Market competitive innovation, business intelligence application and international market strategies in China's valve manufacturing industry: Basis for global market competitiveness advantage framework

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Abstract

This study aims to examine the market competitive innovation, business intelligence application and international market strategy of Chinese valve enterprises to enhance the competitive advantage in the global market, basis for a framework of global market competitiveness advantage. Specially, the market competition innovation was evaluated from three aspects: market research analysis, use of e-commerce and online social platforms, and data-driven decision-making process. Business intelligence application was evaluated from three application scenarios covering procurement management, quality control management and customer relationship management. International market strategy was evaluated in terms of market selection, sales performance assessment and price strategy. Finally, a framework of competitiveness advantage in the global market was formed. Descriptive research and correlational research methods were used in this study, and the questionnaire design provided valuable factual material, formed scientific judgments, and provided important knowledge. Firstly, the study shows that innovation is an important factor to enhance the competitiveness of valve enterprises in the global market. In today's digital age, information technology innovation helps enterprises realize technological innovation, product innovation and management innovation, to improve the product market competitiveness. The application of information technology helps enterprises to carry out market research and analysis more efficiently. E-commerce platforms and social media marketing have opened up new sales channels in overseas markets. The data-driven decision-making process improves the efficiency of enterprise decision making and market insight. Secondly, through business intelligence tools, companies have improved supply chain management, improved product quality, reduced production costs, and improved customer satisfaction, thus standing out in the global market. Innovation and digital reforms have prompted companies to develop more favorable international market strategies to adapt to the changing international market environment. Thirdly, using business intelligence and information technology, enterprises have a deeper and more comprehensive analysis and understanding of the international market

and can make informed choices. The company regularly evaluates the sales performance of selected markets and continuously updates the market scope that needs to be focused on investment. Using advanced information technology means, enterprises can scientifically formulate price strategies to help maximize international marketing revenue. Furthermore, the study finds that the three independent variables of market competitive innovation, business intelligence application and international market strategy are highly positively correlated. Innovation drives the development of business intelligence, and at the same time, the positive feedback of business intelligence applications will continue to encourage innovation and upgrading. Meanwhile, business intelligence applications help enterprises to accurately formulate international market strategies, and the successful implementation of market strategies will, in turn, affirm the effect of business intelligence applications, prompting enterprises to continue to invest in business intelligence. Moreover, innovation is conducive to enterprises to develop accurate and forward-looking market strategies, while successful international market strategies provide important support for enterprises continuously to innovate. Continuous innovation can provide enterprises with a competitive advantage, support and strengthen the execution and implementation of their international market strategy. Therefore, enterprises should closely combine innovation, digital application and international market strategy to form a virtuous circle, so as to enhance the competitive advantage of enterprises in the global market. Finally, based on the interaction among those three independent variables, a framework is formed to enhance the competitive advantage of enterprises in the global market.

Keywords: innovation, business intelligence application, market strategy, market competitiveness advantage, valve industry

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1. Introduction

The valve is a key mechanical device to control the flow of medium in the pipeline, which is widely used in the pipeline system of oil, gas and chemical industry. The valve industry is the gatekeeper of the national industrial system, and the precise control of the valve on the fluid determines the safety and efficiency of the entire system. In recent years, with the industrial upgrading of Europe and the United States, the global valve industry began to transfer to the region, and China has become one of the main manufacturing bases of global valve products with its larger cost advantage. In the context of today's economic globalization, China's valve manufacturing enterprises have gone abroad to enter the international market. In the face of global market opportunities and fierce market competition, how to gain a firm foothold in the global market is a major challenge faced by Chinese valve enterprises. To enhance the competitive advantage of enterprises in the international market is an urgent need for enterprises to achieve long-term sustainable development. Tseng et al. (2022) studied that enterprise innovation behavior can help improve the export competitiveness of China's manufacturing industry. Research by Tang et al. (2022) suggested that companies that integrate digital innovation and data-driven decision-making into their operations are more likely to expand their global market share. In the context of intense international competition, Nguyen et al. (2021) emphasized the importance of selecting appropriate international market entry methods, while Mohapatra et al. (2017) discussed how multinational enterprises (MNEs) can balance localization with global operations to achieve a market development strategy for sustained growth. However, there is little research on the topic of Chinese valve manufacturing enterprises relying on digital reform and innovation to promote their competitive advantage in the international market. This study aims to fill this gap by applying digital-driven market innovation ideas to the traditional valve manufacturing industry and enhancing the international competitive advantage of enterprises.

This study takes international market competitiveness as the starting point, and conducts a questionnaire survey from three aspects: market competition innovation, business intelligence application and international market strategy. Firstly, market competition innovation is carried out from three aspects: market research analysis, e-commerce online marketing platform operation and data-driven decision-making model. Through in-depth market research and analysis, enterprises can grasp the global market dynamics in time and provide a data basis for enterprises to formulate market strategies. The application of online marketing channels such as e-commerce platforms and social media has changed the way valve companies interact with international customers, facilitating direct relationships with end users. At the same time, the data-driven decision-making mode can help enterprises optimize the valve production process, improve the market response speed, and enhance the market competitiveness of enterprises. Secondly, the application of BI tools in three departments of valve enterprises: procurement, quality control and customer relationship management is studied. The data analysis and trend prediction capabilities of business intelligence tools can optimize business operations management processes and respond to global market dynamics in a timely manner. Finally, the international market strategy for exploring global market share is studied. The international marketing strategy consists of three aspects: selecting suitable new markets, evaluating market performance and developing flexible pricing strategies. Through the systematic study of the above three independent variables, it is found that the interaction of market innovation, business intelligence application and effective market strategy together forms the core competitiveness of the firm, and thus the framework of the competitive advantage in the international market was formed.

At present, China's valve manufacturing industry is booming, according to China's valve industry statistics

show that as of 2023, the number of valve production enterprises is more than 6,000, and there are about 1,800 valve production enterprises with qualifications above scale (the annual operating income of enterprises is usually $2.768 million and above). These enterprises are concentrated in two valve manufacturing clusters in southern and northern China, of which the southern region is represented by Shanghai, Jiangsu and Fujian provinces; while, the northern region is represented by Tianjin, Hebei and Liaoning provinces. At the same time, Chinese valve enterprises occupy an important position in the global market. According to the statistics of the China Valve Industry Research Institute, the size of China's valve market in 2023 is about 15.7 billion US dollars, accounting for 19.12% of the global market, and is the second largest valve market in the world. However, China's valve enterprises are also facing a variety of challenges. Chinese valve enterprises have strong competitiveness in the middle/low-end market, but the high-end market competitiveness is insufficient, especially involving core technology products, there is still a technology gap with enterprises in developed countries such as Europe, the United States and Japan.

Meanwhile, the brand awareness is low, which makes Chinese valve companies face greater brand perception obstacles when developing the high-end market. In addition, the quality standards and quality consistency management of Chinese valves on a global scale still need to be improved. While innovation is happening in the valve industry, it is not reaching its full potential due to a lack of integration between the innovation process and the market strategy. In addition, the adoption of business intelligence tools remains limited, especially among small and medium-sized valve companies, which prevents these companies from fully optimizing their operations and market positioning. With the continuous release of the demand for basic parts in the global industry 4.0 upgrade, the intelligent manufacturing of valves, data-driven and inter-connectivity with industrial equipment are becoming an important driving force to promote the upgrading of the valve industry. The "Made in China 2025" policy provides a clear development direction and strong policy support for valve manufacturing enterprises. In addition, with the promotion of the global "carbon peak and carbon neutral" policy and the adjustment of the energy structure, the market demand of the new energy industry will maintain a high growth, which brings the corresponding market incremental space and profit growth space for the valve industry.

Over years of working experience in valve industry, I've observed the challenges Chinese valve companies face in international competition. With rapid technological advancements, boosting competitiveness has become crucial for companies aiming to establish and consolidate themselves globally. This inspired the topic of my dissertation. This study provides a fundamental framework for valve enterprises, offering strategies for improving efficiency, embracing technological advancements, and gaining a competitive edge in the global market. Meanwhile, each company can leverage its unique strengths to build differentiated core capabilities. Overall, it contributes to a broader understanding of global competitiveness and serves as a reference for industries aiming to innovate and expand internationally.

Objectives of the Study - This study analyzed the market competitive innovation, business intelligence application, and international market strategies in China's valve manufacturing industry. It identifies the key factors influencing global market competitiveness of China's valve enterprises. Specifically, this study determined the market competitive Innovation in terms of market research and analysis, use of e-commerce and online platform, and use of data-driven decision-making process; determined the business intelligence application in terms of procurement management, quality control management and customer relationship management; determined the international market strategies in terms of market analysis and selection, sales performance and evaluation and price strategy; tested the significant relationship among market competitive innovation, business intelligence application and market strategy; and finally , an integrated framework on global market competitiveness of China's valve enterprises was developed based from the findings of the study.

2. Methods

Research Design - Descriptive research design methods were used in this study to objectively and accurately interpret the findings. A descriptive research method is to objectively describe and summarize the

research object, and accurately explain the characteristics and relationships of the research object through quantitative research and statistical analysis. Based on the research purpose of seeking the competitive advantage of valve enterprises in the global market, the researchers described the relationship between three independent variables: market competition innovation, business intelligence application and international market strategy, and formed a questionnaire.

Participants of the Study - According to the statistics of the Valve Branch of China General Machinery Industry Association, there are more than 6,200 valve enterprises in China. The research includes 702 questionnaires from 14 valve enterprises choose from two representative and mature valve manufacturing areas in northern and southern China. The northern region is the valve manufacturing base of the *Tianjin, Hebei and Liaoning* province (6 valve companies). The southern region is the valve production base represented by *Shanghai, Jiangsu, and Fujian province* (8 valve companies). 55 questionnaires were distributed to each represented companies, and there are total 702 questionnaires were collected with 68 questionnaires been tailored off. The questionnaire was collected by "Questionnaire Star" chosen for its professionalism and efficiency. The participants are managers of the valve enterprise, foreign trade sales personnel, production, quality control, procurement management personnel. The type of participating companies is chosen from five aspects: the years of establishment of the company, the number of employees, the years of foreign trade operation, the percentage of foreign trade personnel and foreign trade sales in the total sales of the company.

Data Gathering Instruments - In the study, a self-designed questionnaire was used to collect data, and Likert 4 scales were used for measurement. The questionnaire consists of two parts: the profile of participants and questionnaire survey related to three groups of independent variables, which are market competitive innovation, business intelligence application and international market strategies. For market competitive innovation, there are three dimensions: market innovation, use of e-commerce platforms, and data-driven decision-making processes, totaling 16 questions. For business intelligence application, there are also three dimensions, focusing on business application in procurement, quality control and customer relationship management, with 15 questions in total. International market strategies encompass three dimensions as well, including market selection, sales performance evaluation, and price strategy, with a total of 14 questions. Each question is scored on a four-level scale: (4) Strongly Agree, (3)Agree, (2)Disagree, and (1)Strongly Disagree. The Cronbach's Alpha measurement value, calculated to test reliability, was above 0.70, indicating that the questionnaire is reliable and suitable for data collection. The general test result of data is as below:

Table A
Test of Reliability

Variable	No. of Items	Cronbach Alpha	Remarks
1. Market Competitive Innovation			
1A. Market Analysis and Research	5	0.792	Acceptable
1B. Use of E-Commerce and Online Platform	5	0.828	Good
1C. Use of Data Driven Decision Making Process	6	0.832	Good
2. Business Intelligence Application			
2A. Procurement Management	5	0.775	Acceptable
2B. Quality Control Management	5	0.710	Acceptable
2C. Customer Relationship Management	5	0.829	Good
3. International Market Strategies			
3A. Market Analysis and Selection	5	0.743	Acceptable
3B. Sales Performance Evaluation	6	0.748	Acceptable
3C. Price Strategy	7	0.776	Acceptable

George and Mallery (2003) provided the ff rule of thumb: ≥0.90 = Excellent; ≥0.80 = Good; ≥0.70 = Acceptable; ≥0.60 = Questionable; ≥0.50 = Poor; <0.50 = Unacceptable

Data Gathering Procedure - To design the questionnaire, the researchers began by reviewing relevant literature, including valve industry journals, online market reports and industry conference reports, meanwhile, conducting interviews with valve industry experts to gain insights. Based on this preliminary research, a draft questionnaire was developed and subsequently refined based on feedback from the adviser. A pretest was then conducted with 30 participants to assess the reliability of the questionnaire. The results show that Cronbach's

Alpha of all variables is greater than 0.7, demonstrating good reliability. Based on the predictive feedback, the content and language of the questionnaire were further optimized and the final draft was made. The final questionnaire was distributed through the online survey tool "Questionnaire Star", chosen for its professionalism and efficiency. After collection, the questionnaire was carefully reviewed and tailored to ensure data quality and accuracy.

Data Analysis - To this study, weighted mean and rank were used to 1. determine the Market Competitive Innovation in terms of market research and analysis, use of e-commerce and online platforms, and use in data-driven decision making process; 2. Determine business intelligence application in terms of procurement management, quality control management and customer relationship management; 3. Determine market strategies in terms of market analysis and selection, sales performance and evaluation, and price strategy. The result of the Shapiro-Wilk Test showed that p-values of all variables were less than 0.05 which means that the data set was not normally distributed. Therefore, Spearman rho was used as part of the non-parametric tests to determine the significant relationship. All analyses were performed using SPSS version 28.

Ethical Considerations - Ethical considerations will be practiced in the conduct of the research work to warrant that every information that was gathered are used for research purposes only to maintain the quality and integrity of the research. The researcher will also seek the consent of the related organizations through letter and communication to make sure that the target respondents will be prepared to answer necessary questions involved in the research. It also ensured the confidentiality and anonymity of the respondents by not seeking their names as they were answering the questionnaires. The researcher will also ensure that the respondents voluntarily answer the questionnaires according to their will. Lastly, it will also ensure that none of the respondents of the study will be hurt or harmed and their safety and security is of top priority.

3. Results and discussion

Table 1
Summary Table on Market Innovation

Key Result Areas	Composite Mean	VI	Rank
Market Research and Analysis	2.68	Agree	3
Use of E-commerce and Online Platform	2.69	Agree	2
Use in Data Driven Decision-Making Process	2.71	Agree	1
Grand Composite Mean	2.70	Agree	

Legend:3.50-4.00=Strongly Agree;2.50-3.49=Agree;1.50-2.49=Disagree;1.00-1.49=Strongly Disagree

This table summarizes three key result areas in market innovation, evaluating their respective composite means and their contribution to market competitiveness. The grand composite mean is 2.70, with a verbal interpretation of Agree, suggesting that respondents generally believe that the organization is effectively leveraging market innovation to enhance competitiveness.

The highest-ranked key result area is Use in Data-Driven Decision-Making Process, with a composite mean of 2.71 and a verbal interpretation of Agree**.** It indicates that data-driven decision-making plays an important role in valve enterprise decision-making. Data-driven decision making has many advantages. First, data-driven decision making improves decision accuracy and response speed. As the valve manufacturing industry involves complex production processes, supply chain management and customer needs, data-driven decision making greatly improves decision efficiency. By analyzing production data, companies can identify production bottlenecks and improve production efficiency. Through supply chain data analysis, companies can optimize inventory management and logistics arrangements, thereby reducing costs and increasing customer satisfaction. Second, data-driven decision making provides companies with foresight and predictability. In a competitive global market, companies use data analytics to predict customer needs, market trends, and identify potential risks to develop strategies. Research of Davenport et al. (2013) pointed out that after implementing data-driven AI technology, the productivity of enterprises increased by 20% on average and the prediction accuracy increased by 15%. In manufacturing, AI combined with data analytics has significantly enhanced supply chain forecasting

and market demand analysis, helping companies better predict market fluctuations and driving sales growth of up to 12%. Third, data-driven decision making increases flexibility in the application of new technologies. The valve industry continues to introduce new technologies, such as the Internet of Things, artificial intelligence, etc., through which companies are able to automate their data collection and analysis processes, reduce human error and improve efficiency. Therefore, the valve company has recognized the important role of data-driven decision-making and actively applied it to the business management to ensure the continuous innovation and efficient operation of the company in the global competition.

The middle-ranked key result area is Use of E-commerce and Online Platforms, with a composite mean of 2.69 and a verbal interpretation of Agree. The lowest-ranked key result area is Market Research and Analysis, with a composite mean of 2.68 and a verbal interpretation of Agree. Although this score is still positive, the low ranking indicates that the use of market research analysis to drive competitive innovation in the market is not obvious. Research by Chen et al. (2018) found that many companies face difficulties in collecting and interpreting complex market data, especially in the technology industry where customer needs are constantly changing. In order to leverage market research for market competitive innovation, companies shall actively foster a data-driven culture in the company, build a strong data collection and analysis infrastructure, promote cross-functional collaboration and integration, and bring in external market analysis experts or consultants when necessary to complement the limitations of internal perspectives.

In summary, table 1 highlights that data-driven decision making is the largest contributor to competitive innovation in the market, reflecting the important role of market research analysis in corporate strategic planning. Meanwhile, valve companies also recognize the value of e-commerce and online platforms, although it is moderate and needs to be improved. To address the gap in making full use of market research for innovation, companies should actively cultivate a digital culture to better leverage market research insights for innovation and enhance their market competitiveness and customer satisfaction.

Table 2
Summary Table on Business Intelligence Application

Key Result Areas	Composite Mean	VI	Rank
Procurement Management	2.72	Agree	1
Quality Control Management	2.70	Agree	2.5
Customer Relationship Management	2.70	Agree	2.5
Grand Composite Mean	2.71	Agree	

Legend:3.50-4.00=Strongly Agree;2.50-3.49=Agree;1.50-2.49=Disagree;1.00-1.49=Strongly Disagree

Table 2 wraps up how business intelligence is used in various areas including procurement, quality control, and customer relationship management. Overall, people tend to agree with its use, giving it an overall weighted average score of 2.71, all said Agree. In terms of procurement management, the application of business intelligence (BI) is highly recognized, which indicates that enterprises attach great importance to the use of BI technology to optimize supplier selection, procurement processes and cost management. The complexity of procurement management requires the analysis and real-time monitoring of large amounts of data, and BI tools play an important role in this regard, helping companies evaluate supplier performance, control procurement costs, and manage inventory levels to improve procurement efficiency and reduce supply chain risk.

Quality control management and customer relationship management have slightly lower BI scores (both 2.70) than procurement management (2.75), which may be mainly affected by insufficient data integrity, difficulties in system integration, and lack of professional talent. In quality control, BI tools may not be fully functional due to incomplete production data or incompatible systems with production processes. In customer relationship management, data silos and a lack of analytics talent limit the use of BI in customer behavior analysis and marketing optimization. These issues point to the need to improve data management, optimize system compatibility, and strengthen professional skills development to further enhance the effectiveness of BI tools in these areas.

Overall, table 2 shows that the application of BI in several business areas has achieved remarkable results, especially in procurement management. However, in quality control management and customer feedback analysis, enterprises also need to further enhance data integration capabilities and technical support to achieve more efficient business improvement.

Table 3
Summary Table on International Market Strategies

Key Result Areas	Composite Mean	VI	Rank
Market Analysis and Selection	2.69	Agree	1.5
Sales Performance and Evaluation	2.69	Agree	1.5
Price Strategy	2.67	Agree	3
Grand Composite Mean	2.68	Agree	

Legend:3.50-4.00=Strongly Agree;2.50-3.49=Agree;1.50-2.49=Disagree;1.00-1.49=Strongly Disagree

This table generally evaluates the implementation effect of the international market strategy based on market analysis, market performance evaluation and price strategy. The composite mean is 2.68, interpreted as agreement, indicating that respondents generally believe that these three factors promote the implementation of the international market strategy of enterprises to varying degrees.

Among them, the two categories of market analysis and sales performance evaluation tied for first place, with a composite mean of 2.69, agreed. It can be seen that effective market analysis and timely sales performance evaluation together help form an excellent international marketing strategy. For valve enterprises, market analysis based on advanced information technology tools is of great significance to international market development. Market research analysis helps enterprises to accurately locate the target market, obtain new product development strategies, and identify potential market risks. Wamba et al. (2020) emphasized that with BI support, enterprises can optimize market resource allocation and reduce market entry risks, thus significantly enhancing their competitiveness in the international market. In addition, timely evaluation of market performance helps optimize sales channels and reduce operational risks. With the help of modern information technology tools, enterprises can interpret market data more efficiently and adjust market investment strategies.

The indicator that ranks relatively low is price strategy, with a composite mean of 2.67, agreed. This shows that due to the complexity of different market conditions, enterprises face challenges in determining the optimal price of their products in the global market. Due to the diversified and complex international market demand, enterprises often find it difficult to balance the pricing of high-end and low-end products and lose market share, or due to the wrong forecast of market demand, the price is too high or too low, reducing profits. In addition, frequent exchange rate fluctuations will also affect the price of products in the target market and corporate profits.

In summary, table 3 shows that market analysis, sales performance evaluation and pricing strategies all contribute to enhancing a firm's competitiveness in the international market. However, while the first two indicators were considered more influential, pricing strategies scored slightly lower, indicating possible shortfalls in optimizing global pricing to accommodate different market conditions.

Table 4 presents the correlation between market competitive innovation and business intelligence (BI) application showing how these variables interact within the valve manufacturing industry. The results are evaluated using Spearman's rho correlation coefficient and p-values, all of which indicate highly significant relationships at the 0.01 level. There are three parts separately analyzing correlation ship among those variables. Part one is the correlation between market research and analysis and business intelligence application in procurement, quality control and customer relationship management. Part two is the correlation between usage of e-commerce and online platforms with business intelligence application in procurement, quality control and customer relationship management. And part three is the correlation between usage in data driven decision making process with business intelligence application in procurement, quality control and customer relationship management.

Table 4

Relationship Between Market Competitive Innovation and Business Intelligence Application

Variables	rho	p-value	Interpretation
Market Research and Analysis			
Procurement Management	0.842**	< .001	Highly Significant
Quality Control Management	0.862**	< .001	Highly Significant
Customer Relationship Management	0.854**	< .001	Highly Significant
Use of E-commerce and Online Platform			
Procurement Management	0.839**	< .001	Highly Significant
Quality Control Management	0.859**	< .001	Highly Significant
Customer Relationship Management	0.843**	< .001	Highly Significant
Use in Data Driven Decision Making Process			
Procurement Management	0.822**	< .001	Highly Significant
Quality Control Management	0.838**	< .001	Highly Significant
Customer Relationship Management	0.823**	< .001	Highly Significant

**. Correlation is significant at the 0.01 level

The correlation coefficient between Market Research and Quality Control Management is the highest, 0.862, also highly significant with a p-value < .001, indicating that the correlation is very strong and significant. It shows that when enterprises in the valve manufacturing industry enhance their market research capabilities, their quality control management will be significantly improved. This high correlation can be attributed to several factors: First, market responsiveness: Companies that excel in international market research can collect accurate customer feedback, market trends, and competitor analysis, allowing them to adjust their production processes to meet customer expectations. For example, understanding customer preferences for product durability, performance, or safety standards directly affects the quality control standards used in the manufacturing process. The second is proactive adjustment: Companies with a solid market research foundation often proactively adjust their quality control management mechanisms because they can predict changes in customer needs or quality requirements in different regions. This ability to respond quickly helps them implement corrective actions before quality problems arise, improving overall product quality. Integrating market research insights into enterprise quality management can help reduce the rate of product defects and product returns. Market research contributes to continuous improvement of the quality management system. By providing dynamic data, market research helps companies identify areas for improvement and closes the loop with the quality management system (TQM) for flexible adjustment and continuous improvement. In short, we can clearly see that market research can help enterprises make more accurate decisions in quality control, thereby improving product quality, reducing rework costs, and enhancing the market competitiveness of enterprises. Although the correlation coefficient between Market Research and Procurement Management is 0.842, with a p-value < .001, it is the lowest among all dimensions. The lower correlation can be explained by the fact that procurement management, while influenced by market insights, relies more on internal supply chain logistics, cost management, and supplier relationships than on direct market research. The main reasons may include the following three aspects:

First, supplier constraints: procurement management is usually more focused on ensuring supply chain stability, cost optimization and supplier relationship management, and these factors are mainly influenced by the supply chain itself and internal operational pressure, rather than direct market research. Although market research can provide some demand forecasting for procurement, in the actual procurement process, companies pay more attention to the delivery capacity of suppliers, raw material price fluctuations, and the optimization of contract terms than market trends. Second, there is often a time difference between the market research results and the procurement needs. We find that market research tends to reveal the best match between long-term supply and demand, while procurement management focuses more on short-term supply and cost issues. In the face of urgent material procurement, purchasing managers often rely on the existing suppliers rather than on market research forecasts. Research by Gao et. al.(2019) pointed out that in the case of urgent procurement demand, more than 70% of enterprises ignore market research data, choosing instead to rely on established supplier networks.

In addition, operational efficiency is also a key factor. Purchasing managers are often more focused on

purchasing efficiency and cost minimization than following market trends, which can mean that market research is of little reference value to purchasing decisions. Consider implementing procurement platforms that integrate real-time market research data that can highlight fluctuations in demand for valve raw materials in different regional markets and help purchasing managers dynamically regulate purchasing practices to make more informed purchasing decisions. The correlation coefficient between Market Research and Customer Relationship Management is in the middle, being 0.854, with a p-value < .001, showing another highly significant relationship. Simply, effective market research enables companies to better understand their customers' needs and preferences, tailor appropriate customer service strategies, and thus improve customer retention and loyalty. In short summary, the correlation between market research and quality control management based on business intelligence applications is strongest, suggesting that using customer feedback and market insight to adjust the production process leads to better quality results. However, the relatively low correlation with procurement management suggests that there is room for improvement in aligning procurement decisions with market dynamics. To optimize these two areas, companies should invest in cross-functional collaboration, advanced analytics, and integration platforms to apply market research insights in real time across all dimensions.

Part two is the correlation between usage of e-commerce and online platforms with business intelligence separately applied in procurement, quality control and customer relationship management. The correlation between E-commerce and Quality Control Management is 0.859, highest among others, and highly significant with a p-value <.001. This is because e-commerce platforms can provide real-time monitoring and data visualization to help companies track quality performance at every step, from production to delivery. E-commerce technology can quickly identify problems in production through real-time data integration and adjust quality control processes based on customer feedback. In addition, e-commerce platforms promote operational transparency, enabling every participant in the supply chain to have timely access to relevant data, which helps companies make more accurate quality management decisions.

However, the correlation coefficient between E-commerce and Procurement Management is relatively lowest, in 0.839, with a p-value <.001. This shows that although e-commerce platforms can optimize procurement management, they are slightly less relevant. The reason for this is that procurement management relies more on supply chain stability and price fluctuation control, rather than market - or platform-driven demand fluctuations. Procurement decisions often take into account suppliers' ability to supply and cost control, and these factors are not always directly influenced by e-commerce platform data. E-commerce can improve the automation and efficiency of the procurement process, but its impact is relatively limited in core aspects such as supplier selection and contract negotiation. Deeper integration of e-commerce platforms with supply chain management systems enables purchasing management to make purchasing decisions not only based on historical supplier data, but also with real-time reference to changes in market demand and inventory levels. At the same time, an intelligent procurement decision-making system based on big data is introduced to automatically analyze market trends, supply chain dynamics and customer needs, thereby improving the accuracy and response speed of procurement decisions.

The correlation between e-commerce platform and customer relationship management is moderate (middle, correlation: 0.843, p-value <.001), lower than quality control, higher than procurement, mainly because e-commerce platform provides convenient communication channels, enabling enterprises to respond to customer needs and feedback in real time, and improve customer service level. In short, e-commerce platforms have the highest impact on quality control management because of their ability to provide real-time monitoring and feedback mechanisms, while the impact on procurement management is relatively low, mainly because procurement decisions are more dependent on supply chain and cost management. Enterprises can further optimize the effectiveness of both aspects of management by integrating data and introducing intelligent systems.

Part three is the correlation between usage in data driven decision making processes with business intelligence separately applied in procurement, quality control and customer relationship management. The

results show that the correlation between data-driven decision making and quality management is the highest, which is 0.838, highly significant, $p < 0.001$. This shows that data-driven decision making plays the most significant role in valve quality control management. First, the application of business intelligence tools in the valve quality management system helps to detect quality problems early. For example, when the processing parameters of the valve machining line deviate from the standard, BI tools can quickly sound an alarm to ensure that the problem is solved at an early stage and reduce production losses. Second, data-driven root cause analysis of quality problems helps organizations prevent potential quality problems. BI tools through big data analysis can quickly locate the root cause of quality problems and recommend corresponding corrective measures, which helps enterprises to establish a mechanism for eliminating quality problems in advance.

The correlation between data-driven decision making and procurement management was the lowest (0.822, $p < 0.001$). This shows that while data-driven decision making is good for procurement management, there are still shortcomings. This may be because the procurement management of valve enterprises is more subject to external factors such as the relationship with suppliers, supply chain risks, exchange rate risks and price fluctuations. Due to the complex supplier network of valve enterprises, long-term cooperation suppliers can provide more reliable and stable products. Therefore, even if data-driven purchasing decisions can optimize procurement costs, long-term stable supplier relationships are still an important consideration for purchasing departments. At the same time, while information technology can help companies anticipate procurement needs, it is powerless when supply chains are suddenly at risk of disruption. For example, affected by regional wars, the international transportation of a certain raw material is blocked, so the enterprise is forced to purchase from alternative domestic suppliers at a higher price.

The role of data-driven decision-making in CRM is relatively significant (0.823, $p < .001$). This shows that data-driven decision making can help improve customer relationships. Generally, data-driven decision making has the greatest impact on quality control management, mainly due to the critical role of real-time data analysis capabilities of BI tools in production quality optimization. Procurement management is less relevant as it relies more on supplier relationships and external market fluctuations. To optimize data-driven decisions in purchasing management, companies can introduce supply chain resilience analysis tools. Customer relationship management is highly relevant to improve customer interaction and enhance personalized service through BI tools. In summary, the highly significant relationship between market competitive innovation and BI application across all three dimensions, but the depth of the impact varies across different dimensions. Market research, e-commerce platform operations and data-driven decision-making are all highest related to quality control management. These findings highlight the critical role of business intelligence technologies in enhancing quality control, procurement, and customer relationship management in the valve manufacturing industry.

Table 5
Relationship Between Market Innovation and International Marketing Strategies

Variables	rho	p-value	Interpretation
Market Research and Analysis			
Market Selection	0.853**	< .001	Highly Significant
Sales Performance and Evaluation	0.854**	< .001	Highly Significant
Price Strategy	0.833**	< .001	Highly Significant
Use of E-commerce and Online Platform			
Market Selection	0.852**	< .001	Highly Significant
Sales Performance and Evaluation	0.864**	< .001	Highly Significant
Price Strategy	0.828**	< .001	Highly Significant
Use in Data Driven Decision Making Process			
Market Selection	0.836**	< .001	Highly Significant
Sales Performance and Evaluation	0.841**	< .001	Highly Significant
Price Strategy	0.812**	< .001	Highly Significant

**. Correlation is significant at the 0.01 level

Table 5 shows the correlation between various aspects of market innovation and international marketing strategies in the valve manufacturing industry. The results are assessed using Spearman's rho correlation coefficient and p-values, all of which indicate highly significant relationships at the 0.01 level. There are three

parts separately analyzing correlation among those variables. Part one is the correlation between market research and international marketing strategies in terms of market selection, sales performance and evaluation, and price strategy. Part two is the correlation between usage of e-commerce and online platforms with international marketing strategies in terms of market selection, sales performance and evaluation, and price strategy. And part three is the correlation between usage in data driven decision making processes with international marketing strategies in terms of market selection, sales performance and evaluation, and price strategy.

Part one shows the relationship between market research and market sales performance, with the rho value 0.854, ranking the highest, and p value <.001, being significantly. It can be seen that accurate and timely market research is helpful to improve the sales performance of enterprises. As the saying goes, good preparation is half the battle. Through market research, enterprises can objectively and deeply understand the market demand, consumer habits and market competition environment of different countries and regions, so as to adopt appropriate market development mode and improve market sales performance. Chaffey et. al.(2020) pointed out that market analysis provides the sales team with key market intelligence, which helps the company to seize the new market and new opportunities faster, and promotes the fulfillment of sales orders. The research found that those enterprises that carry out market research work for a long time, Sales in international markets have increased by an average of 12% per year, higher than the average sales growth. In addition, market research can help enterprises avoid international market risks and reduce losses. In-depth market research can help enterprises identify high risks, such as natural disasters, geopolitics, exchange rate fluctuations, etc., and take measures to avoid them in advance.

The correlation coefficient between Market Research and Price Strategy is 0.833, being lowest, with a p-value < .001. It indicated that market research is normally helpful to pricing strategy. This may be because pricing strategies are affected by a variety of external factors, such as production costs, exchange rate fluctuations, and changes in international conditions. Especially in countries with large exchange rate fluctuations, enterprises are more inclined to adjust pricing dynamically. Market research can help enterprises understand the pricing strategy of competitors and the elasticity of market demand, but it cannot fully predict the impact of external economic conditions and emergencies on pricing, so the direct effect of market research on pricing strategy is limited. In the global market, 80% of enterprises believe that market research is of limited help to pricing, because market fluctuations and uncontrollable factors of cost have a more direct impact on pricing. In this regard, enterprises can consider introducing real-time pricing mechanisms based on market dynamics and flexibly adjust prices according to changes in the external economic environment. At the same time, we develop cost-driven pricing models to ensure timely response to cost and market changes in a highly competitive international market. The correlation coefficient between Market Research and Market Selection is 0.853, with a p-value <.001. It shows that enterprises can reduce the uncertainty of international market entry through systematic market research. Market analysis provides companies with a deep insight into the target market, including the economic environment, cultural factors and consumer behavior, which helps companies assess the potential of the market and the opportunity to enter.

Part two is the correlation between the use of e-commerce platforms with international marketing strategy. The correlation between Use of E-commerce and Sales Performance and Evaluation ranked highest in 0.864, with a p-value < .001, being highly significant. It shows that by using e-commerce platforms, enterprises can greatly improve the sales performance in the global market. E-commerce and online platforms provide companies with real-time market feedback, which can help sales teams quickly adjust strategies, improve market response speed, and improve sales performance.

The correlation between Use of E-commerce and Online Platform and Price Strategy is lowest in 0.828, with a p-value < .001, still showing a highly significant relationship. It shows that in the complex and changeable international market, although e-commerce platforms provide enterprises with a large amount of market information, price strategies are often affected by a variety of external factors, such as tariffs and international trade policies, exchange rate fluctuations, raw material cost fluctuations, etc., making the role of e-commerce

platforms relatively small. According to Grewal et al. (2019), enterprises that utilize e-commerce for price analysis have a 12% higher success rate of sales rate in new markets and are able to better locate high-potential markets. In general, import duties, consumption taxes, and various subsidy policies in different countries will affect the final price of the product.

In addition, exchange rate fluctuations are another key external factor in international markets, which directly affect commodity pricing and profits. When the exchange rate fluctuates sharply, the enterprises of the exporting country may raise the price to maintain the profit due to the depreciation of the exchange rate; otherwise, they may lower the price to maintain the competitiveness. The impact of such exchange rate fluctuations on prices is beyond the control of online platforms. Further, affected by international geopolitical events, natural disasters or economic fluctuations, raw material prices, labor costs and transportation costs in the international market will fluctuate greatly. For example, a sudden increase in the price of raw materials or an increase in transportation expenses can cause a change in the cost structure of the enterprise, forcing the enterprise to adjust the price. The unpredictability of such cost fluctuations is often beyond the coverage of market feedback provided by online platforms, so companies cannot rely solely on data on e-commerce platforms when setting prices, but also need to combine actual cost information.

In summary, e-commerce and online platforms have significant positive effects on the three dimensions of international marketing strategy, especially on sales performance (correlation 0.864). Through real-time data and personalized marketing strategies of online platforms, enterprises can improve sales conversion rate and market response speed. The correlation of market selection is second (0.852). E-commerce provides a large amount of market data support to help enterprises better select and position the market. The price strategy has the lowest correlation (0.828), because it is heavily influenced by external economic factors, and the direct role of online platforms on its decision-making is limited. To optimize pricing strategies, companies can combine real-time market feedback and cost analysis to implement intelligent pricing systems to improve competitiveness.

Part three is the correlation between usage in data driven decision making processes with international marketing strategies in terms of market selection, sales performance and evaluation, and price strategy. The correlation between Use in Data-Driven Decision-Making and Sales Performance and Evaluation is 0.841, the highest rank, with a p-value < .001, also highly significant. It shows that data-driven decision making is highly correlated with sales performance. Through business intelligence tools and big data analytics, companies can effectively optimize sales strategies and improve sales performance in international markets.

The correlation between Use in Data-Driven Decision-Making and Price Strategy is lowest evaluated in 0.812, with a p-value < .001, showing a highly significant relationship. This suggests that while data-driven decision-making plays an important role in modern market strategies, its relevance in pricing strategies is relatively low. The reason may be the unpredictability of the external economy and the complexity of the international competitive environment. Pricing strategies in international markets are subject to many external economic factors, such as production costs, exchange rate fluctuations, inflation, tariff policies and raw material prices. While data-driven decision-making can provide businesses with insight into market demand, competitor pricing, and customers' ability to pay, these tools cannot fully predict or control external economic factors. In addition, while BI tools can provide companies with pricing information from competitors, the complex and changing international market environment makes it necessary to maintain flexibility in pricing strategies. Competitors may engage in short-term promotions, discounts, price wars, etc., and sudden changes in these strategies may not be captured by the data model in a timely manner.

The correlation between Use in Data-Driven Decision-Making and Market Selection is 0.836, moderately ranking, with a p-value < .001, indicating a highly significant relationship. It shows that data-driven decision-making provides enterprises with more market intelligence, allowing enterprises to assess the economic conditions, consumer demand and competitive intensity of the target market through quantitative indicators. In summary, market innovation, particularly in the areas of market research, e-commerce and data-driven

decision-making, has a very significant impact on international market strategy. These relationships highlight the critical role that business intelligence technologies play in improving market selection, sales performance and pricing strategies, ultimately helping to increase a company's competitive advantage in international markets.

Table 6
Relationship Between Business Intelligence Application and International Marketing Strategies

Variables	rho	p-value	Interpretation
Procurement Management			
Market Analysis and Selection	0.817**	< .001	Highly Significant
Sales Performance and Evaluation	0.832**	< .001	Highly Significant
Price Strategy	0.826**	< .001	Highly Significant
Quality Control Management			
Market Analysis and Selection	0.838**	< .001	Highly Significant
Sales Performance and Evaluation	0.856**	< .001	Highly Significant
Price Strategy	0.842**	< .001	Highly Significant
Customer Relationship Management			
Market Analysis and Selection	0.827**	< .001	Highly Significant
Sales Performance and Evaluation	0.841**	< .001	Highly Significant
Price Strategy	0.830**	< .001	Highly Significant

**. Correlation is significant at the 0.01 level

This table presents the correlation between different dimensions of business intelligence (BI) application and international marketing strategies in the valve manufacturing industry. The relationships are evaluated using Spearman's rho correlation coefficient and p-values, all of which are significant at the 0.01 level. There are three parts separately analyzing correlation ship among those variables. Part one is the correlation between procurement management and international marketing strategies in terms of market selection, sales performance and evaluation, and price strategy. Part two is the correlation between quality control management and international marketing strategies in terms of market selection, sales performance and evaluation, and price strategy. And part three is the correlation between customer relationship and international marketing strategy including market selection, sales performance and evaluation, and price strategy.

Part one indicates the correlation between Procurement Management and Sales Performance and Evaluation. The correlation coefficient is 0.832, ranked highest, with a p-value < .001, highly significant. This shows that the sales performance of enterprises in the global market is directly related to the optimization of procurement management. The responsibility of enterprise procurement management is to ensure production supply, control costs and improve market response speed. The smooth supply chain ensures the timely delivery of products and improves the collection efficiency of sales orders. Especially in the international market competition, the ability of fast delivery for enterprises to win market opportunities, enhance the market competitiveness of enterprises. On the contrary, if there is a delay in procurement management or supply shortage, it will not only affect the production and sales of the enterprise, but also may lead to customer loss and sales decline.

The correlation between procurement management and Market Analysis and Selection is lowest rated in 0.817, with a p-value < .001. Although the relationship between procurement management and market analysis and selection is still highly significant, the correlation between the two is lower than that with other sub-variables of international marketing strategy. This may be due to their different focus areas. The market selection process mainly relies on the enterprise's market research, industry trend analysis, cultural understanding and demand assessment, and the determinants of these aspects having little relationship with the actual operation process of the procurement supply chain. Although procurement management affects a firm's cost structure and supply chain flexibility once it enters a new market, it only plays an indirect role in the initial stage of market selection. Procurement decisions are often based on global factors such as supplier networks, costs, and logistics, which have less influence on decisions about specific market choices. When enterprises choose new international markets, the global layout of procurement management is usually fixed, and procurement decisions will not be significantly adjusted according to the specific conditions of the single market, which further weakens the role of procurement management in market selection. In general, procurement management plays a greater role in the execution phase after a company enters a new market, but only indirectly

in the market selection and evaluation phase.

The correlation between procurement management and Price Strategy is 0.826, raking moderately, with a p-value < .001. Although the correlation between purchasing management and pricing strategy is not as high as sales performance, it is still significant. Procurement management plays a key role in controlling the cost of raw materials, thereby enabling companies to gain greater flexibility and competitive advantage on prices.

Part two is the correlation between quality control management and international marketing strategies in terms of market selection, sales performance and evaluation, and price strategy. The correlation between Quality Control Management and Sales Performance and Evaluation is 0.856, ranking highest among others, with a p-value < .001, showing a highly significant relationship. It shows that the sales performance of valve enterprises in the international market is directly affected by their quality management system. In the global market, the durability, safety and compliance of valve products are of Paramount importance. High quality valve products can not only increase the trust of customers, but also improve the repeat purchase rate. At the same time, a comprehensive quality management system can help valve companies ensure the consistency of products in the production process, reduce product defects, and ensure that products meet international standards (such as ISO, API, etc.). Especially in the fields of oil, natural gas, nuclear energy, etc., customers have extremely high requirements for valve quality, and the company's quality reputation directly affects customers' purchasing decisions.

The correlation between Quality Control Management and Market Analysis and Selection is lowest in 0.838, with a p-value < .001. It shows that although quality control is critical to the success of valve companies in the market, the role of quality management is more indirect and limited in the initial stage of market selection. When a company decides to enter a new market, the market potential, the policy environment and the competitive situation are the top priority factors, and the role of quality control is mainly reflected in the subsequent product execution and operation. Zhang et al. (2020)'s research showed that in the early stage of entering a new market, more than 60% of enterprises prioritize market capacity, growth potential and legal environment, and only adjust their quality management system for quality standards and compliance requirements after entering the market. This difference in time has resulted in a more limited role for quality control management in the market analysis and selection stage.

The correlation between Quality Control Management and Price Strategy is 0.842, ranking moderately, with a p-value < .001. For valve companies, quality control management not only affects sales, but also has an impact on pricing strategy by reducing production and operating costs.

Part three is the correlation between customer relationship and international marketing strategies in terms of market selection, sales performance and evaluation, and price strategy. The correlation between Customer Relationship Management and Sales Performance and Evaluation is 0.841, ranking highest , with a p-value < .001, indicating a highly significant relationship. Clearly, the core function of a customer management system is to enhance the customer experience by managing and optimizing customer relationships, thereby boosting sales performance. In the international market, the valve demand of different countries and regions varies greatly, and the customer management system can be segmented according to customer data to develop personalized marketing strategies, thereby increasing the purchase conversion rate. In addition, customer relationship management systems can optimize the sales process and enhance customer interaction. Through a unified customer database, sales teams can access customer information in real time, analyze customer needs, historical transactions and communication records, and better develop follow-up plans.

The correlation between customer relationship management and market selection is 0.827, which is relatively the lowest, with a p value of < 0.001, still highly correlated. It may be because CRM systems focus primarily on the maintenance of existing customers, while marketing options focus more on potential markets. The data of the customer management system is only the internal historical data of the existing customers, and the market selection requires external data such as future industry dynamics and competitive development trends.

In addition, market selection also requires further comprehensive assessment of the geographical location, economic development level and cultural differences of the target market, which have limited support from the customer relationship management system.

The correlation between Customer Relationship Management and Price Strategy is 0.830, with a p-value < .001. The impact of CRM system on pricing strategy is mainly reflected in helping enterprises to understand customers' sensitivity to price and willingness to pay through customer data analysis, and ensure the most appropriate pricing in different markets. Generally, table 6 shows that the scenarios in which business intelligence is applied to enterprise procurement management, quality control management and customer relationship management are highly correlated with various international marketing strategies. These findings highlight the critical role that business intelligence plays in enhancing market selection, sales performance evaluation, and pricing strategies, ultimately helping to enhance a company's global competitive advantage.

A cohesive global market competitive advantage framework, as below, was finally formed, encompassing market competitive innovation, business intelligence application, and international market strategy. Among them, market competition innovation provides market data support for business intelligence applications, and business intelligence applications promote enterprises to specify excellent international market strategies. In turn, the effective implementation of the international market strategy provides feedback for market innovation, while supporting the improvement of business intelligence and continuous innovation. These three variables form a closed loop, from innovation to management to market strategy, and together they form a stable framework that ensures a sustained competitive advantage in the global marketplace.
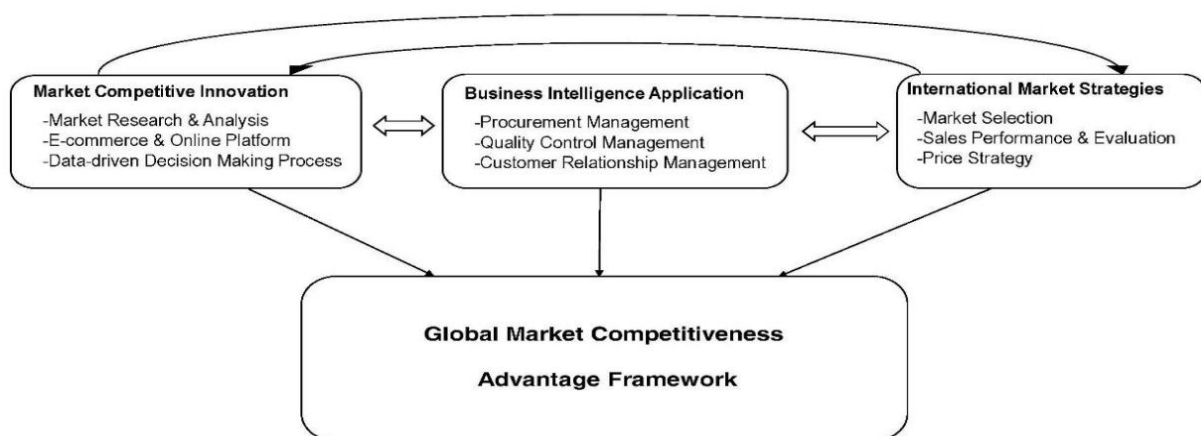

Figure 1.: Global Market Competitiveness Advantage Framework

4. Conclusions and recommendations

The research result shows that market competitive innovation effectively promotes market research and analysis; e-commerce opens new market channels for enterprises; and data-driven decision making significantly improves the operational efficiency of enterprises. Research results show that the application of business intelligence in procurement, quality control and customer relationship management has further improved the efficiency and competitiveness of enterprises. Research results show that market selection, sales performance evaluation and pricing strategies in international marketing strategies significantly enhance the market insight and market share of firms. The survey analysis shows that there is a significant positive correlation between market competitive innovation, business intelligence application and international market strategy, which together promote the competitive advantage of enterprises in the global market. Finally, a framework of global competitive advantage was formed.

Market operation teams may establish intelligent customer co-creation hubs based on e-commerce platforms, engaging key customers in product design to drive innovation and enhance R&D efficiency and competitiveness. Senior leaders could leverage business intelligence to develop a sustainable supply chain management system that tracks carbon emissions and enhances green manufacturing processes. The market strategy team may establish regional market service centers in key international markets to provide localized products and services while gathering feedback to refine product design and marketing strategies, boosting market penetration and customer satisfaction. A framework has been developed for valve enterprises to enhance their global market competitiveness, while each company can leverage its unique strengths to build differentiated core capabilities. Given that Chinese valve companies occupy mid-to-low-end positions in the global market, valve enterprises should focus on advancing high-end valve technologies and strengthening independent brand development to enhance their core competitiveness.

5. References

Chaffey, D., & Ellis-Chadwick, F. (2020). Digital Marketing: Strategy, Implementation and Practice. Pearson.

Chen Guoqing, Wu Gang, Gu Yuandong, Lu Benjiang & Wei Qiang.(2018). Big data-driven research and application challenges in the context of management decision-making: Paradigm shift and research direction. Journal of Management Science (07),1-10.

Davenport, T. H., & Dyché, J. (2013). Big data in big companies. International Institute for Analytics, 3(2), 1-31.

Gao, H., & Sun, Z. (2019). Short-Term Procurement vs. Long-Term Market Insights: A Supply Chain Perspective. *International Journal of Production Research*, 57(10), 3182-3195. DOI: 10.1080/00207543.2018.1530462.

Grewal, D., & Levy, M. (2019). Marketing (7th ed.). McGraw-Hill Education.

Mohapatra, S., & Patra, D. (2017). Retaining competitive advantage in commodities. Emerald Emerging Markets Case Studies,7(4), 1–25.https://doi.org/10.1108/EEMCS-06-2016-0111

Nguyen, B., Melewar, T. C., & Kumar, S. (2021). Data visualization in business decision making: Exploring cognitive load and effectiveness. *Journal of Business Analytics,* 4(1), 56-71.

Tang, G., & Mai, H. (2022). How does manufacturing intelligentization influence innovation in China from a nonlinear perspective and economic servitization background? Sustainability, 14(21), 14032. https://doi.org/10.3390/su142114032

Tseng, M. L., Lim, M. K., & Wu, K. J. (2022). Enabling IT in market intelligence for organizational success. Industrial Marketing Management, 102, 76-89.

Wamba, S. F., Akter, S., & Ren, S. (2020). Customer Relationship Management in the Age of Big Data: BI's Role in Enhancing Customer Engagement. *Journal of Business Research*, 121, 59-69. DOI: 10.1016/j.jbusres.2020.07.006.

Zhang, L., Wei, W., & Chen, X. (2020). The impact of e-commerce on international market entry and sales performance. *Journal of International Marketing,* 28(3), 56-71.