Geopolitical Risk Index

Geopolitical risk and critical resources: corporate reactions to dependence on China for rare earths

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INTRODUCTION

In recent years, the global economic environment has been increasingly characterized by rising geopolitical uncertainty. Sudden military conflicts, protectionist policies, and more and more frequent tensions over the distribution and control of strategic resources are profoundly affecting world markets as well as the enterprises operating within them. These events are significantly transforming the way companies conduct their business as well as their interactions with one another throughout global value chains. In light of the unprecedentedly volatile scenario, companies must adopt a proactive strategic approach[1]. This includes identifying and monitoring the factors that are most at risk of adverse geopolitical events, being able to react quickly to unexpected developments, and ensuring active participation in the sector's transformative trends. As a result, effective crisis management and adaptable organizational structures are becoming essential to supporting business continuity and long-term sustainability.

In particular, actors operating in highly interconnected and complex supply chains at an international level are exhibiting growing vulnerability to external disruptions resulting from political decisions and sudden changes in the balance of power between states. Such events can greatly alter the availability and price of resources for production, the reliability of trading channels, or the access to key markets supporting primary business functions, thus endangering the established organizational work structure. What this new trend highlights is a profound shift away from the stability that was expected in previous decades, when many believed that growing economic interdependence could reduce the likelihood of diplomatic conflicts[2].

Geopolitical risk, defined by the European Central Bank[3] as "the threat, realization, and escalation of adverse events associated with wars, terrorism, and any tensions among states and political actors that affect the peaceful course of international relations", has in fact emerged in recent years as one of the main sources of uncertainty for businesses and the global economy. This is demonstrated by the recent values

[1] Levy, C., Singhal, S., & Watters, M. (2024, July 18), "A proactive approach to navigating geopolitics is essential to thrive", *McKinsey & Company*
[2] Crescenzi, M. J. C. (2003), "Economic exit, interdependence, and conflict", *The Journal of Politics*, 65(3), 809–832
[3] European Central Bank (2025, April), "Geopolitical risk and its implications for macroprudential policy", *Macroprudential Bulletin* 28

reached by Caldara and Iacoviello's Geopolitical Risk Index[4], which measures the frequency and intensity of hostile geopolitical events through the analysis of international press articles. The index has shown a significant increase and greater volatility in values over the last three and a half years compared to the previous decade. The average index calculated for the period 2022-2025 is 140.5, an increase of approximately 52% compared to the average for the previous decade 2012-2021 (92.6). At the same time, the standard deviation has increased from 19.1 to 40.7.

In parallel, the World Economic Forum's Global Risks Report 2024[5] highlighted geopolitical tensions as one of the most significant sources of systemic risk expected in the coming years. The study affirms that armed conflicts between states have taken a prominent position, as new entrants, among the threats considered most likely and impactful by more than 1,490 experts in the short term, confirming a context marked by intensifying conflicts and the real risk of escalation between major powers.

There have been numerous recent events that have clearly demonstrated how such tensions can have a violent and rapid impact on business operations. One notable example is the war between Russia and Ukraine, which began in February 2022 and has had a profound impact on both European energy security, due to the interruption of gas (July-September 2022) and raw materials flows, and the worsening of the global food crisis, following the suspension of Ukrainian wheat exports (March-July 2022). The repercussions of these factors on supply stability in global markets, as well as in price levels, proved substantial, culminating in considerable disruptions for corporate entities. The outbreak of the Israel-Hamas conflict in October 2023, followed by the escalation with Iran that led to war in June 2025 and the subsequent United States intervention, has further intensified instability in the Middle East. The "Twelve-Day War", as it came to be known, triggered a wave of uncertainty, impacting global trade and financial markets. Among the most disruptive developments was Iran’s immediate threat to shut down the Strait of Hormuz[6], a strategic chokepoint through which roughly 20% of the world’s oil and over 25% of its liquefied natural gas exports, primarily from

[4] Caldara, D., & Iacoviello, M. (2022, April), “Measuring Geopolitical Risk”, *American Economic Review* 112(4), pp.1194-1225
[5] World Economic Forum (2024, January), “Global risks report 2024” (19a ed.), *World Economic Forum*
[6] Iorio, V. (2025, June 24), “Stretto di Hormuz, perché la minaccia della chiusura mette più a rischio il GNL del petrolio”, *Corriere della Sera*

Qatar, flow. This situation led to operational unpredictability and complicated planning, especially for energy-intensive companies.

In these circumstances, trade wars have also intensified, introducing further complexity for operators around the world. All these events are having a major impact on organisations' supply chains because of how connected they are and how vulnerable the global economy is to just-in-time flows. This highlights how important it is to rethink conventional business processes in the global economy, especially supply models.

A prime example of this is the growing tensions between the United States and China that have intensified as both nations put restrictions on export and import of essential commodities, overstressing priority industrial sectors' supply chains such as the defence and military industry, semiconductors, electronics, automotive, and telecommunications[7]. China, the world's biggest producer of rare earth elements, has leveraged them as a geopolitical tool, starting a new form of trade war. It has imposed controls on the export of selected rare earths and, immediately after, requested detailed information from foreign companies on their use in finished goods, highlighting the risks of reliance on a single nation-supplier and demonstrating the influence of bilateral country agreements on business management. [8] [9]

This work fits into this perspective, with the aim of exploring how economic operators respond to an international context increasingly dominated by the politicisation of economic interdependencies.

Specifically, it aims to analyse the responses of multinational companies to the export restrictions imposed by China on rare earths in April 2025, how they are trying to reduce the risks associated with extremely concentrated supply chains, and what effects China's hegemonic position in rare earth processing is having on international industries. It also aims to observe the effect of supply uncertainty on companies' operational planning and resilience. By systematising and highlighting the strategies adopted, a map of interventions is created, useful to producers and policy makers,

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[7] White, E., McMorrow, R., & Dempsey, H. (2025, May 18), "Global supply chains threatened by lack of Chinese rare earths", *Financial Times*
[8] Jackson, L., Lv, A., Onstad, E., & Scheyder, E. (2025, April 4), "China hits back at US tariffs with export controls on key rare earths", *Reuters*
[9] McMorrow, R., Leahy, J., & Inagaki, K. (2025, June 12), "China demands sensitive information for rare earth exports, companies warn", *Financial Times*

which allows to observe how this specific geopolitical risk is translated into managerial and strategic choices.

The structure of the thesis is as follows: an overview of the rare earth elements and value chain is provided in the first chapter, along with a description of the restrictions introduced by China in April 2025. The second chapter analyses the responses adopted by companies across different industries, drawing on a conceptual framework derived from the literature and integrated with publicly available information. Finally, the third chapter presents the in-depth business case of B&C Speakers, an Italian listed company affected by the Chinese restrictions, which shared details of its responses directly.

CHAPTER 1 - Rare earth elements and global dependence

1.1) Rare earth elements and industrial relevance

Rare earth elements (REEs) are a group of 17 metallic elements that share electrochemical, magnetic, alloy-strengthening, and luminescent properties[10], which make them extremely useful in a wide variety of applications. This group is composed of the fifteen lanthanides, from lanthanum (La) to lutetium (Lu), as well as scandium (Sc) and yttrium (Y). However, just four of these elements - neodymium (Nd), praseodymium (Pr), dysprosium (Dy), and terbium (Tb) - account for about 90% of the total market value. Depending on their electron configuration, this family is commonly divided into two groups: the light rare earth elements (LREEs), which typically include elements from lanthanum to samarium (Sm), and the heavy rare earth elements (HREEs). Heavy REEs are less common, which typically makes them more valuable.[11] Despite being called "rare", REEs are relatively abundant in the Earth's crust. What makes them rare is the rarity of finding them in quantities supporting economical mining and extraction. They typically do not geologically occur as individual elements but instead in differing and low concentrations in ore-accessory minerals.

Permanent magnets based on neodymium, praseodymium, dysprosium, and terbium are the most significant channel through which rare earths enter industrial applications. In energy systems, rare earths are indispensable for renewable power generation, as they are used in wind turbines and in solar panels to enhance energy conversion. Their relevance continues in the automotive sector, where hybrid and electric vehicles depend on them for motors and components that combine durability with high performance. In electronics and communications, they are heavily used in the production of devices such as smartphones, computers, semiconductors, advanced display systems, microphones, speakers, and fibre optics. The medical field also takes advantage of their features, utilizing them in diagnostic imaging and precision lasers. Again, in the defence and military sector, rare earths play a key role from radars to aircraft engines and sophisticated communications equipment. Finally, they find

[10] Ganguli, R., & Cook, D. R. (2018, May), "Rare earths: A review of the landscape", *MRS Energy & Sustainability: A Review Journal*
[11] Drobniak, A., & Mastalerz, M. (2022, January), "Rare Earth Elements: A brief overview", *Indiana Journal of Earth Sciences*

application in other advanced material areas where they improve alloys, ceramics, and glass and are used as catalysts in oil refining and chemical applications.[12]

These fields show how rare earth elements have become essential in the modern world. Their applications highlight how important it is for crucial sectors to have a reliable and stable supply of these materials in the face of rising demand.

1.2) Global value chain of rare earths[13]

The global value chain of rare earth elements is organised into a sequence of interconnected stages. The starting point is mining, where these elements are extracted from mineral deposits such as bastnaesite and monazite. Then, an extractive metallurgy process called concentration or beneficiation upgrades the value of raw REE-containing mineral ores by removing low-value minerals, returning a higher-grade and concentrated product. Physical beneficiation methods include gravity separation, magnetic separation, electrostatic separation, desliming, and froth flotation. According to the analysis conducted by BCG[14] in 2023, at a global level, China controls around 60% of the mining and beneficiation phases, followed by the United States and Australia with smaller but still relevant shares (respectively 13% and 11%). This makes the upstream phase sufficiently diversified, even if China retains a clear leadership position.

From this stage, the material moves into separation and processing, which represent the most technical phase of the chain, as rare earths are very chemically similar and separating them from one another into individual oxides requires resource-intensive chemical processes. Unlike mining, this midstream segment is highly concentrated, with China carrying out close to 87% of global separation and processing. This lack of geographical diversity explains why midstream is widely considered a relevant bottleneck of the value chain.

The downstream stage of the chain first involves the manufacturing of intermediate products such as permanent magnets, metals, and alloys. At this level, the

[12] Leal Filho, W., Kotter, R., Özuyar, P. G., Abubakar, I. R., Eustachio, J. H. P. P., & Matandirotya, N. R. (2023), "Understanding Rare Earth Elements as Critical Raw Materials", *Sustainability*, 15(3), 1919
[13] U.S. Department of Energy - Office of Energy Efficiency & Renewable Energy (2020, April), "Critical materials rare earths supply chain: a situational white paper", *U.S. Department of Energy*
[14] Detry, E. et al. (2023, July 6), "Five steps for solving the rare earth metals shortage", *BCG*

concentration is extremely pronounced: more than 91% of NdFeB magnets, the most valuable application of rare earths, are produced in China. This stage represents the point at which rare earths acquire most of their economic value, where processed oxides are transformed into critical components for advanced technologies. The final phase consists of the manufacturing of equipment, where rare-earth-based components are incorporated into end-use products, finally entering all the sectors identified before.

1.3) China's dominance and recent geopolitical events

As highlighted in the previous paragraph, China is the world's dominant force in the rare earth value chain. It achieved this superiority through a combination of early moves into the industry, government-driven investment along the full length of the chain, export control, and low labour costs sustained by years of weak environmental regulation and illegal mines and processing plants[15].

Following the first REEs mining sites discoveries in Mongolia, and in the Shandong and Sichuan Provinces made in the 1950s, Beijing's government recognised the strategic importance of these resources and created a national leading group in 1975 for allocating funds to research in the mining and processing phases. By the late 1980s, China was a major producer, and in the 1990s, it began to export rare earth metals "in large quantities and at low prices, causing other producers to close or reduce output"[16].In later decades, Beijing amplified this process by forbidding foreign companies from mining, establishing quotas for domestic production, enacting export bans and taxation policy, and concentrating the industry in four large state-owned companies. These methods boosted domestic value-added procedures and enabled China to achieve its current dominant status in the international industry. At the same time, the decline of the United States' rare earth industry created favourable conditions for China's rise. According to Park et al. (2023)[17], environmental concerns, stricter EPA regulations, and short-term economic interests of US firms led to outsourcing processing to China to reduce costs. By the late 1990s, beneficiation

[15] Andrews-Speed, P., & Hove, A. (2023, June), "China's rare earths dominance and policy responses", *Oxford Institute for Energy Studies*
[16] Ibid
[17] Park, S., Tracy, C. L., & Ewing, R. C. (2023, August), "Reimagining US rare earth production: Domestic failures and the decline of US rare earth production dominance - Lessons learned and recommendations", *Resources Policy*, 85

and magnet manufacturing had been progressively transferred abroad, allowing China not only to expand its capabilities but also to accumulate the technological know-how.

The Chinese government has increasingly exploited its dominant position in the rare earth sector to target strategic rivals, turning these resources into what many analysts describe as a geopolitical weapon[18]. The first instance of this initiative occurred in 2010, when, during a diplomatic crisis over the detention of a Chinese fishing trawler captain, the country imposed a ban on rare earth exports to Japan[19].

Fifteen years later, Beijing has once again leveraged export controls to address geopolitical disputes. The People's Government of China, on April 4, 2025, announced the imposition of new restrictions upon global exports of certain rare earth products in response to the latest tariffs imposed by the Trump administration[20]. The Ministry of Commerce (MOFCOM) disclosed that seven rare earth elements (samarium, gadolinium, terbium, dysprosium, lutetium, scandium, and yttrium), along with their derivative products such as permanent magnets, would need to be subject to new export licensing requirements[21]. In order to export these materials, companies had to apply for special licences directly from the MOFCOM. The procedure, however, was not precisely defined and has proven highly demanding, requiring foreign firms to submit extensive proprietary product information both to Chinese export companies and to the Chinese authorities and exporters to provide a signed end-use certificate, photographic evidence of the magnets' assembly lines, a chemical composition report, and a detailed description of the manufacturing process. The stated purpose of this rigorous verification process was to ensure that the materials would not have dual-use applications such as military, nuclear, or aerospace uses[22]. Although the measure did not amount to a full export ban, it heavily affected the rare earths flow, exposing the

[18] Chen, L. (2025, June 6), "China's rare earth weapon changes contours of trade war battlefield", *Reuters*
[19] Baskaran, G., & Schwartz, M. (2025, April 14), "The consequences of China's new rare earths export restrictions", *Center for Strategic and International Studies*
[20] Jackson, L., Lv, A., Onstad, E., & Scheyder, E. (2025, April 4). "China hits back at US tariffs with export controls on key rare earths", *Reuters*
[21] Ministry of Commerce of the People's Republic of China. (2025, April 4). "Announcement No.18 of 2025 of The Ministry of Commerce and The General Administration of Customs of The People's Republic of China announcing the decision to implement export control on some medium and heavy rare earth related items", *MOFCOM*
[22] Murphy, I. (2025, April 9), "China's rare earth export controls", *Rare Earth Exchanges*

structural vulnerability of global supply chains and triggering immediate reactions from global companies - responses that will be examined in detail in the next Chapter.

CHAPTER 2 - Analysis of the strategies adopted by companies in the rare earth value chain

As previously discussed, China's restrictions on rare earths exports have affected many sectors, consequently impacting a wide range of companies. These include energy, electronics, defence, and the automotive industry, as well as other industries that rely on electronic components, such as industrial automation, precision manufacturing equipment, and scientific instrumentation. The affected companies vary in size from small enterprises to global corporations and are located in all continents.

An overall analysis of public sources reveals that the main issue flagged by company executives is supply chain disruption, which can directly affect production continuity, pose risks to reputation, and lead to increasing costs. The latter includes higher operating expenses (OPEX) and capital expenditures (CAPEX) required to diversify supply chains, identify new suppliers, and support initiatives such as investing in start-ups or forming partnerships with alternative providers.
Following China's announcement in April, some companies reacted reporting serious concerns about their ability to maintain business continuity under the new restrictions. They warned that the new regulatory barriers could lead to immediate consequences, including production delays and, in the most severe scenarios, the temporary or even permanent shutdown of some facilities. The automotive industry raised the most significant alarm, with worries voiced by both companies and industry associations. All BMW, Ford, Hyundai, Suzuki, Tesla, and CLEPA (the European Association of Automotive Suppliers)[23] [24] issued statements about the impact of China's decision regarding rare earths.

In this context, the risk management literature offers two key concepts to understand firm-level responses to disruptions: resilience and robustness. According to Miroudot (2025)[25], resilience refers to a company's ability to return to normal after a shock, i.e.

[23] White, E., McMorrow, R., & Dempsey, H. (2025, May 18), "Global supply chains threatened by lack of Chinese rare earths", *Financial Times*
[24] Carter, T. (2025, June 5), "China is flexing its supply chain muscles - and the auto industry is freaking out", *Business Insider*
[25] Miroudot, S. (2025, June 18), "Resilience versus robustness in global value chains: some policy implications", *VOXEU Centre for Economic Policy Research*

the capacity to restore operations to their pre-shock state, while robustness describes its capacity to continue operating during the ongoing crisis.

Applied to the case of rare earths, these concepts can be utilized to explain how companies are responding to supply chain interruptions. For instance, increasing the firm's robustness can imply diversifying sourcing or stockpiling major inventories to ensure production even during supply interruption. While building resilience requires a more transformative response, for example, investments in alternative materials, product redesign, or reshoring of production processes.

An analysis of recent literature, articles, and corporate communications following China's latest curbs on the international trade of rare earth materials suggests that firms are actively reacting to the disruptions, rather than passively waiting for a return to equilibrium in their value chain. The extent of these responses naturally relies on firms' expectations of the potential length of the limitations. Although as of June, Beijing began to ease restrictions slightly by issuing licenses more quickly and re-enabling some trade flows again[26], the requirements for detailed documentation have continued to slow the processing of export applications, which means that significant challenges are still in place[27]. Publicly available information reveals that several firms have established dedicated teams or outlined clear actions to address the new restrictions, with the objective of responding to the immediate disruption, accelerating efforts in existing projects designed to reduce the risk associated with heavy dependence on China.

When examining how companies can react to this situation, a wide spectrum of both implemented and potential strategies becomes visible. These include supply chain management, geographic diversification, vertical integration, innovation and substitution, and the adoption of a circular economy and recycling. The following sections explore these main strategies in depth, aiming to examine both their theoretical foundations and practical applications.

[26] CLEPA (2025, June 3), "Progress in the processing of export licenses, but risk of rare earth supply chain disruptions remains significant", *CLEPA News*
[27] McMorrow, R., Leahy, J., & Inagaki, K. (2025, June 12), "China demands sensitive information for rare earth exports, companies warn", *Financial Times*

2.1) Supply chain management

As defined by Min et al. (2019)[28], supply chain management (SCM) involves the systemic, strategic coordination of the traditional business functions within a particular company and across businesses within the supply chain, for the purposes of improving the long-term performance of the individual companies and the supply chain as a whole. According to this definition, modern SCM focuses not only on value improvement in goods and information flows but also on developing robust competencies to effectively respond to adverse shocks and maintain high-quality standards. Having a clear Supply Chain Orientation (SCO), defined as the organization's internal readiness to engage in collaborative value chain practices, represents a necessary prerequisite to effective SCM implementation within scenarios of uncertainty.

In recent months, companies have adopted a combination of tactical and strategic measures within the broader framework of supply chain management to manage disruptions caused by China's export restrictions on rare earth elements. These actions address both current challenges and long-term vulnerabilities.

Tactical responses have focused on increasing the firm's robustness and short-term mitigation efforts, especially to ensure production continuity against uncertainty. Two of the most common measures include:

- Stockpiling critical inventory: several manufacturers, particularly in the automotive and electronics sectors, have increased their reserves of rare earth magnets to avoid production stoppages amid logistics uncertainty. For instance, Hyundai and its affiliate Kia have built up a reserve of critical materials sufficient to sustain production for approximately one year, temporarily shielding them from China's export restrictions[29]. Similarly, German-based Daimler Trucks AG also stocked inventories as a way of being in a position to address value chain

[28] Min, S., Zacharia, Z. G., & Smith, C. D. (2019), "Defining supply chain management: in the past, present, and future", *Journal of Business Logistics*, 40(1), 44-55
[29] Yang, H. (2025, June 10), "Exclusive: Hyundai Motor has a rare earths stockpile that can last about a year, source says", *Reuters*

issues from Beijing, reporting having learned the lesson through the 2020-2023 chip shortage[30].

- Securing long-term contracts: another important response has been the negotiation of multi-year contracts with non-Chinese rare earth producers. A case in point is Apple, which signed a multi-year, $500 million contract with MP Materials, a United States-based rare earth miner and refiner. The deal conditions include Apple getting deliveries of domestically produced rare-earth magnets beginning in 2027. The contract has a $200 million upfront payment, which is a clear sign of Apple's positioning towards supply chain autonomy[31].

On the other hand, strategic responses focus on strengthening the structural resilience of supply lines. These long-term initiatives are designed to reduce systemic vulnerabilities and improve adaptability so that the organization can recover its standard operating procedure after an event with disruptive potential has occurred.

A growing number of firms are implementing advanced management systems based on supply chain risk awareness, aiming at anticipating disruptions instead of reacting once they take place. One of the clearest manifestations of this is the prioritisation of projects that improve supply chain visibility.

Visibility allows companies to track the origin of raw materials, recognize supplier dependencies, map risks across tiers, and have a lot of information at their fingertips within minutes after a potential shock. Yet, as stated by Choi, Rogers, and Vakil (2020)[32], most companies were caught unprepared during the COVID-19 crisis because they had no detailed knowledge of their supply networks, which led to delayed and fragmented responses. In contrast, companies that had previously invested in supply line mapping were able to quickly identify at-risk suppliers and maintain continuity following disruptions.

To support this goal, companies are increasingly trying to deploy technology-based solutions to collect, process, and verify supply chain data. Volvo's deal with Circulor offers one helpful case study: they developed an EX90 all-electric truck "battery

[30] Ergenay, O., & Mannes, M. (2025, June 17), “European truckmakers tackle rare-earths bottleneck with stockpiling, supply chain shifts”, *Reuters*

[31] Apple (2025, July 22), “Apple expands US supply chain with $500 million USD commitment”, *Apple Newsroom*

[32] Choi, T., Rogers, D., & Vakil, B. (2020, March 27), “Coronavirus is a wake-up call for supply chain management”, *Harvard Business Review*

passport" on blockchain in 2024, enabling consumers to trace materials like cobalt and nickel from mine to car[33]. This facilitates transparency and accountability and also aligns with evolving regulatory requirements for critical materials like Trump's Executive Order 14272[34] in the US and the European Critical Raw Materials Act[35].

More broadly, existing studies highlight digitalization as an important factor helping to reduce the impact of hostile shocks. Those businesses that already applied digital responses to areas of supply chain configurations showed higher flexibility and responsiveness to recent crises[36] [37].

In this context, it is evident that there is a profound interconnection between supply chain visibility and technology adoption. Digital technologies are essential enablers for the establishment of a product lifecycle network characterised by higher transparency, flexibility, and risk awareness.

2.2) Geographic diversification

One of the most well-known strategies for increasing supply chain resilience is to diversify the supplier base by sourcing materials and components from multiple vendors from different geographical locations. This allows companies to spread the risk of operational disruption caused by geopolitical tensions or trade restrictions, as it significantly reduces the dependency on a single supplier or region.

This approach has already been adopted on numerous occasions by international firms in response to supply chain disruptions or threats. For instance, following China's imposition of an embargo on rare earth elements in 2010, Japan implemented several actions in this direction. A notable element of these was the investment by the national agency JOGMEC in the development of multiple critical minerals mines in Australia, Vietnam, India, Kazakhstan, and Southern Africa. This initiative played a key role in

[33] Khan, Y. (2024, June 4), “Volvo says users can track source of battery metals in its EVs”, *The Wall Street Journal*

[34] The White House (2025, May 30), “Executive Order 14272: Ensuring national security and economic resilience through Section 232 tariffs”, *The American Presidency Project*

[35] European Commission (2023, March 16), “Critical Raw Materials Act”, *Single Market Economy - European Commission*

[36] Abidi, N., El Herradi, M., & Sakha, S. (2022), “Digitalization and resilience: firm-Level evidence during the COVID-19 pandemic”, *International Monetary Fund*

[37] Gopalan, S., & Reddy, K. (2023), "Global value chain disruptions and firm survival during COVID-19: an empirical investigation", Working Papers DP-2023-13, *Economic Research Institute for ASEAN and East Asia (ERIA)*

reducing Japan's reliance on Chinese REEs, which decreased from over 90% to approximately 58% in recent years[38]. Once more, in 2023, multinational corporations such as Intel, Infineon, and Micron made substantial investments in Penang, Malaysia, with the objective of circumventing potential logistical crises engendered by the ongoing technological rivalry between the United States and China in the semiconductor industry. Consequently, the Malaysian island received $12.8 billion in foreign direct investment that year from both non-Chinese and Chinese businesses, which rapidly established or expanded their manufacturing operations there[39].

Following China's imposition of rare earth export controls in April, leading firms and governments have taken concrete steps to implement or speed up geographic supply chain diversification. These efforts include qualifying alternative suppliers from outside China by improving the processing and refining of rare earth materials mined from existing mines, and investments focusing on the construction of new mines and refineries internationally. However, in order for these projects to be commercially effective, key enablers such as strong governmental support and strategic industrial partnerships are needed. The former reduces the risks of investments via tools such as subsidies, preferential taxation, or purchase guarantees, while the latter allows stakeholders to be able to draw on common know-how and gain economies of scale that would be impossible to achieve independently by a single company.

A recent data-driven analysis conducted by Baskaran and Schwartz for the Center for Strategic & International Studies[40] identified which countries are best positioned to develop into cost-competitive hubs for rare earth processing, evaluating 10 quantifiable criteria across 10 countries. The study highlights the United States as a potential top-performing region in the processing of these elements, with Australia and Saudi Arabia following closely behind. The unique strengths of the United States consist of advanced infrastructures, feedstock availability, and strong governmental support, including grants and guarantees of supply. Future developments at Texas and California processing plants give promise of realizing an emerging magnet supply

[38] World Economic Forum (2023, October 11), "Why Japan is quietly building reserves of rare earth minerals", *World Economic Forum*
[39] Ruehl, M., & Tindera, M. (2024, April 3), "A surprising winner in the US-China chip wars", *FT Podcast - Behind the Money*
[40] Baskaran, G., & Schwartz, M. (2025, July), "Developing rare earth processing hubs: an analytical approach", *Center for Strategic and International Studies (CSIS)*

chain less dependent on China. Australia and Saudi Arabia are both forming strategic partnerships with the United States, and the three countries as a group offer favourable environments defined by consistency of rules and investment incentives.

We can now consider some of the best examples of companies based in these countries, operating in the upstream and midstream of the REEs value chain that could be part of a broader portfolio of rare earth suppliers to downstream producers worldwide.

The US-based MP Materials has secured funding and offtake agreements to increase its domestic refining capabilities and reduce its reliance on Chinese processors. Notably, in July 2025, the US Department of Defence took a $400 million equity stake in the company, amounting to 15%, and agreed to purchase its output at a fixed double current market price for 10 years. This follows the US government's clear commitment to restoring domestic supply chains for the 17 elements crucial to defence and national security technologies[41].

Lynas Rare Earths, a listed Australian company and one of the largest non-Chinese rare earth developers, specialises in mining lighter metals in Western Australia and in refining them in Malaysia. Although it does not yet refine heavy rare earths, it plans to expand its Malaysian processing site to produce dysprosium and terbium for export to magnet manufacturers by mid-2025. The company is also constructing a rare earths separation plant in Seadrift, Texas, funded by the US Department of Defense to the value of $258 million.

Iluka Resources, which is also based in Australia, plans to start refining DyTb (a combination of dysprosium and terbium) in 2027 at a new HREEs refinery in Eneabba. The company secured $960 million in loans from the Australian government last year to fund this project[42].

Finally, the Saudi Arabian Mining Company Ma'aden has signed a Memorandum of Understanding with MP Materials to jointly develop a vertically integrated rare earth supply line in the Middle Eastern country, from mining and processing to making

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[41] McMorrow, R., Leahy, J., & Inagaki, K. (2025, June 12), "China demands sensitive information for rare earth exports, companies warn", *Financial Times*
[42] Fildes, N. (2025, April 11), "Australian miners benefit from new Chinese restrictions on rare earth exports", *Financial Times*

permanent magnets. A final investment decision is pending, but it is expected that construction of the mine will begin in 2025, with production expected to commence mid-2028[43].

2.3) Vertical integration

There are more ways for companies to address value chain risk than simply changing the composition of their suppliers. They can also adjust their level of vertical integration in response to such shocks. In fact, theories on the boundaries of firms suggest that concerns about supply assurance may lead firms to integrate vertically[44] [45]. Ersahin, Giannetti, and Huang (2023)[46] were apparently the first to empirically demonstrate that supply chain risk can drive vertical integration. Their results suggest that higher supply chain uncertainty leads to a higher probability of M&As with a supplier or a customer by 32.5% and 38.6% relative to the baseline merger probability of 0.51% and 0.43%, respectively.

Various initiatives have been launched over time by companies, governments, or partnerships to pursue strategies within the rare earth value chain, such as upstream vertical integration into mining and processing or downstream value-added component and magnet production.

Over the past decade, for example, Chinese operators have largely integrated themselves along the chain. From 2021 to 2023, the Chinese government further consolidated the industry by merging all REEs companies other than CNRE China Northern Rare Earth Group into CREG China Rare Earth Group. This is now a state-owned mega-conglomerate involved in all stages of the chain, from exploration and mining to smelting, separation, and deep processing[47].

[43] MP Materials (2025, May 14), "Maaden and MP Materials collaborate to establish full value chain for rare earth magnetics", *MP Materials Investor Relations*
[44] Williamson, O. E. (1971), "The vertical integration of production: market failure considerations", *The American Economic Review*, 61(2), 112–123
[45] Bolton, P., & Whinston, M. D. (1993), "Incomplete contracts, vertical integration, and supply assurance", *The Review of Economic Studies*, 60(1), 121–148
[46] Ersahin, C., Giannetti, M., & Huang, J. (2023, April), "Supply chain risk: changes in supplier composition and vertical integration", Working Paper No. 31134, *National Bureau of Economic Research*
[47] Zhou, Q., & Brooke, S. (2021, December 30), "China merges three rare earths state-owned entities to increase pricing power and efficiency", *China Briefing*

More recently, US-based MP Material announced in January 2025 that they started commercial production of neodymium-praseodymium (NdPr) metal and trial production of automotive-grade, sintered neodymium-iron-boron (NdFeB) magnets in their manufacturing facility in Fort Worth, Texas[48]. These achievements, as highlighted by James Litinsky, founder, chairman, and CEO of the company, bring the U.S. closer to reestablishing a fully integrated domestic supply chain for rare earth elements for the first time in decades.

2.4) Innovation and substitution

In his 2002 "Directed technical change" paper, Acemoglu proved that when a hard-to-substitute input becomes scarce or costly due to a tax, regulation, or a supply shock, firms react quickly with massive innovation and factor allocation[49]. They immediately shift their R&D programmes to solve this problem: most of the time trying to increase the efficiency of that input in question, reduce its usage, or identify an alternative that can replace it entirely in the manufacturing process.
In support of this, a recent paper by Alfaro et al. (2025)[50] highlighted how Chinese export restrictions on REEs have resulted in a quantifiable surge in innovation and productivity in critical minerals downstream industries outside China, as well as in a considerable escalation in their exports to the rest of the world.

Although most rare earth elements are difficult to substitute in specific, highly specialised and technologically sophisticated applications[51], Eggert et al. (2016)[52] presented five types of substitution that apply to the REEs magnets industry and were developed in response to the 2010 REE ban from China and the subsequent two-year price surge:

- Element-for-element: this form of substitution means replacing one element with another. In NdFeB magnets, for example, terbium can substitute dysprosium (another REE) in high-temperature applications like electric motors. However,

[48] MP Materials (2025, July 10), "MP Materials restores U.S. rare earth magnet production", *MP Materials Investor Relations*
[49] Acemoglu, D. (2002), "Directed technical change", *Review of Economic Studies* 69(4): 781-809
[50] Alfaro, L. et al. (2025, May), "Trade and industrial policy in supply chains: directed technological change in rare earths", Working Paper, *Harvard Business Review*
[51] Cit. Alfaro, L. et al. (2025, June 20), "When supply shocks to essential inputs spur innovation: lessons from the global rare earths disruption", *VOXEU CEPR*
[52] Eggert, R., et al. (2016), "Rare earths: market disruption, innovation, and global supply chains" *Annual review of environment and resources* 41.1: 199-222. Web.

this is not an ideal replacement, as the former is even more expensive than the latter.

- Technology-for-element: here, a different production method allows for reduced use of a critical input. One such approach is diffusion technology, which concentrates dysprosium around the grain boundaries in the crystal structure rather than distributing it throughout the grains.
- Grade-for-grade: by using the common fundamental design of NdFeB magnets, manufacturers can produce magnets in a range of grades, each defined by its maximum energy product and its maximum operating temperature. This means users can purchase magnets with lower maximum operating temperatures and less dysprosium according to their needs.
- Magnet-for-magnet: this involves the usage of other magnets which are not REEs-based, such as samarium-cobalt, ferrite, or aluminium-nickel-cobalt ones. However, these potential alternatives are less convenient, as they all have a lower energy production power, meaning that companies would need bigger and heavier components.
- System-for-system: this form of substitution involves redesigning the entire system to reduce or eliminate reliance on REEs altogether.

An example of technology-for-element substitution was achieved by Toyota in 2018[53], as the organization publicized the creation of the neodymium-reduced and heat-resistant magnet. The combination of innovative material processing and structure design enabled the decrease of neodymium content by 50%, substituted with the less expensive lanthanum and cerium, and eliminated the necessity for the two vital heavy rare earths dysprosium and terbium. The Japanese company did this while maintaining both comparable magnetic performance and thermal stability.

2.5) Circular economy and recycling

According to the European Parliament[54], a circular economy is defined as a "model of production and consumption where people share, lease, reuse, repair, refurbish, and recycle existing materials and products as long as possible". The key is to reduce

[53] Toyota Motor Corporation (2018, February 20), "Toyota develops new magnet for electric motors aiming to reduce use of critical rare-earth element by up to 50%", *Press release*
[54] European Parliament (2023, May 24), "Circular economy: definition, importance and benefits", *European Parliament*

waste to a bare minimum: when a product reaches the end of its life, its materials are kept within the economy thanks to recycling, creating further value from what would otherwise be discarded.

Welch, Soufani, and Morales (2025)[55] state that circular economy is an underused tool to address the current global supply chain volatility. Even if traditional responses like dual sourcing, stockpiling inventories, or vertical integration still matter, companies should consider circularity and recycling as a proper strategy to mitigate supply risk and build resilience. This is because it reduces the need for material imports, opens new revenue streams, and moreover builds customer loyalty.

However, the adoption of circularity as a way of dealing with rising geopolitical forces seems to be limited by misaligned incentives: executives often prioritise short-term profit and loss performance, as well as rewarding unit sales, and are reluctant to support investments with long payback periods or without an immediate business case, especially during periods characterised by uncertainty.

Against this backdrop, there are several cases where companies, particularly startups, through public investments, have started to implement circular economy strategies specifically focused on rare earth elements. The following section gives a selection of such initiatives, illustrating how recycling is being and could be leveraged to reduce dependency on China[56].

HyProMag is a UK-based company founded by staff members of the University of Birmingham's School of Metallurgy and Materials. It uses electronic waste as a valuable and profitable source of rare earth minerals. Acquired by a subsidiary of Canada's Mkango Resources in 2023, the company now plans to recycle a range of end-of-life products, including car motors, wind turbine generators, MRI scanner components, and hard drive parts. It expects to produce 25-30 tonnes of recycled NdFeB magnets per year after starting large-scale production at its new, higher-capacity Birmingham plant.

[55] Welch, S., Soufani, K., & Morales, E. (2023, June 18), “How circularity can be a strategic response to tariffs”, *Harvard Business Review*
[56] Wright, R. (2025, February 11), “The start-ups seeking to challenge China’s stranglehold on rare minerals”, *Financial Times*

Cyclic Materials is a clean technology start-up based in Toronto whose investors include the Climate Innovation Fund, backed by Microsoft. The company's technique uses a “mechanical process” to access the magnets in products before separating the individual elements by immersing the magnets in chemicals. The company plans to increase its production capacity from 100 tonnes of rare earth oxides per year in 2024 to 600 tonnes by the end of 2025.

Envipro is a Tokyo Stock Exchange-listed group and a leader in the circular economy. One of the challenges it faces is the closed-loop recycling of lithium-ion batteries, in order to meet the growing global demand for minor metals associated with electrified mobility and widespread renewable energy use.

Umicore, a Belgium-based group, has been an early mover in the development of circular strategies for rare earth elements. Back in 2011, the company partnered with Rhodia to launch an innovative process for recycling rare earths from nickel-metal hydride (NiMH) rechargeable batteries. Over the years, continued investment in closed-loop capabilities has positioned Umicore to deal with China’s export restrictions on critical minerals without significant disruption to its operations[57].

Finally, as reported by Forbes[58], other companies engaged in critical minerals recycling include Hitachi Metals, Global Tungsten & Powders Corp., Osram Licht AG, and Solvay SA.

The following table provides a summary of the strategies adopted by companies across various sectors in response to supply chain disruptions caused by China’s new REEs export licensing requirements seen so far. It categorizes the responses into five macro-areas and highlights specific characteristics. For each one, it describes the nature and depth of the strategic shift (reactive, tactical, preventive, proactive, structural, transformational), the expected time horizon (short, medium, long term), and lists some key enablers that would be needed for successful implementation.

[57] Rhodes, D. (2025, August 1), “Umicore sees no problem so far from China's curbs on critical minerals”, *Reuters*
[58] Silverstein, K., (2024, July 24), “Recycling rare earths beats mining them and may weaken China’s market”, *Forbes*

Table: Summary of companies’ responses to China’s REEs export restrictions

Macro Response	Specific Response	Type	Time Horizon	Enablers
Supply chain management	Stockpiling inventory	Reactive and tactical	Short-term	Liquidity availability, warehousing capacity, digital maturity & IT integration, strong supplier relationships, geopolitical risk intelligence
	Securing long-term contracts	Preventive and structural	Medium to long-term	
	Adoption of advanced Risk-Aware supply chain management	Proactive and transformational	Medium to long-term	
Geographic diversification	Qualifying non-Chinese suppliers	Preventive and tactical	Short to medium-term	Availability of capable non-Chinese suppliers, government and policy support, strategic industrial partnership
	Developing new mining and refining capacity in other countries	Proactive and transformational	Long-term	
Vertical integration	Upstream integration into mining and processing	Proactive and transformational	Medium to long-term	Capital investment, strong supply chain relationships, technological know-how
	Downstream value-added components and magnets production integration	Proactive and transformational	Medium to long-term	
Innovation and substitution	Material substitution	Reactive and tactical	Medium-term	Technological know-how, capital investment, strategic industrial partnership
	Efficiency-enhancing innovation	Proactive and structural	Medium to long-term	
	Functional replacement	Structural and transformational	Long-term	
Circular economy and recycling	Recycling of end-of-life products for critical mineral recovery	Proactive and structural	Medium to long-term	Technical know-how, capital investment, government and policy support
	Closed-loop recycling systems within industrial ecosystems	Preventive and transformational	Long-term	

CHAPTER 3 - B&C Speakers case study

During the research phase for this thesis, while reviewing articles and studies on China's restrictions on rare earth exports, I came across an article in the Financial Times entitled "China demands sensitive information for rare earth exports, companies warn" by Ryan McMorrow, Joe Leahy, and Kana Inagaki that was published on 12 June 2025[59]. The piece featured interviews with several companies relying on Chinese rare earths in their products that had been asked by the Chinese authorities to provide sensitive information for their suppliers to obtain export licences for rare-earth-containing magnets. One of these appeared to be a strong candidate for developing a case study within the context of this thesis: B&C Speakers is an Italian, publicly listed company, and a leading player in the professional audio component industry, recognised as an excellence in its field. Moreover, its 2023 acquisition of the US-based company Eminence offers an opportunity to examine how Chinese policy actions have affected operations in both Europe and the United States, and to compare the strategic responses implemented in these two regions. The following analysis draws on insights from a direct discussion and interview with Andrea Pratesi, Supply Chain Director and Chief Procurement Officer of B&C Speakers, conducted in August 2025.

3.1) Company profile[60]

The B&C Speakers Group is a leading international player specialising in the design, production, distribution, and commercialisation of premium quality electro-acoustic transducers (commonly known as loudspeakers, the main components of cabinets for the reproduction of music). The firm's primary line consists of high-frequency drivers and horns, coaxial components, and cone drivers. The company primarily operates in the professional audio sector, which includes segments such as touring and rental, installed leisure, portable sound systems, and instrument amplification. However, it has also expanded into adjacent markets, including the car audio sector, served mainly

[59] McMorrow, R., Leahy, J., & Inagaki, K. (2025, June 12), "China demands sensitive information for rare earth exports, companies warn", Financial Times

[60] Zampaloni, A., & Arena, L. (2025, May 14), "B&C Speakers - Margin upside marks strong start to FY25" [Equity Research Report], *Alantra Capital Markets*
Di Grado, M. T. (2024, December 4), "B&C Speakers - Acquisitions offset Asian market challenges" [Equity Research Update], *KT&Partners*
B&C Speakers S.p.A. (2025, April 30), Investor presentation, *Company presentation*
B&C Speakers S.p.A. (2025, August), *Company website*, Retrieved August 2025, from https://www.bcspeakers.com/en

through the B&C and Ciare brands, and the premium home audio segment, addressed via Architettura Sonora, an innovative design initiative that delivers high-performance acoustic solutions and immersive listening experiences.

Founded in 1946 in Florence, Italy, B&C Speakers traces its origins to a small workshop called BBC Elettroacustica Professionale, dedicated to crafting basic acoustic transducers. From being initially focused on public address applications, such as installations used during the 1948 Italian general elections, the company gradually expanded into cinema and theatre systems and outdoor public areas through several collaborations with major Italian loudspeaker producers.

The 1970s and 1980s marked a decisive phase of growth, driven by expanding worldwide live music events and growing demand for professional-grade sound reinforcement. During the two decades, the company developed technical skills, identified sound reinforcement as its main strategic focus, and changed its name first to BBC Speakers S.p.A. in 1988 and then to B&C Speakers S.p.A. in 1993 to create a worldwide identity.

Meanwhile, B&C also started expanding outside Italy, setting up in Europe and in the United States, and capitalising on cost leverage in supplying high-quality components at low costs. Centralisation of production occurred in Florence at Bagno a Ripoli in 1996, leaving room for higher capacity and effectiveness in operations. From there, the company grew to become one of the globe's most prominent manufacturers of professional audio components, and it today distributes in over 70 countries. Listed since 2007 at the Borsa Italiana and at Euronext Milan - STAR Segment since 2013, at the beginning of August 2025 its market value is €180 million.

The company's financial results are solid and demonstrate a positive growth trajectory. In 2024, the group reported revenues of €100 million, marking a 7% increase on the previous year. Over 90% of the company's sales are generated abroad, primarily in Europe (55%), North America (21%), and the Asia-Pacific region (17%). It primarily serves top-tier original equipment manufacturers in the pro-audio sector, accounting for 70% of sales, and sells directly under its own brands, accounting for 30%. This gives the company a significant market share in touring and live events, as well as a strong presence in installations. B&C Speakers has experienced solid growth in recent years, with net sales increasing by 14% each year on average between 2016 and 2023. This has further strengthened its position as a global leader in professional loudspeakers. Apart from the period of the pandemic, when many live events were cancelled, the group has grown steadily. The Research and Development Department represents 12% of employees and the group allocates approximately 40% of its indirect personnel costs to R&D, witnessing its commitment to innovation.

Furthermore, the company reports an EBITDA margin of approximately 21% and a net profit margin of 18%, underscoring the group's solid operating efficiency and high value-added positioning.

The group operates today through four main brands. B&C Speakers, as the original and core brand, designs and manufactures transducers entirely in Italy, with an emphasis on performance and reliability. Eighteen Sound, acquired in 2017, is a technology-driven label recognised for innovative professional transducers that combine advanced engineering with distinctive design. Ciare is a historic Italian brand offering solutions for the car audio, home hi-fi, and professional audio markets, with a focus on value-oriented products. Eminence, acquired in 2023, is an American firm specialising in cost-effective instrument amplifiers and portable audio transducers, manufactured in the United States (Kentucky) and China (Dongguan). Distribution logistics are managed through a network of distributors and dedicated subsidiaries in Italy, the United States, and Brazil.

3.2) Use of rare earth elements

B&C Speakers' reliance on rare earth elements is entirely linked to its use of high-performance permanent magnets in loudspeaker production. The company does not import raw elements directly. Instead, it sources finished magnets, primarily neodymium-based, from Chinese manufacturers and suppliers. Neodymium magnets, recognised as the most widely used type worldwide, offer the highest performance-to-volume ratio among commercially available magnets. Used in a vast range of industrial applications, they enable, in B&C's case, to obtain the high power and acoustic performance required in professional audio systems.

The key rare earths used indirectly in B&C's products are praseodymium, dysprosium, some terbium, and neodymium itself. As of now, the company considers these materials irreplaceable for its needs. As highlighted by Andrea Pratesi, the firm has conducted years of research, dedicating internal R&D resources to exploring possible substitutes. While incremental technological improvements have reduced the amount of rare earths required per magnet without deeply sacrificing performance, no alternative material has yet matched the neodymium-based solutions.

The company's product portfolio reflects this dependency: more than 80% of B&C's loudspeakers incorporate rare earth-based magnets. The remaining ~20% use ferrite magnets, which offer roughly one-tenth the performance of neodymium magnets and are generally used in lower specialised products.

Given this configuration, B&C's rare earth exposure is concentrated not at the mining stage, but in the downstream magnet manufacturing segment, which, as described in Chapter 1, is heavily concentrated in China. At the time of the interview, the company confirmed that 100% of its magnets were sourced from Chinese manufacturers, making it directly dependent on the stability of Chinese exports of rare-earth-containing components.

3.3) Impact of Chinese export restrictions and licensing process at B&C Speakers

The recent imposition of new export restrictions by the Chinese Ministry of Commerce had an immediate and direct effect on B&C Speakers. Practically overnight, the flow of magnets from China stopped as all shipments required individual export licenses. The sudden change in regulation created uncertainty not only for foreign customers but also for Chinese customs authorities, which were unprepared for the new procedures. In the absence of clear operational guidelines, several customs offices chose to put all outgoing shipments of magnets on hold. This reaction extended even to ferrite ones, which contain no rare earth elements and were not subject to the restrictions. The resulting climate of uncertainty amplified the impact on B&C's supply chain, as the company could not predict when or how magnet shipments would resume.

In order to enable its suppliers to obtain the newly required export licenses, B&C Speakers was asked to provide documentation to the Ministry of Commerce. They submitted a description of the activities as a professional loudspeaker manufacturer, photographic evidence of its assembly lines, and an aggregated breakdown of sales by geographic area, with the U.S. share reported conservatively to avoid potential delays in approval. No customer names were disclosed, and the company also signed declarations confirming that magnets would not be used for dual-use purposes such as military applications. According to the interviewee, these requirements were not regarded by either B&C or its Chinese partners as an attempt to collect strategically sensitive information for competitive purposes, but rather as a bureaucratic countermeasure introduced in response to U.S. tariff threats.

The licensing process took more than two months before the first approval was granted, allowing shipments to the Italian branch to resume. The delay, however, obliged the company to resort to costly air freight to shorten delivery times, increasing logistics expenses compared to the regular use of sea transport. While the situation for the Italian operations gradually stabilised, with licences being released by the Chinese government in approximately forty-five days, the United States subsidiary had still not received any license at the time of the interview, leaving its American operations fully exposed to continuing supply disruptions.

3.4) B&C's responses to the crisis

In navigating the challenges brought on by the Chinese export restrictions, B&C Speakers drew on both pre-existing strategies and new solutions implemented in response to the critical situation.

One significant factor that allowed B&C to maintain operational continuity was the inventory buffer they had already established. Before the crisis unfolded, the company had recognized the importance of maintaining a substantial stock of critical materials. This foresight allowed them to continue production during the initial two-and-a-half-month period when no new shipments were arriving. As soon as the first licenses were granted and shipments resumed, B&C immediately began rebuilding its inventory levels via plane to ensure they could withstand any further disruptions, targeting a stock that would last them through the end of the year.

Furthermore, even before these restrictions were imposed, B&C had already initiated efforts to diversify its supplier base. As stated in the 2024 balance statement report, concerns raised at the board level about supplier concentration had prompted the firm to broaden its sourcing base. While a single Chinese supplier still accounts for the bulk of neodymium magnets, B&C has begun expanding its portfolio "even if it means paying a bit more" and is actively monitoring options beyond its core relationships. In this context, the company keeps contacts open with potential partners, mentioning a Korean downstream firm building a facility in Vietnam and an Australian player active along the rare-earth value chain.

After the crisis began, additional responses were introduced. Given that the U.S. subsidiary had not obtained any export license at the time of the interview, B&C started working on an alternative route with a Chinese-owned producer operating outside mainland China, in Vietnam, which can carry out sufficient processing to change the certificate of origin of the magnets. This project is still in development and production has not yet commenced at the facility. However, once operational, this arrangement could enable some magnet processing to take place outside China, thereby reducing dependence on shipments that are directly subject to export licensing. Although this initiative is still in its early stages, it has been described as an important step towards building a more resilient supply chain for the future.

In parallel, B&C approved for production a different magnet specification that removed the need for heavy rare earths such as dysprosium and terbium. This adjustment was technically feasible because the company's loudspeakers operate at significantly lower thermal requirements compared to other applications, such as electric vehicle traction motors. Chinese manufacturers quickly adapted their processes, making use of hydrogen-based treatment to improve particle alignment within the magnet. This adaptation enabled the production of magnets based solely on light rare earths, which complied with the new regulatory framework. The shift to these heavy-rare-earth-free magnets made it possible for B&C's suppliers to obtain export licenses and restore the flow of compliant magnets, covering most of the company's product range.

3.5) Strategic responses assessed through the case study

In discussing the broader set of corporate responses to geopolitical risk outlined in Chapter 2, several reflections emerged regarding their feasibility and effectiveness for B&C Speakers. Inventory accumulation was confirmed as an effective short-term measure: existing stocks had allowed the company to overcome the licensing delays without production stoppages, although at the cost of resorting to more expensive air shipments. Long-term supply agreements, by contrast, were seen as of limited value for a small-sized player, since structural bottlenecks in processing capacity make such arrangements viable only for very large firms, as in the case of Apple’s deal with MP Materials.

Geographic diversification was considered both necessary and realistic, though complex. B&C has already expanded its supplier base within China and is exploring opportunities with partners in Asia and Australia, while also following potential developments of production capacities outside mainland China. Vertical integration, on the other hand, was viewed as largely impractical for a company of its scale, requiring multi-year investments that remain beyond reach in the long term.

On the technological-innovation side, as said, the company has already adopted magnets free of heavy rare earths such as dysprosium and terbium, demonstrating how incremental innovation can offer concrete relief in the short run. Finally, recycling and circular-economy solutions were judged promising but not yet feasible: current costs are several times higher than primary supply and performance losses remain significant, making them unsuitable for immediate adoption.

Overall, the reflections confirmed that while many strategies are discussed at the industry level, only some are practically applicable to B&C. In the short term, measures such as inventory buffers, product-level adjustments, and cautious geographic diversification stand out as the most viable, whereas structural or capital-intensive solutions remain distant possibilities.

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