Chapter 34
Critical Raw Materials and UK Defence Acquisition:
The Case of Rare Earth Elements

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ABSTRACT

This chapter examines the factors which could affect future critical raw material availability for UK defence, focusing on the availability of rare earth elements (REE). These include tighter regulatory policy and its enforcement, export policies, promoting greater efficiency in resource use, efforts to mitigate resource depletion and more efficient resource extraction while reducing its associated environmental impact. There is also the effect these factors might have on global supply chains, the impact on material insecurity and how this may exacerbate the issue of their use in UK defence acquisition. While this chapter looks at the issues and vulnerabilities surrounding the availability of REE, underlying this is the increasing vulnerability of military supply chains in an increasingly globalised world.

INTRODUCTION

One of the biggest challenges facing both the UK Ministry of Defence (MoD) and the Defence Industry is trying to predict the future. This occurs in terms of planning for future conflicts and the forces that will be used to fight them (see for example MoD, 2014) but which also feeds into trying to estimate future demand for resources, their availability and security of supply, as well as the growing public pressure to achieve a more sustainable and greener military capability (EDA, 2012; Hedrick, 2013; MoD, 2011).

These challenges, combined with questions over the availability of certain critical raw materials, widespread increases in their prices, limited sources of supply and the dependence on a limited number of politically unstable or authoritarian countries as sources, pose further risks and potential insecurities to industry as a whole, and to defence in particular. (Bradsher, 2011; KPMG, 2012) Such risks have the

DOI: 10.4018/978-1-5225-7912-0.ch034

potential to have a negative impact on the conduct of future operations, as much of the digital technology that has become available in the last few years relies on imported, yet strategically important, raw materials. Such a dependence on complex global (but fragile) supply chains is only likely to increase both the risk of systemic failure as well as its impact. In the future, will the primary concern be about accessibility rather than availability (Humphries, 2013)?

Furthermore, the environmental impacts associated with ensuring resource availability are likely to increase as the most abundant and easily accessed reserves are exhausted in response to population growth, continuing industrialisation and higher material prosperity (Ahmed, 2014). Even if substitutes are available – and in many cases they are not (Dennehy, 2013) – better overall environmental performance and reducing the impact on the environment are sometimes achieved through the use of materials that have an even greater environmental impact or a dangerous extraction method. This paradox may be avoided by developing new material processing techniques that are less hazardous and have greater security, or utilising materials common in the wider economy that have exceptional performance characteristics and lower environmental costs, in order to satisfy demand from the UK defence and security sector (Powell-Turner et al, 2011).

This chapter examines the factors which could affect future critical raw material availability for UK defence, focusing on the availability of rare earth elements (REE). These include tighter regulatory policy and its enforcement, export policies, promoting greater efficiency in resource use, efforts to mitigate resource depletion and more efficient resource extraction while reducing its associated environmental impact. There is also the effect these factors might have on global supply chains, the impact on material insecurity and how this may exacerbate the issue of their use in UK defence acquisition. While this chapter looks at the issues and vulnerabilities surrounding the availability of REE, underlying this is the increasing vulnerability of military supply chains in an increasingly globalised world.

THE CHARACTERISTICS OF RARE EARTH ELEMENTS

Despite the name, REE are not rare, but are a moderately abundant group of seventeen metallic elements (see Figure 1) found in low concentrations throughout the earth's crust. For example, the most abundant REE is cerium, which is more prevalent than copper at sixty parts per million (ppm), while the least abundant elements, lutetium (0.5ppm) and thulium (0.5ppm), are more prevalent than antimony, bismuth, cadmium and thallium. REE includes fifteen elements from the group known as the lanthanides (which have atomic numbers ranging from 57 to 71), along with scandium (atomic number 21) and yttrium (atomic number 39). They are generally classified into two groups: light group rare earths (LREE – which consists of cerium, lanthanum, neodymium, praseodymium, promethium and samarium) and heavy group rare earths (HREE – which consists of dysprosium, erbium, europium, gadolinium, holmium, lutetium, terbium, thulium, ytterbium and yttrium). Yttrium is usually included in the HREE as it has similar chemical properties, while scandium is not included in either group. Although minerals of both types may occur in a single deposit, minerals in LREE are generally more abundant than those of HREE (Hedrick, 2004; Vulcan, 2008).

It is the difficulty with which these elements can be extracted which causes their scarcity. The majority of the economically viable REE is derived from LREE ores. The production process is complex

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