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**Implications of Dual-Use Technologies on
Critical Minerals Policy and Strategy**

Dr. Fabian Villalobos

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The Problem of Dual-Use Technologies

Actions to address critical materials vulnerabilities are complicated by the fact that components needed by the defense industrial base (DIB) to build military systems and equipment are dual-use technologies.

Dual-use technologies are those that are developed by academia and commercial industry primarily for non-defense or security applications in response to the potential demand from larger, civilian markets but which also have military utility or can be applied in military platforms and weapons systems. Lithium-ion batteries (LIBs) for energy storage are a prime example. LIBs have captured the greatest share of civilian demand for mobile energy storage, primarily because of their relatively high specific energy, which translates into longer life for mobile electronics or longer range for electric vehicles. LIBs, for these same reasons, are needed to fill DoD demand for mobile energy storage, whether for extending operational capabilities that depend on portable energy or introducing new ones. There are other reasons to adopt civilian technologies, not the least of which is cheaper products due to larger scales of production.

However, in dual-use technology markets such as the LIB market, the DoD is often a small consumer within a larger market driven by demand from commercial applications. In contrast to technologies and capabilities with limited applicability outside warfare, such as munitions, the DoD has little leverage to shape and influence suppliers to meet specific military requirements or address concerns from a national security perspective.

This limits the effectiveness of policy options available to the DoD and shapes the overall strategy with which to approach risk mitigation.

Risks from Disruption of Critical Minerals Supply Chains to the DoD

Previous RAND research has categorized the risks to the Department of Defense (DoD) posed by critical materials.¹ These risks are placed into three categories of hazards² that could:

1. restrict the broader U.S. economy's access to critical materials (i.e., competition risks);

¹ Fabian Villalobos, Jonathan L. Brosmer, Richard Silbergliitt, Justin M. Lee, and Aimee E. Curtright, *Time for Resilient Critical Material Supply Chain Policies*, RAND Corporation, RR-A2102-1, 2022.

² The term 'hazard' is used here to distinguish from 'risk' which is usually a calculation of the costs of a particular 'hazard' and the probability of the consequence occurring. However, throughout this memo 'risk' is used in the colloquial sense and can be interchanged with 'hazard'.

2. restrict the defense industrial base’s ability to deliver needed capabilities (i.e., industrial readiness risks); and
3. restrict the DoD’s ability to operate during a conflict (i.e., operational risks)

Competition Risk

Ensuring access to material inputs for the broader U.S. economy benefits economic security – i.e., the “ability to protect or advance U.S. economic interests in the face of events, actions, or other developments that threaten or block those interests.”³ At times this may include the support of specific industries important to economic growth and welfare. In addition, the National Science and Technology Council has also denoted certain technological areas as potentially important to national security and labeled them “critical and emerging technologies”.⁴ Several of these industries are dependent on critical minerals and also essential to the clean energy transition – e.g., batteries, renewables, semiconductors and microchips, and more.

Maintaining competitiveness in these industries is thus a priority for U.S. policymakers and threats to competitiveness in the industries that produce these technologies can place both national and economic security at risk.

Industrial Readiness Risk

The military services’ responsibilities are to train and equip forces assigned to combatant commands; this includes the acquisition of materiel. The DoD’s acquisition system depends on original equipment manufacturers (OEMs) to produce weapon platforms, systems, and other equipment. This group of OEMs, often referred to as the “Primes”, constitute the larger players within the defense industrial base. However, they too are reliant upon multiple tiers of suppliers that integrate and test subsystems, manufacture major subsystems or components, and ultimately those that produce basic subcomponents and raw materials.⁵

The DoD has identified risks pertaining to the DIB. These include: foreign dependencies, single source suppliers, production capacity of facilities, emergencies or disasters, financial health of suppliers, specialized equipment or skills, and obsolete items.⁶ Vulnerabilities inherent

³ Neu, C. Richard and Charles Wolf, Jr., *The Economic Dimensions of National Security*, RAND Corporation, MR-466-OSD, 1994. As of September 1, 2023: https://www.rand.org/pubs/monograph_reports/MR466.html

⁴ The White House, *Critical and Emerging Technologies List Update*, National Science and Technology Council, February 2022. As of September 8, 2023: <https://www.whitehouse.gov/wp-content/uploads/2022/02/02-2022-Critical-and-Emerging-Technologies-List-Update.pdf>

⁵ United States. Government Accountability Office, and Marie A. Mak. *Defense Industrial Base: Integrating Existing Supplier Data and Addressing Workforce Challenges Could Improve Risk Analysis: Report to the Chairman of the Committee on Armed Services, House of Representatives*. United States Government Accountability Office, 2018.

⁶ United States. Government Accountability Office, and Marie A. Mak. *Defense Industrial Base: Integrating Existing Supplier Data and Addressing Workforce Challenges Could Improve Risk Analysis: Report to the Chairman of the Committee on Armed Services, House of Representatives*. United States Government Accountability Office, 2018.

in critical minerals supply chains can manifest in each of these categories of risk. For example, relying on foreign suppliers for material inputs exposes the DoD's OEMs to potential supply disruptions outside the U.S. In another example, volatility in commodity markets may cause sudden decreases in prices for specific minerals. Suppliers to the DIB that are also producers of the specific mineral may have their financial health negatively impacted by such price decreases and may place them in jeopardy of bankruptcy or other outcomes that impact the DoD's acquisition of materiel.

Additionally, when dual-use technologies require critical minerals, other consumers of critical minerals in the DIB may be affected by prices, material availability, and other issues due to their smaller procurement quantities. One example is the use of lithium in thermal batteries. If LIB demand from other industries like autos and mobile electronics grows significantly, suppliers of lithium products may choose not to service smaller customers with more complicated needs like thermal batteries or to raise prices. Depending on the particular contract agreements for a program of record, the DIB supplier may be placed in financial trouble.

Whether due to human factors (malign or unintended) or natural causes, after a disruption, an OEM's continued access to materials becomes clouded in uncertainty and could impede the delivery of systems, platforms, or equipment essential to military readiness.⁷

Operational Risk

During an on-going conflict, stockpiles of munitions or the loss of specific equipment, weapons systems, or platforms may induce demand for additional units. However, production lines can be slow to restart or expand capacity in response to sudden spikes in demand – e.g., the Russo-Ukrainian war has strained OEMs to produce munitions such as Stinger missiles.⁸ Should a specific system require inputs from critical minerals, this could place access to these systems at risk. As we can see, “[c]onsequences at the operational level would likely require several (un)fortuitous events to coincide. For example, a spare component that depends on [rare earths] (e.g., an electric motor) could be out of stock during a disruption. In this case, disruption could cause a platform or weapon system to be sidelined during a conflict. This results from one hazard (DIB unable to receive [rare earth] inputs) compounding on another (spare [parts] out of stock).”

⁹ Coincidental though they may be, these disruptions happen. There are also fears that

⁷ Military readiness includes a measure of equipment and supplies on hand. For more, see Joint Staff, Force Readiness Reporting, Washington, D.C.: Joint Staff, CJCSI 3401.02B, July 17, 2014.

⁸ Copp, T., America is sending so many arms to Ukraine that it's putting major pressure on the Pentagon's weapons stockpile, *Fortune*, November 24, 2022. As of September 11, 2023: <https://fortune.com/2022/11/24/us-sending-arms-ukraine-pressure-pentagon-stockpile/>.

⁹ Fabian Villalobos, Jonathan L. Brosmer, Richard Silbergliitt, Justin M. Lee, and Aimee E. Curtright, *Time for Resilient Critical Material Supply Chain Policies*, RAND Corporation, RR-A2102-1, 2022.

disruptions could be deliberately implemented during a conflict to directly impact the warfighter on the battlefield.

Implications for Policy Strategy

The DoD has a responsibility to ensure access to critical minerals for its own purposes – it does not have responsibility to ensure access to these same materials for the entire U.S. economy, nor is it realistic to believe it has the ability to do so.

Using tools such as the Defense Production Act Title III to invest in a specific mine or processing facility to help build domestic capacity can be useful for reducing competition and industrial readiness risks, but the effectiveness of this tactic may be unclear until years later. Likewise, investments in research and development of alternative processing methods or alternative technologies that use less critical minerals may reduce risks in these two categories, but also have uncertainty related to their probability of success. A more strategic approach to policy selection and implementation is required to effectively address these risks.

Because the DoD will find itself more often than not a small consumer of dual-use technologies compared to the larger civilian market, the approach of the DoD may be to reduce emphasis on shaping the behavior of market suppliers and investors and focus on becoming a better customer for said suppliers. To ease the process of doing business with the defense acquisition system, requirements and acquisition professionals in the DoD will need to communicate with each other and with suppliers of components reliant upon critical minerals. It is these groups of defense personnel who interact most with suppliers and have the greatest impact on individual programs of record where these vulnerabilities ultimately manifest.

Implications for Competition Risk

Impacts from the growing demand for dual-use technologies in the civilian sector are most likely to affect competition risks. Industries providing these technologies are likely to be designated more often as important to economic growth and welfare due to their market size. Large civilian demand for dual-use technologies is also likely to increase the pool of suppliers to include foreign competitors and thus introduces the risk of foreign dependencies via suppliers aiming to increase efficiency and drive down manufacturing costs by sourcing abroad. Unfortunately, it is these industries that the DoD is likely to find it the hardest to influence due to their small size in the market. Instead, the DoD can decide when to conform requirements to match the quality and performance of components that civilian markets can produce and when to pursue more defense-specific capabilities. There is no doubt that not all components will be able to conform to civilian markets, but considerably more can be done to make the DoD a better customer for these domestic and trusted foreign suppliers in these markets.

Another way to become a better customer to civilian markets is by increasing the DoD's demand signal for dual-use technologies. Through the use of stockpiling; increasing foreign

military sales; or acquisition of larger quantities of units, spares, and replacements, the DoD could increase its procurement quantities and signal to suppliers that it is a stable source of revenue. This may benefit the DoD's ability to influence civilian markets or at least certain subsets of suppliers.

Lastly, “de-coupling” supply chains was seen as a possible pathway towards mitigating risks from foreign dependencies but has given way to “de-risking” due to low feasibility of de-coupling. Neu and Wolf Jr. note that withdraw or isolation from foreign markets may “do more harm than would any shocks. Instead, the U.S. should seek to ensure access to foreign markets at market prices.”¹⁰ Taken within the context of critical minerals, the U.S. should seek to ensure its Primes and their suppliers have access to critical minerals in foreign markets at fair market prices.

Implications for Industrial Readiness Risk

Risks to industrial readiness are also likely exacerbated by the problem of dual-use technologies. The DIB is likely to be dependent on civilian suppliers for its dual-use technology needs, though they are likely to source these components or systems from domestic suppliers given the regulations and guidance they must follow. However, these domestic suppliers of dual-use technology may or may not source their critical mineral inputs or critical mineral-reliant sub-components domestically.¹¹ Upstream transparency is thus a concern for the DoD. Providing incentives to suppliers to adopt practices for better transparency into raw materials sourcing can help the DoD target which critical minerals and programs are of greatest concern and can help prioritize efforts to build domestic extraction and processing capacity.

In practice, individual programs of record and their program managers must oversee multiple tiers of suppliers. Whether a major defense acquisition program or a commercial-off-the-shelf solution, it is at this granular level that changes must be implemented. Program managers (PMs) must be educated on issues of foreign dependence on critical minerals, which components or sub-systems in their programs are most at risk, and be cognizant of the options for risk mitigation. Program executive offices, which oversee multiple programs of record, can therefore play a role in coordinating risk reduction and mitigation efforts across programs.

The DoD has regulations and guidance to source items domestically to address national security concerns. This is done to avoid dependence on politically unreliable foreign suppliers or to protect technologies and products that are classified, offer warfighting superiority, or enable

¹⁰ Neu, C. Richard and Charles Wolf, Jr., *The Economic Dimensions of National Security*, RAND Corporation, MR-466-OSD, 1994. As of September 1, 2023: https://www.rand.org/pubs/monograph_reports/MR466.html

¹¹ A RAND study of uncrewed vehicles has demonstrated DoD Program Office reliance on Chinese suppliers for LIBs. See Wilson, Bradley, Ellen M. Pint, Elizabeth Hastings Roer, Emily Ellinger, Fabian Villalobos, Mark Stalczynski, Jonathan L. Brosmer, Annie Brothers, and Elliott Grant, *Characterizing the Uncrewed Systems Industrial Base*, RAND Corporation, RR-A1474-1, 2023.

countermeasures to U.S. capabilities. However, in practice exemptions are made and transparency into these lower tier suppliers is not guaranteed. Aligning the DoD's technological needs – via capability requirements and, later, military standards – with civilian industries' technical capabilities whenever possible is a way to ensure that developments in the civilian market do not outpace the DoD (causing obsolescence issues) while also broadening the number of potential suppliers of the DoD's materiel. Reducing domestic sourcing requirements to focus solely on those defense applications that cannot rely on the level of technical ability available from civilian suppliers could also help increase the DoD's demand signal. In practice, the requirements community and program managers must communicate these issues and options for risk mitigation to each other with input from civilian suppliers.

Implications for Operational Risk

Without involving program managers in discussions to reduce or mitigate risks from critical minerals dependencies, individual programs will be exposed to those risks to varying degrees. In an ideal situation, training of program managers would include emphasis on critical minerals dependencies thereby ensuring all programs and their PMs are prepared to reduce these risks. In reality, the DoD may find that prioritizing certain programs, and their PMs, that are most vulnerable or most needed on the battlefield could be a faster pathway to reducing risk and uncertainty. This may involve the review of operational plans for specific scenarios and theaters. However, the DoD should not try to become a “reader of crystal balls”; that is, the DoD should take measures that do not disregard the uncertainty of which scenario will play out and in which theater. Instead, the DoD should take a robust approach to reducing or mitigating risk across a number of scenarios or theaters. This can be pursued by using decision-making under deep uncertainty methodologies.

Concluding Thoughts

Dual-use technologies are likely to spur development of multiple suppliers amongst allies and partners to the U.S. as well as domestically. Competitive and industrial readiness risks are most likely to be exacerbated by dual-use technologies due to the broader group of affected stakeholders and the small demand coming from the DoD. Operational risks can be reduced by prioritizing the programs most likely to be needed on the battlefield or are most reliant upon critical minerals inputs.

“As in military affairs, capitalizing on one's own strengths or exploiting an opponent's weaknesses may prove a more effective counter than trying to meet an opponent's challenge head-on.”¹² Trying to match the production capacity of countries of concern like China, Russia, or others using piece-meal investments tools will be difficult. However, the risks complicated by

¹² Neu, C. Richard and Charles Wolf, Jr., *The Economic Dimensions of National Security*, RAND Corporation, MR-466-OSD, 1994. As of September 1, 2023: https://www.rand.org/pubs/monograph_reports/MR466.html

dual-use technologies may be reduced or mitigated if the DoD can increase its demand signal; align its material, component, and system inputs with the civilian sector; and accept that foreign reliance on allies and partners is a different risk qualitatively than foreign reliance on countries of concern.