questions. By employing this technique, interviews delved into the nuanced aspects of quality improvement. The interactive nature of these interviews enabled a comprehensive exploration of the subject, allowing participants to provide detailed insights into how the application of X technology influenced the quality of the silver powder.

Another research objective focused on examining the production cost and profit margin of silver powder products post-implementation of X technology by the ABC Company. Semi-structured interviews provided a unique opportunity to delve deep into this aspect. Brown & Danaher (2019, pp. 76-90) discussed how semi-structured interviews allowed for dynamic interactions between the researcher and the participant. This interaction helped elucidate the intricacies of production costs, identifying any specific areas where X technology made a substantial impact, positively or negatively. By allowing participants to express their perspectives and experiences, these interviews contributed to a nuanced understanding of the financial implications.

The research aimed to evaluate the benefits of applying X technology to ABC Company's competitiveness. In this context, semi-structured interviews offered a comprehensive means of understanding the multifaceted dimensions of competitiveness. Participants shared insights into how X technology had affected their customer product systems, production costs, profit margins, and market share. By allowing for open-ended questions and dynamic interactions, these interviews uncovered the subtle yet critical shifts in competitiveness brought about by the application of X technology.

Furthermore, Silverman (2002, p. 131) discussed the significance of semi-structured interviews in allowing the researcher to explore diverse viewpoints and interpretations, making it a versatile method for a wide range of research topics. By

providing a framework of key questions while still permitting flexibility and follow-up inquiries, semi-structured interviews struck a balance between structure and spontaneity, making them a valuable approach in qualitative research.

Data Analysis

1. Data analysis method for the document study

The data analysis method was a secondary research or literature review. The analysis involved synthesizing and reviewing the available literature related to the key performance indicators for silver powder quality, the use of X technology to enhance product quality and decrease production costs, and the benefits of applying X technology to customer product systems, market share, and competitiveness. The data sources included academic journals, research articles, conference proceedings, technical reports, industry publications, and company publications. The researcher analyzed the data by critically examining and comparing the various sources of information to identify the common themes, trends, and insights. The analysis involved identifying gaps in the existing literature and drawing conclusions from the available information.

2. Data analysis method for case studies

This research utilized comparative analysis methods, such as static and dynamic comparison. The static comparison involved the analysis of sales data for various silver powder products of ABC Company. On the other hand, the dynamic comparison involved the examination of the proportion of usage of back silver powder by three customers among the top ten domestic manufacturers of back silver paste. At the time, ABC Company was the primary supplier of silver powder for back silver paste in Guangzhou Ruxing, which was the leading manufacturer of back silver paste in China. The objective of adopting X technology was to align with the technological advancements of the company and the industry.

The researcher used comparative analysis methods to analyze the data in this research. Sales data for various silver powder products of ABC Company were compared using both static and dynamic comparison methods. Static comparison was used to compare the sales data of different silver powder products over time, while dynamic comparison was used to compare the proportion of usage of back silver powder by three customers among the top ten domestic manufacturers of back silver paste. The production data collected from ABC Company was also analyzed to determine the effects of X technology on production costs, profit margins, customer

product systems, market share, and competitiveness. Statistical methods, such as regression analysis, were used to establish the effects of X technology.

Regression analysis is a powerful statistical tool commonly used in research to explore relationships between variables and to make predictions based on those relationships (Ciaburro, 2018, p. 422). In the context of your research, it could be a valuable technique for understanding how X technology impacted various aspects of ABC Company's operations. When applying regression analysis to your research, you could use it to quantify the relationships between X technology and the different variables you were investigating. For example, you could have performed regression analyses to determine:

By analyzing the data, you can use regression to understand how changes in the use of X technology correspond to changes in production costs. This can help quantify the cost savings or increases associated with the technology's implementation. Regression analysis can also reveal how X technology influences profit margins. You can assess whether the technology leads to increased profits, helping to establish its financial benefits. For customer product systems, regression can be used to assess the impact of X technology on customer product systems. For example, you can analyze how the technology affects the efficiency and quality of the products. To determine the effects of X technology on market share and competitiveness, regression analysis can provide insights into the relationships between technology adoption and changes in market performance.

Regression analysis was applied to quantify the relationships between X technology and these variables. The results of the analysis provided empirical evidence of the technology's impact, helping to support your research objectives and draw conclusions about its effectiveness in improving various aspects of ABC Company's operations.

The qualitative data gathered from interviews and relevant documents underwent content analysis methods to uncover key themes and patterns. These patterns and themes provided a deeper understanding of the perspectives and experiences of the participants concerning the implementation of X technology in the silver powder industry. The analysis involved several steps, such as data preparation, where the information was organized, and a coding system was established for data analysis. The data was then systematically analyzed and categorized based on predetermined categories or themes. The coded data then underwent analysis to reveal emerging patterns and themes. Finally, the identified patterns and themes were interpreted in the context of the research question to draw conclusions and make recommendations.