INDUSTRY INSIGHTS ON CRITICAL RAW MATERIAL SUPPLY CHAIN RISKS AND SOLUTIONS

Findings from Stakeholder Engagement Activities
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INTRODUCTION

Increased globalisation has led to many benefits for manufacturers with the ability to obtain products, processes and services from almost every corner of the world. However, this has also led to a great level of complexity in supply chains. With the drive to minimise storage costs and deliver goods just-in-time, this can lead to issues in business continuity.

Here we will specifically focus on the supply chain risks associated with Critical Raw Materials (CRMs). CRMs are crucial to Europe’s economy and essential to maintaining our quality of life, but also have their own very specific challenges and solutions when it comes to minimising supply chain risk.

SCRREEN built an expert network on CRMs through Europe http://scrreen.eu. As part of its awareness raising and knowledge exchange activities, the KTN reached out to a range of stakeholders (through surveys and interviews) to better understand the current perception of risk associated with CRMs and the drivers for taking steps (or not) to minimise these risks.

The project also raised awareness of the role that substitution of materials can play in alleviating these supply chain risks. In the context of this work, substitution has four different meanings:

1. **Substance for Substance**
   - A replacement of one material for another with, nominally, the same or similar functionality.

2. **Service for Product**
   - When a function that uses a product containing critical raw materials is replaced with a service that no longer requires the use of that product.

3. **Process for Process**
   - A specific process that uses a critical material is replaced by another process that delivers the same or similar function, but using different materials.

4. **New Technology for Substance**
   - A new product or technology is developed that no longer requires the use of the critical material under consideration.

*Figure 1: Summary of substitute options*
A range of different stakeholders, including global businesses, SMEs and academics were consulted through these engagement activities to provide a broad viewpoint. The results from these activities are presented below.

**Summary of Feedback from Stakeholders**

Results have been collated from a series of engagement activities:

1. **Online survey** - sent out in January 2019 to +500 individuals, 24 responses received

2. **Short interactive survey** - held at the Materials Research Exchange Event in London 2018, completed by 20 individuals

3. **1-to-1 interviews** – 13 interviews have been undertaken with representatives from large multi-nationals, SMEs and expert consultants operating in key sectors and at different points in the supply chain (specifically, those with interests in alloys, magnets, batteries, electronic components and catalysts).

**Type of organisation engaged with and type of materials used**

The on-line survey was completed by 24 individuals who are employed in large industry, SMEs, academia or an “other” type of organisation. The “Other” category is represented by Geological surveys, RTOs, Government mines departments, National Laboratories and Trade / Industrial Associations.
These respondents were subsequently asked to identify which CRMs they used in their business or research. Refer to Figure 3.

Unsurprisingly, we received different responses to this question in our interviews depending on the sector in which the company operates. That said, the responses to the online survey are broadly consistent with the interviews in that multiple businesses mentioned that they use Cobalt, Light Rare Earth Elements (L-REEs), Heavy Rare Earth Elements (H-REEs) and Platinum Group Metals (PGMs).

An option was offered in the online survey for additional information to be gathered on materials that are not currently classified as a CRM by the European Commission but are considered by the respondent to be critical to their business or research. Some of the common responses to this question which were verified in interviews were Lithium and Nickel. However it should be noted that not everyone interviewed would agree that Lithium should be classified as a CRM, with some companies not expecting a supply issue while others are concerned about significant price increases. Mica was also flagged up by a large multi-national OEM as a mineral they classify as a CRM within their business due to concerns over child labour practices associated with its extraction.

Further feedback collected during our interviews highlighted that many businesses describe certain chemicals, rather than specific elements, as ‘critical’ due to the current or projected-future regulatory pressures to find a replacement. Examples that came up during our interviews include: NMP (a solvent used in coatings); chromic acid and other chemicals containing Chromium VI; and isocyanates.
Of the CRMs listed, respondents were then asked which are the top three materials that can cause issues with business continuity. A range of answers were given, but the most common answers were:

- Heavy and light rare earths
- Platinum Group Metals (PGMs)
- Cobalt
- Indium

This question was also discussed with interviewees and Cobalt was consistently identified as a CRM by all companies operating in the battery and alloy sectors. Niobium, Vanadium and coking coal were highlighted as CRMs by those invested in steel alloys whilst PGMs were unsurprisingly consistently flagged as CRMs by those in the catalyst business. Indium is a major concern in electronics, particularly as Indium Tin Oxide in liquid crystal displays. H-REEs (specifically Dysprosium and Terbium) and L-REEs (specifically Neodymium and Praseodymium) were described as CRMs by those in the permanent magnet (PM) supply chain.

Notably companies working on super conducting magnets were more concerned about Helium (which is essential for cooling) than the REEs, this is due to the fact that significantly fewer REEs are used in super conducting magnets.

**Type of risk related to supply of CRM**

In the next question we asked respondents to identify the most common type of supply chain risk or issue they faced. This was asked as part of the online and interactive survey, and the information below is a summary of all responses.

Figure 4 shows the results when multiple answers could be given, and Figure 5 shows the results when the question asked respondents to choose their top priority.

![Issues of Material Supply (multiple answers)](image)

*Figure 4: The business issue respondents identified with in relation to CRMs (multiple answers possible)*
There are a large number of respondents that replied with “no” - they don’t have issues with CRM supply. However, of those that do experience an issue, “sharp price rises” was identified as the biggest single issue, followed by “materials becoming subject to regulation”. A number of people responded that there were “other” issues associated with the supply of CRMs. A few examples of “other” issues provided were: working with waste; regulation of material from conflict regions of the world; and that some materials are priced according to completely free market drivers (i.e. no London Metal Exchange listing to provide a guide).

The most common type of supply risk/issue identified during our one-to-one interviews was sharp price increases, consistent with the Survey findings. This is an issue for all companies, from small R&D focused companies up to large multi-nationals. One of the SMEs interviewed - who is developing new technology in batteries - told us they purchase their CRMs well in advance in order to minimise disruption and to allow time for budgeting. They are concerned about the increased supply chain risks as they move from R&D into full production. All companies big and small find it difficult to obtain reliable forecasting data from their suppliers around pricing of CRMs. The majority of interviewees also cited concerns regarding the regulation of CRMs which could impact their business, in particular Environmental and Health and Safety regulations and regulations relating to the import/export of certain CRMs.

**Action taken to mitigate risk**

Respondents were asked if there were any steps that their organisation has taken, or might take in the future, in order to mitigate the risk(s) identified. Again, multiple answers were allowed first (refer to Figure 6), followed by identifying the single most important mitigation action (refer to Figure 7).
The survey findings are broadly consistent with the feedback from interviews. We didn’t find anyone who was looking at acquiring part of their supply chain (vertical integration) as a means to mitigate supply chain risk, however most companies told us they were working closely with their suppliers and other supply chain partners to identify alternative sources of supply to help mitigate supply risk. Some companies are looking at more local primary sources of CRMs and some are considering CRMs that are extracted/produced as a by-product of another activity. All companies interviewed are very active in R&D to mitigate supply chain risk. Those working in more established markets (e.g. catalysts) have a big focus on thrifting, reducing the amount of CRM required whilst maintaining performance mitigates the CRM risk and is economically viable.
Some of the interviews representing large multi-national companies involved in alloys, catalysts and electronics told us they have well developed business models and recycling technologies or approaches. This has enabled them to create a circular economy through material recovery and recycling activities within their business and through the supply chain to help close the loop. In some cases, policy has helped however here is a general sentiment that policy could be improved to encourage better recycling, recovery and closed loop practice.

Companies developing products in emerging and high-growth markets (e.g. batteries) are active in R&D projects looking at some form of substitution. For example we interviewed two innovators – Deregellera (UK) and Cerpotech (Norway) - who are developing alternative cathode materials that would avoid the use of Cobalt (examples of ‘substance-for-substance’ substitution). In another example EpiValence (UK) was involved in EU Project INFINITY which investigated indium-free transparent conductive oxides. Tokamak Energy (UK) is developing a ‘technology-for-substance’ substitution option by developing applications for its superconducting magnets which could replace permanent magnets in certain applications.

In terms of barriers to substitution, we heard from multiple businesses that it can be difficult to get customers interested unless they can be convinced that performance will be uncompromised. The costs of re-certification (which in some sectors can take years) can also be a major economic cost in established markets, so businesses involved need to be confident that an investment will pay off. In some applications (i.e. permanent magnets) there is a limit to the amount of substitution that can be achieved without compromising performance, as a result substitution is not always the most appropriate route. In some cases, policy has helped, although there is a general sentiment that policy could be improved to encourage better recycling, recovery and closed loop practice.

All interviewees agreed that current global consumer and technology trends will result in using more – not less – CRMs, and using them in more complex mixtures, therefore an increased focus on R&D in substitution as well as recycling and recovery technologies for second life and secondary production will be required to help mitigate CRM supply risks.
Comparison of CRM risk with other business risks

For the on-line survey, and with some interviews, respondents were asked how the issue of CRM risks were prioritised with in comparison with other business continuity risks.

![Figure 8: How do risks related to CRMs compare with other business continuity risks?](image)

As can be seen from the diagram, there is an equal split between those organisations that have dedicated resource to mitigate CRM risks, and those that have not considered the risks. The experience from our interviews is that the vast majority of the organisations take CRM supply risks seriously. In large organisations we found that the people responsible for considering CRM supply chain risks are also responsible for other business areas, like sustainability or compliance, and are working closely with their colleagues in Procurement and Strategy to ensure a cohesion approach across the business.

Collective action

The final question in the interactive survey asked respondents to indicate what collective action could be taken that would support organisations to reduce the likely impact of CRMs on their operations. The results shows that the two most popular actions to take are:

1. Develop greater and more secure recycling and recovery route for key materials; and
2. Fund research and innovation into new products and materials.

The results of the survey are consistent with the interviews conducted so far in that all of the companies interviewed are involved in activities associated with recycling/recovery and/or R&D in substitution.
Figure 9: What collective actions would help minimise impact on your business?

Summary

In Summary, the data from Surveys and feedback from the interviews tell us:

- The most common CRMs that organisations highlighted as causing supply chain disruption are: Heavy and light rare earths; PGMs; Cobalt; Indium however this is often their response:
  1. their position in the supply chain;
  2. scale of operation;
  3. current commitment to a particular technology; and
  4. sector/ application focus.

- Other materials that are not currently on the European Commission list of CRMs, but businesses told us are critical to their business include: Nickel, Lithium and Mica. Businesses also flagged a number of chemicals as critical due to key role they play and the fact that they are now (or projected to be) subject to banned or subject to regulatory scrutiny.

- The most common type of supply chain risk that organisations experience is sharp price rises and this is expected to get worse in the future, not better. Many companies are also concerned by changes in export/import and EHS regulations.

- In order to mitigate supply chain risk, companies are working closely with suppliers and other partners to add a second source of supply. They are also active in R&D associated with recovery and recycling. Many companies, particularly those in emerging markets, are active in R&D associated with substitution.

- A significant number of organisations have dedicated resource to mitigate CRM risk. However, there is an equal number of organisations that do not have any dedicated resource to manage this risk – further awareness raising activities could be helpful to this community.
This report was produced during the course of the SCRREEN project. This and other CRM-related reports is publicly available on the SCRREEN website.

www.scrreen.eu