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Aluminum Production Costs: A Comparative Case Study of Production Strategy

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Abstract 1

Slumping world aluminum prices have energized some aluminum producers to institute strategies to reduce product costs. This multiple comparative case study explored the strategies used by 4 aluminum producers in Western Europe: 2 companies that have successfully reduced production costs and 2 companies that have not. Wicksteed's **economic theory of production and production costs** served as the conceptual framework for this research. Data were analyzed using **pattern finding**, a recursive approach to data analysis established by Miles, Huberman, and Saldana. Six themes emerged: (a) upstream integration, (b) energy and price efficiency, (c) carbon-manufacturing capability, (d) operational excellence, (e) technological and research developmental abilities, and (f) circular economy.

Problem 2

Aluminum commodity prices fell by **24%** from 2008 until 2013, and the prices remained below marginal production costs for many producers because of persistent global aluminum outputs that continued to surpass demand (World Bank, 2013). The raw material prices increased across metal markets by over **20%** (Trench, Sykes, & Robinson, 2015). While many aluminum producers experienced declining profitability and adverse production costs, some producers **lacked the strategies** to reduce production costs.

Purpose 3

The purpose of this study was to explore the strategies that some aluminum producers in Western Europe might implement to reduce production costs and to sustain the business. I studied **four companies** to compare production strategies: **two** companies that were achieving sustained production costs and **two** that were not. I used semistructured interviews of senior managers and analyzed documents to identify core concepts that producers may develop into strategies to reduce production costs.

Research Questions 4

- **RQ1:** What strategies might aluminum managers implement to reduce production costs?
- **RQ2:** How can a manager develop core capabilities in production units to decrease production costs? .

Theory or Framework 5

Wicksteed's (1894) economic theory of production (ETP) and production costs guided the exploration of production strategies. The **ETP** is the study of production focusing on converting inputs into outputs through a production function (Cobb & Douglas, 1928).

- Wicksteed (1894) used the ETP to identify productive factors in a production system and described how variable resources could influence production costs.
- Cobb and Douglas (1928) extended Wicksteed's works and suggested that a company can develop capabilities to increase efficiency and productivity in the long-term.

Relevant Literature 6

Three streams of literature were available for this study:

- The economic theory of production: three important concepts **(a)** technical efficiency and production frontier (Cobb & Douglas, 1928; Farrel, 1957), **(b)** allocative efficiency(Restuccia & Rogerson, 2013), and **(c)** flexible operational modes (Ajmal, Hussain, Kristianto, & Tenkorang, 2012)
- The economies of scale and backward integration (Miltenburg, 2005; Porter, 1980).
- Circular economy (Tukker, 2015).

Participants

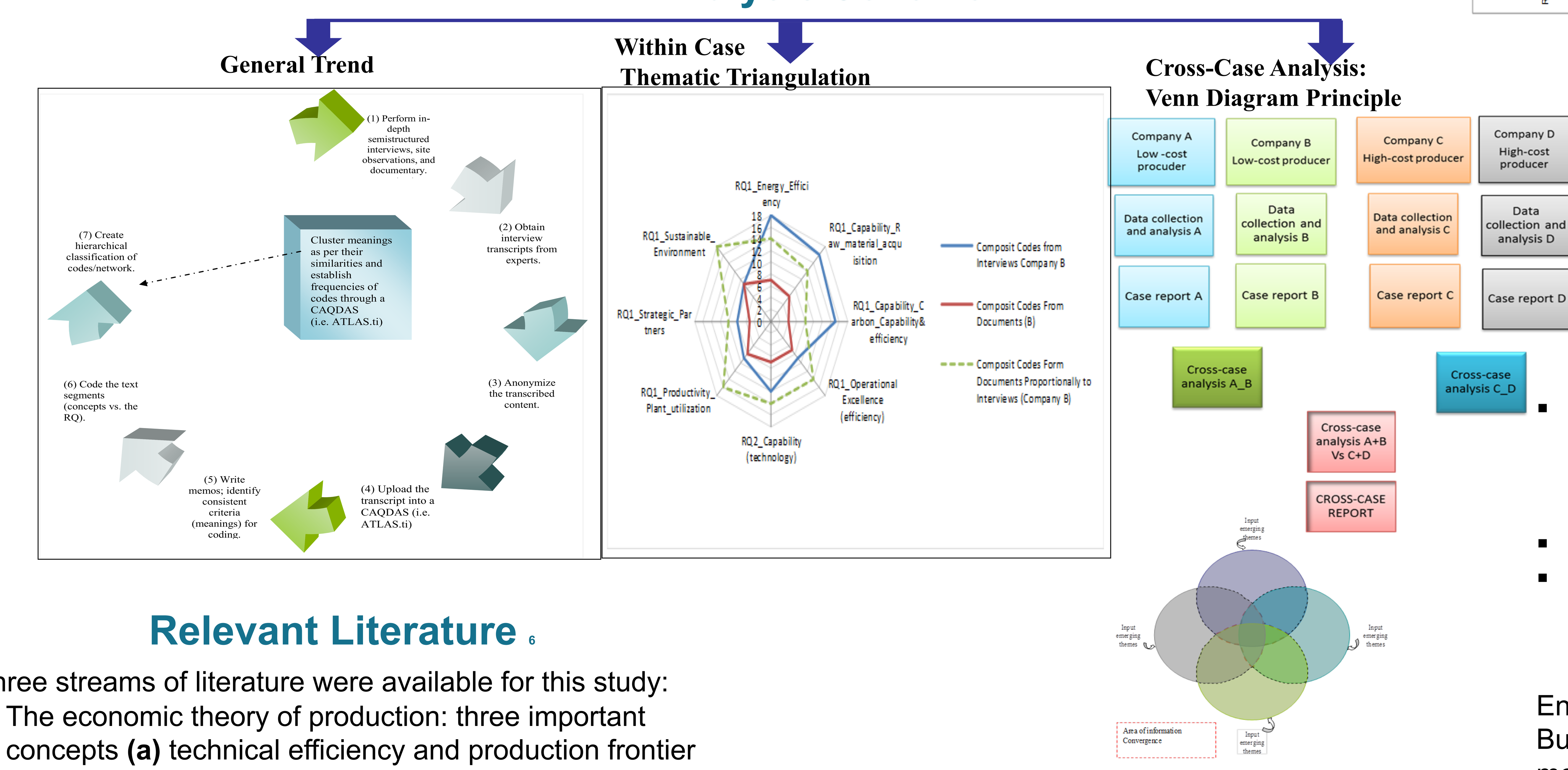
I used the **purposeful** sample approach, targeting experienced senior managers who had the knowledge and ability to information power.

Within the purposeful sample, I used the **homogeneous** sampling approach to eliminate variation due to cognitive bias. I considered only senior managers involved in the production strategy development for >5 years.

Procedures 7

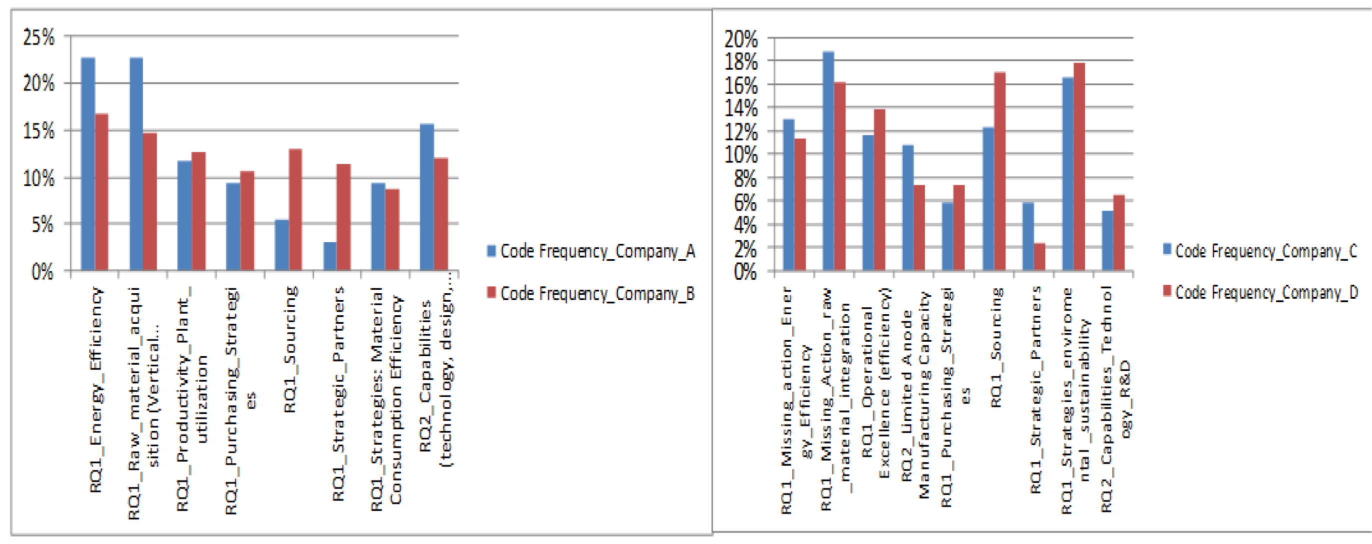
- I selected 4 companies paired into two categories that could yield literal and theoretical replications along two theoretical dimensions: (a) production costs and (b) production strategies.
- I used semistructured interviews and documents analysis to triangulate core themes.
- Interview duration was 30-50 minutes.
- Documents used included aluminum industry and companies' strategic reports.
- Data used were quantitative and qualitative to compare costs.
- I sought saturation at two levels: data collection and thematic analysis levels.

Analysis Scheme 8



Interpretation 9

Analysis of themes indicated that the most significant strategies to improve production costs included (a) minimizing energy and material **(17-22% of codes)** use such as cathodes and carbon, (b) vertically integrating alumina production **(15-20%)** , (c) developing an efficient circular economy model that integrates the material properties to expand recyclability of waste **(10-17%),** and (d) increasing the cathode life **(10-15%).**



Findings 10

Six themes emerged: (a) upstream integration, (b) energy and price efficiency, (c) carbon-manufacturing capability, (d) operational excellence, (e) technological and research developmental abilities, and (f) circular economy.

Recommendations 11

- Companies should reduce energy costs through price efficiency, energy modulation, efficiency, and energy self-generation. Companies can increase efficiency by using selective assets with higher returns.
- Alumina backward integration seemed profitable.
- Circular economy allowed to implement material recycling.

Social Change Implications 12

The findings may:

- allow companies increasing their business sustainability by optimizing their use of resources and energy consumption.
- Allow companies using circular economy models to reduce material consumption and waste, which contribute to environmental protection.

Limitations 13

Limitations may have included:

- Difficulty to negotiate the permission for entry to perform site observations because companies were reluctant about issues of confidentiality. These restrictions limited the possibility to observe core processes and assets.
- Some participants had discomfort when disclosing sensitive information about their company's strategies.

Conclusions 14

Energy and material use mainly affected production costs. Businesses that integrated alumina supplies appeared more cost efficient than those that purchased alumina at spot prices. Alumina self-generation seemed to provide competitive-supply security and a certainty of cost visibility. Energy-price efficiency depended on the electricity contract type (fixed-power price contracts, variable-power price contracts, other contracts).

Acknowledgements

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