International Risk Management

Group 9

When vision Takes Flight, Success Takes Root

MSc program

Businees Intelligence

BDEEM

Besançon

2025

Team Members:

Kartick Kushwaha

Infantia Joseph

Mane Khosrovyan

Chidinma Ukandu

Table of Contents

List of Figures

List of Tables

Introduction

In this report, we have chosen **Chart Industries**, a leading global giant in the manufacturing of **vacuum insulated piping (VIP)** systems. Chart Industries specializes in delivering innovative and efficient cryogenic solutions across various sectors, including **energy, industrial gases, and healthcare**. The company operates in **169 countries**, providing high-quality products such as storage tanks and vacuum insulated pipes.

Our group has focused on the topic **"Purchase of Steel in Euros for VIP,"** examining the procurement process of stainless steelan essential material in the production of vacuum insulated pipes due to its excellent resistance to corrosion and performance in low-temperature environments.

This report aims to explore several critical aspects, including:

- **Market Growth Analysis of the VIP Industry**
  Understanding the current trends and future growth potential of the VIP market, with a focus on market projections and key growth drivers.
- **Identification of Potential Stainless Steel Suppliers**
  Evaluating major stainless steel suppliers and their market share, considering their capabilities and role in VIP manufacturing.
- **Volatility of Stainless Steel Prices**
  Analyzing price fluctuations from 2021 onwards, identifying key factors influencing volatility and their impact on procurement strategies.
- **Risk Identification Main Causes and Consequences**
  Identifying potential risks associated with stainless steel procurement, such as supply chain disruptions, regulatory challenges, and currency fluctuations.
- **Internal and External Strategies**
  Exploring various strategies, including supplier diversification, financial hedging, inventory optimization, and risk management techniques to ensure a stable supply chain.
- **Case Study Implementation**

Applying these strategies in a real-world procurement scenario to assess their effectiveness in achieving cost stability and operational resilience.

Through this report, we aim to provide **valuable insights and strategic recommendations** to enhance Chart Industries' procurement processes, ensuring **operational efficiency and financial stability** in the dynamic VIP market.

1. Chapter: 1

1.1 About Chart Industries

Chart Industries is a globally recognized leader in the design and manufacturing of cryogenic equipment, specializing in the handling of gases such as LNG, hydrogen, oxygen, and nitrogen. With a presence in over 169 countries, the company provides advanced engineering solutions for industries such as energy, healthcare, food and beverage, and aerospace.

Figure 1. Chart Industries

Chart Industries offers a wide range of products, including vacuum insulated piping (VIP) systems, storage tanks, and cryogenic distribution equipment, ensuring efficient and reliable management of liquefied gases in various applications. The company is known for its commitment to innovation, sustainability, and operational excellence, making it a trusted partner for businesses worldwide.

1.2 Vacuum insulated piping (VIP

The vacuum insulated piping (VIP) solutions provided by Chart Industries are designed to minimize heat loss and ensure the efficient transfer of cryogenic liquids over long distances.

Stainless steel is the primary material used in VIP systems due to its exceptional durability and corrosion resistance in extreme low-temperature environments. Chart Industries continues to expand its global footprint by investing in advanced manufacturing technologies and strategic partnerships, ensuring it remains at the forefront of the cryogenic equipment market. With a strong focus on quality, safety, and customer satisfaction, Chart Industries plays a crucial role in supporting the transition to cleaner energy solutions such as LNG and hydrogen.

Figure 2. Vaccum Insulated Pipe

1.3 Stainless Steel Suppliers

In this report, we have identified several key suppliers in the stainless steel industry that play a significant role in the production of vacuum insulated piping (VIP) systems. Stainless steel is a crucial material due to its excellent resistance to corrosion and superior performance in extreme low-temperature environments, making it ideal for cryogenic applications. Our group has focused on evaluating major suppliers such as **Baosteel (China)**, **Jindal Stainless (India)**, **Thyssenkrupp (Germany)**, **North American Stainless (USA)**, and **Outokumpu (Finland)**. These companies have established themselves as leaders in the stainless steel market, each offering specialized products catering to industrial and cryogenic needs.

Key Stainless Steel Suppliers

- **Baosteel (China):**
  - Holds a significant share of the global stainless steel market.
  - Benefits from China's dominance in steel production, which accounts for nearly **50-55%** of the global market.
- **Jindal Stainless (India):**
  - Indias largest stainless steel producer.
  - Expanding its market share due to growing domestic demand.
  - Projected annual growth rate of **7.9%**.
- **Thyssenkrupp (Germany):**
  - Known for providing high-quality, corrosion-resistant, and cryogenic-grade stainless steel solutions.
  - Primarily caters to European and global markets.
- **North American Stainless (USA):**
  - A major supplier of high-grade **304 and 316** stainless steel.
  - Ensures consistent quality and reliability for industrial pipelines.
- **Outokumpu (Finland):**
  - A global leader specializing in high-grade stainless steel, particularly grades **304, 316, and 321**.
  - Strong presence in both European and international markets.

1.4 VIP Market Research

The Vacuum Insulated Pipe (VIP) market is projected to experience significant growth over the next decade. According to market forecasts, the market value is expected to increase from **$1.2 billion in 2024** to **$2 billion by 2034**, reflecting a compound annual growth rate (CAGR) of **5.1%** during the forecast period of next 10 years.

Figure 3. Market Research

The VIP market consists of various segments, with the **standard vacuum segment** projected to exceed **$1 billion** by 2034. Meanwhile, the **cryogenic vacuum segment** is forecasted to grow at a CAGR of **4.5%**, indicating steady demand across industries requiring cryogenic applications.

Vacuum Insulated Pipe Market Analysis	
Market Statistics	■ **Market Value (2024):** $1.2 billion. ■ **Market Value (2034):** Expected to reach $2 billion. ■ **CAGR (2025-2034):** Estimated at 5.1%.
Segment Statistics	■ **Standard Vacuum Segment:** Projected to exceed $1 billion by 2034. ■ **Cryogenic Vacuum Segment CAGR:** Expected growth rate of 4.5%.

Table 1. VIP Market Growth Overview

The robust growth of the VIP market is attributed to the increasing demand for energy-efficient solutions, advancements in cryogenic technology, and the expanding applications across industries such as energy, healthcare, and industrial gases. The market is expected to witness sustained investments in infrastructure development and technological innovation, further driving its expansion.

1.5 Volatility of Stainless Steel Prices

From the data, it is evident that stainless steel prices have experienced significant fluctuations over the past few years. As of **March 2024**, prices have returned to levels similar to **April 2021**, indicating a cycle of sharp increases followed by gradual stabilization. However, a notable price spike occurred in mid-2022, reaching a peak of **$5,566/MT in June 2022**, followed by a steady decline. Several global economic and geopolitical factors contributed to this volatility.

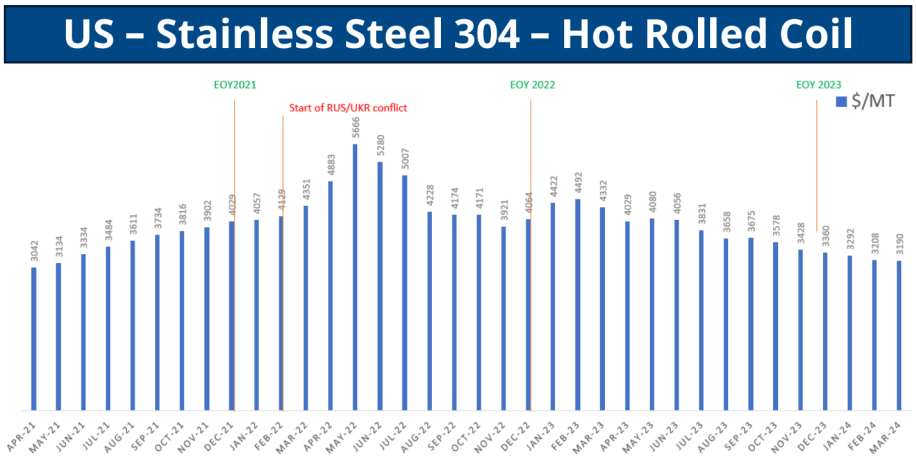

Figure 4. Stainless Steel Price Volatility Analysis

Analysis of the Causes of Volatility

1. Global Economic Factors

- **COVID-19 Disruptions:**
  - Lockdowns led to reduced mining and production, resulting in raw material shortages.
  - Freight costs surged due to shipping delays, increasing overall demand and pushing prices higher.
- **Post-Pandemic Recovery:**
  - As industries resumed operations in 2021, there was a surge in demand, leading to a sharp increase in prices.

2. Raw Material Costs

- **Nickel Volatility:**
  - Speculative trading and supply constraints caused dramatic price spikes, notably during the **2022 LME nickel crisis**, which significantly affected stainless steel production costs.
- **Chromium and Iron:**
  - Demand fluctuations in key sectors such as construction and automotive industries contributed to market instability and influenced pricing trends.

3. Regional Differences

- **North America:**
  - The region's reliance on imports and fragmented supply chains resulted in greater exposure to price fluctuations, making prices more volatile.
- **Asia:**
  - Government interventions and localized supply chains helped maintain relatively stable prices, offering a buffer against global supply disruptions.

4. Geopolitical and Policy Issues

- **Trade Restrictions:**
  - U.S. tariffs on imported steel and Chinas export controls disrupted global market balances, creating supply-demand mismatches and causing price surges.
- **Sanctions:**
  - Economic sanctions on key raw material suppliers further limited availability.

2. Risks, Main Causes, Internal & External Strategies

2.1 Identification of Risks, Main Causes, and Main Consequences

Understanding and managing risks is crucial for businesses operating in volatile markets. This section outlines key risk categories, their root causes, and potential consequences to help organizations mitigate financial and operational challenges effectively.

2.1.1 Exchange Rate Risk

Main Cause:

- Fluctuations in currency values due to global economic changes, inflation, interest rates, and speculative trading in foreign exchange markets.

Main Consequences:

1. Increased procurement costs leading to financial losses.
2. Budget uncertainty affecting financial planning.
3. Reduced profit margins due to unfavorable exchange rates.

2.1.2 Price Volatility Risk

Main Cause:

- Changes in demand and supply, speculative activities, and geopolitical factors influencing raw material (nickel, chromium) prices.

Main Consequences:

1. Unexpected cost fluctuations impacting profitability.

2. Need for constant price renegotiations with suppliers.
3. Difficulty in maintaining stable product pricing for customers.

2.1.3 Supply Chain Disruption Risk

Main Cause:

- Transportation delays, port congestion, supplier reliability issues, and geopolitical tensions.

Main Consequences:

1. Delayed deliveries leading to production halts.
2. Loss of customer trust due to delivery failures.
3. Increased operational inefficiency and missed deadlines.

2.1.4 Regulatory and Geopolitical Risk

Main Cause:

- Tariffs, sanctions, export restrictions, and environmental regulations affecting international trade.

Main Consequences:

1. Increased procurement costs due to imposed duties and tariffs.
2. Compliance challenges leading to operational delays.
3. Limited supplier options leading to sourcing difficulties.

2.1.5 Operational Risk

Main Cause:

- Inefficient procurement processes, inaccurate forecasting, and dependency on manual

operations.

Main Consequences:

1. Cash flow problems due to inefficient stock management.
2. Overstocking or understocking leading to financial losses.
3. Reduced operational efficiency and increased lead times.

2.2 Procurement Strategies

In this section, we have outlined the **top five internal and external strategies** that can help **Chart Industries** optimize its procurement processes and position itself as a leader in the industry. These strategies aim to enhance cost efficiency, mitigate risks, and ensure a stable supply chain in an increasingly volatile market.

Internal Strategies

The internal strategies focus on improving procurement efficiency through diversification, cost control, and operational adaptability:

1. **Supply Diversification**
   - **Why:** To reduce dependency on a single supplier or region.
   - **How:** Source 50% of materials from Asia for stability and 50% from North America for quality assurance.
   - **Benefit:** Balances risks associated with regional volatility and ensures a consistent supply.
2. **Inventory Management**
   - **Why:** Prevents over- or under-stocking, which can disrupt cash flow during volatile periods.
   - **How:** Utilize predictive analytics to maintain buffer stocks for price peaks and implement Just-in-Time (JIT) systems to improve efficiency.
3. **Long-Term Fixed-Price Contracts**
   - **Why:** Stabilizes procurement costs over an extended period.

- **How:** Negotiating agreements with suppliers at fixed prices to ensure cost predictability.

4. **Operational Flexibility**
   - **Why:** Reduces reliance on stainless steel during market volatility.
   - **How:** Investing in alternative materials such as aluminum for non-critical applications.

External Strategies

The external strategies provide financial protection and risk-sharing mechanisms through market instruments and collaborative agreements:

1. **Futures Contracts**
   - **What:** Lock in prices for future delivery to avoid market fluctuations.
   - **Example:** A futures contract at 6,500 USD/tonne shields against potential surges to 7,500 USD/tonne.
2. **Options Contracts**
   - **What:** Provide the right, but not the obligation, to buy at a predetermined price.
   - **Example:** A call option at 6,700 USD/tonne offers flexibility for demand surges.
3. **Currency Hedging**
   - **Why:** Multi-region sourcing introduces exchange rate risks.
   - **How:** Use forward contracts to stabilize costs across USD, CNY, and EUR.
4. **Shared Risk Agreements**
   - **What:** Collaborate with suppliers to share price risks.
   - **How:** Include price adjustment clauses in contracts.
5. **Commodity Insurance**
   - **What:** Protect against extreme price movements or supply disruptions.
   - **How:** Purchase specialized insurance products tailored to the commodity market.

By implementing these carefully designed strategies, **Chart Industries** can strengthen its procurement framework, achieve financial stability, and establish itself as a market leader in the vacuum insulated piping industry.

3. Case Study

Case Study: Strategic Procurement of Stainless Steel

In this section, our aim is to provide a comprehensive case study using all the important points mentioned in the internal and external strategies. This case study demonstrates how an effective procurement strategy can help a global manufacturing company stabilize procurement costs, ensure supply continuity, and maintain operational resilience in volatile markets. The strategy incorporates sourcing diversification, financial hedging, and operational safeguards to mitigate procurement risks effectively.

Scenario

Chart Industries recently received a significant order for the production of vacuum insulated piping (VIP), with delivery scheduled for March 2025. To successfully meet this demand, the company must ensure a steady supply of high-quality stainless steel while addressing procurement challenges related to market volatility, fluctuating prices, and logistical uncertainties.

To achieve cost predictability, supply continuity, and operational resilience, Chart Industries has implemented a comprehensive risk management strategy. This approach includes sourcing diversification, financial hedging, and operational safeguards to mitigate procurement risks and optimize efficiency. The following case study outlines the key elements of the procurement strategy that Chart Industries is employing to fulfill this critical order.

Case Details

1. **Purchased Quantity**
    - **Core Requirement:** 100 tonnes of Cold Rolled Coil 316 Stainless Steel to meet immediate production needs.

- **Contingency Reserve:** An additional 20 tonnes secured through a call option, ensuring flexibility for unforeseen demand increases.

2. **Timeline**
   - **Shipping Date:** January 21, 2025.
   - **Delivery Date:** February 24, 2025.

   Why These Dates Matter:
   - **Seasonal Demand:** Aligns with the companys production cycle for inventory replenishment.
   - **Buffer for Delays:** A 4-week shipping lead time ensures logistical flexibility and minimizes transit risks.
3. **Agreed Pricing**
   - **Futures Contract for 100 Tonnes:**

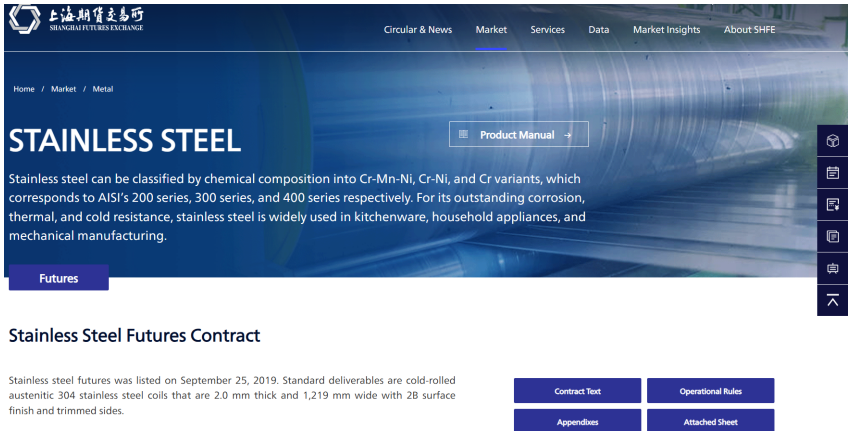

Figure 5. Future Contract from Shanghai Futures Exchange (SHFE)

   - **Price:** Secured at 2,115 USD/tonne via the Shanghai Futures Exchange (SHFE).

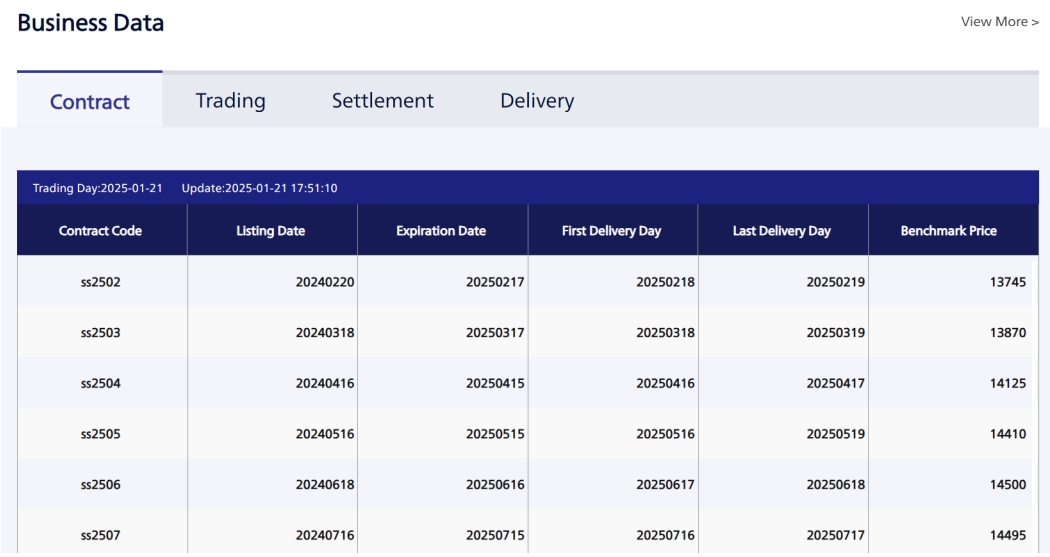

Figure 6. Future Contract from Shanghai Futures Exchange (SHFE)

Table 2. Shanghai Futures Exchange Stainless Steel Prices in US Dollars

Contract Code	Listing Date	Expiration Date	Benchmark Price (USD/Tonne)
ss2502	2024-02-20	2025-02-17	2114.62
ss2503	2024-03-18	2025-03-17	2133.85
ss2504	2024-04-16	2025-04-15	2173.08
ss2505	2024-05-16	2025-05-15	2216.92
ss2506	2024-06-18	2025-06-16	2230.77

  - **Rationale:** Protects against price volatility influenced by raw material constraints such as nickel and chromium.
- **Call Option for 20 Tonnes:**
  - **Strike Price:** 6,700 USD/tonne, expiring February 28, 2024.
  - **Purpose:** Provides the right to purchase additional quantities without financial overcommitment.

4. **Payment Terms**
   - **30% Upfront Payment (Due January 19, 2025):**
     - Secures supplier commitment and locks in inventory allocation.
     - Guarantees priority in the suppliers production schedule.
   - **70% Final Payment (Due February 24, 2025):**
     - Maintains financial liquidity and aligns cash flow with operational timelines.

5. **Supplier Strategy**
    - **50% Sourced from Asia:**
        - Stable pricing and robust supply chains make Asia cost-effective.
    - **30% Sourced from North America:**
        - Ensures superior material quality and shorter transit times.
    - **20% Sourced from Europe:**
        - Access to high-end technology and specialized suppliers.
6. **Insurance and Currency Hedging**
    - **Shipping Insurance:** Protects against transit delays, weather disruptions, and geopolitical risks.
    - **Currency Hedging:** Stabilizes exchange rates across USD, CNY, and EUR to ensure procurement cost stability.
7. **Risk Mitigation Techniques**
    - **Supply Chain Diversification:** Balancing procurement between Asia and North America to reduce regional dependencies.
    - **Logistics Partnerships:**
        - Partnered with experienced logistics providers in Asia and North America for seamless delivery.

By implementing these strategic measures, the company can achieve cost stability, operational resilience, and long-term sustainability in a dynamic market environment.

Summary

In this report, we have conducted an in-depth analysis of the procurement process for stainless steel used in the production of vacuum insulated piping (VIP) at Chart Industries. Our market research indicates that the VIP market is projected to grow from $1.2 billion in 2024 to $2 billion by 2034, with a compound annual growth rate (CAGR) of 5.1%. This growth underscores the increasing demand for energy-efficient solutions and advancements in cryogenic technology.

By implementing the **internal and external strategies** outlined in this report, Chart Industries can address procurement challenges and optimize supply chain efficiency. These strategies include sourcing diversification, financial hedging, and operational safeguards, which aim to achieve cost stability, enhance flexibility, and mitigate potential risks in a volatile market environment.

Strategic Benefits

By adopting these measures, Chart Industries can realize several strategic benefits, such as:

1. **Cost Stability:**
    - Futures contracts can help ensure predictable costs, facilitating accurate budget planning and shielding against volatile raw material markets.
2. **Flexibility and Agility:**
    - Call options provide operational readiness, allowing the company to respond to demand surges without financial overcommitment.
3. **Operational Resilience:**
    - Diversified sourcing ensures uninterrupted supply, even during region-specific disruptions.
4. **Risk Mitigation:**
    - **Insurance:** Protection against shipment delays or damage.

- **Currency Hedging:** Shields against financial losses from exchange rate fluctuations.

5. **Enhanced Supplier Relationships:**
   - Upfront payments and long-term contracts can strengthen partnerships with key suppliers, ensuring priority access and favorable terms during high-demand periods.

By adopting these strategies, Chart Industries can enhance procurement efficiency, minimize financial risks, and establish a resilient supply chain, ultimately positioning itself as a leader in the competitive VIP market.