



SMARTSAT
COOPERATIVE RESEARCH CENTRE

SECTOR PRIORITIES

Mining And Energy

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This report should be cited as:

SmartSat 2021, Mining and Energy Sector Priorities 2021, SmartSat CRC, Adelaide, Australia.

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SmartSat acknowledges the contribution made by Nova Systems Australia towards the writing and compilation of this technical report.

Acknowledgements and Preamble

The SmartSat is a collaborative consortium of industry and research organisations that are developing enhanced satellite connectivity, navigation and monitoring capability to propel Australia's space industry forward and generate transformative technologies to support sector needs. The technologies developed by SmartSat have the potential for application across a wide range of sectors.

As part of its planning, SmartSat had established three End User Boards to identify the challenges and needs of their sector and formed working groups to develop their respective Sector Priorities under the guidance of SmartSat's Industry and Deputy Industry Directors. Sector Priorities have been developed for: Agriculture and Natural Resources, Mining and Energy, Defence and National Security

These priorities will inform the SmartSat Research Program and help improve the sustainability and prosperity of critical sectors through harnessing transformative space industry technologies. Across each of the sectors, common problems have been identified which further highlighted the need for strong and robust cross-sector collaboration and the need for the space industry to leverage and pivot their technology and capability to service multiple sectors.

The priorities identified can be used by SmartSat partner organisations and the space community to help guide development of project proposals and identify priority areas for further research and development.

SmartSat would like to acknowledge the members of the Mining and Energy End User Advisory Board for their contributions:

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Mining and Energy Sector Priorities 2021

Purpose	To improve the effectiveness and sustainability of the Mining & Energy sector through the enablement of transformative space technologies		
Summary	<ul style="list-style-type: none"> • Australia’s challenging geography and limited built infrastructure create a need for integration of innovative technologies into operations to maintain viability. • Transformative technologies in the fields of automation, robotics and data analytics can help revolutionise the Mining & Energy sector with aid from SmartSat CRC’s enabled satellite technology. • Maintaining operational viability, countering resource quality reductions and managing Social License to Operate are key issues facing the Mining & Energy sector. 		
Sector Needs	<p><u>Need 1: Value Chain Optimisation</u> Optimising value chain efficiency, operability, and profitability through increased digitisation and data tracking.</p>	<p><u>Need 2: Reducing Sector Risks</u> Management of evolving risks and threats to maintain sector safety and combat the increasing complexity and scarcity of resources.</p>	<p><u>Need 3: Social License to Operate</u> Management of issues sensitive to Social License to Operate including transparency, social expectations and corporate social responsibility.</p>
Priority Focus Areas	<p>Focus 1.1: Enhanced Digitisation Across the Entire Value Chain Digitisation capability that supports collection and connectivity of data across the entire value chain enabling data-driven decision making through connection IoT and digital twins.</p> <p>Focus 1.2: Communications and Data Transfer Communication and data transfer capabilities that support full value chain responsiveness.</p> <p>Focus 1.3: Automation, Robotics and Artificial Intelligence Capability and technology development to support industry uptake in automation, robotics, AI, deep learning, machine learning and data analytics.</p>	<p>Focus 2.1: Cybersecurity Cybersecurity measures to manage the evolving threats introduced by increased digitisation.</p> <p>Focus 2.2: Enhanced Remote Operations Enhance remote operating capabilities through sophisticated technologies to safely manage the growing complexity of resource extraction.</p> <p>Focus 2.3: Resource Identification Broaden and sharpen methods to discover previously unidentified resources in both explored and unexplored geographies.</p>	<p>Focus 3.1: Clean Energy Technology Integration Clean technology integration into both existing and future operations to reduce reliance on fossil fuels and to ensure that environmental targets are met.</p> <p>Focus 3.2: Environmental Threat Management and Rehabilitation Transparency Management, monitoring and mitigation of environmental threats imposed by operations across the entire asset lifecycle to ensure environmental and personal safety through Earth Observation technologies.</p> <p>Focus 3.3: Health and Safety Technology development to ensure the continued safety and wellbeing of all people within the workforce.</p>
Principles and Objectives	<ol style="list-style-type: none"> 1. Delivery of R&D programs that harness automation, robotics and data analytics to assist in the transformation of the Mining & Energy sector 2. Development of skills in both the current workforce and STEM students to meet the needs of the future in the Mining & Energy sector 3. Creation of a diverse, ethical and multicultural workforce that has a focus on safety and wellbeing programs to support healthy and productive work environments 4. Communications that foster the adoption of new technologies and promote both intra-sector and cross-sector collaboration 5. Develop and assemble data analytics solutions that are FAIR (Findable, Accessible, Interoperable and Reusable) 		

1 Introduction

The SmartSat CRC (SmartSat) is a collaborative consortium of industry and research organisations that will develop enhanced satellite connectivity, navigation and monitoring capability to propel Australia's space industry forward and generate transformative technologies to support sector needs. It will catapult Australia to leadership in niche areas of intelligent satellite systems, advanced communications and Earth Observation driven data analytics.

The technologies developed by SmartSat have the potential for application across a wide range of sectors including Mining and Energy. Transformative technologies in the area of Earth Observations from space, Global Navigational Satellite Systems (GNSS) and satellite enabled communications can address the gap between data and decisions for Mining and Energy.

This document provides snapshot of key industry needs and research focus areas as well as a foundation for SmartSat to develop and implement projects and solutions based on the principles and objectives. The priority areas identified in this document were developed by the SmartSat CRC Mining and Energy End User Advisory Board (EUAB).

This document will be used by SmartSat to guide the development of project-focused strategies and establish SmartSat priorities. The project strategies will take into consideration the impact, cross-sector collaboration, leverage of other initiatives and programs, returns on investments, and returns and benefits to project partners and the industry as a whole.

This document may be used by SmartSat partner organisations to help guide development of project proposals and identify priority areas for further research and development.

2 Background

In 2018-19, the Mining and Energy sector contributed just over 10% of Australia's economy, with seven of Australia's top 10 export commodities produced by the Mining and Energy sector. Clearly, both Mining and Energy are important to the health of Australia's economy and future.

For the purposes of this guide, Mining refers to the extraction of ores or material from the earth – for example, iron ore, aluminium (bauxite) and precious metals – while Energy refers to the extraction of energy from the earth – for example, oil & gas, coal and uranium.

The term Energy sector is often used to encompass the total energy cycle including extraction, refining, manufacturing and distribution. This encompasses fossil fuels as well as renewable energy, energy storage, transmission and distribution. While the components of the Energy sector beyond extraction share common elements with the extraction portion, the needs and issues are sufficiently different to warrant separate consideration. The non-extraction elements of the Energy sector are therefore excluded from this analysis.

3 Strategic Principles and Objectives

The Mining and Energy Sector Priorities 2020 is framed by the following strategic principles and objectives:

- Initiate high-calibre R&D programs that further investigate the challenges and needs in different sectors. Selected programs will harness the application of Earth Observation, Automation, Robotics and Data Analytics in transforming the sector to a whole new level of digitisation.
- Stay ahead by thinking and planning in advance to overcome and combat unforeseeable challenges. Upskill the current workforce and develop STEM students to meet the needs of the future.
- Develop and introduce technologies that can ease communication gaps, enable remote operations and reduce unnecessary cost, through intra-sector and cross-sector collaboration.
- Build a resilient, ethical, multicultural and diverse workforce, with a focus on safety and on wellbeing programs that support a healthy and productive work environment.
- Develop and assemble data analytics solutions that are FAIR (Findable, Accessible, Interoperable and Reusable).

4 Sector Needs and Research Focus Areas

4.1 Need 1: Value Chain Optimisation

Mining and Energy projects in Australia frequently face remote operations, long supply chains and isolated working conditions. When coupled with complicated operations, these characteristics conspire to increase the waste and cost in operations. To ensure economic viability of operations across the sector, value chain optimisation must be achieved.

Optimising value chains has the potential to deliver increased productivity gains, enhanced resilience against dynamic demand changes, improved forecasting of market conditions and operational output. The key to unlocking this optimal state is total connectivity across the entire value chain, which will require solution development in the fields of digitisation, communications, and innovative technologies.

Research Focus Area 1.1: Enhanced Digitisation Across the Entire Value Chain

To enable a digitally enhanced operational value chain, digitisation capabilities need to be improved, both in development and usage, in several areas. Enhanced development and usage of IoT technology will provide critical situational awareness information for many aspects of a value chain, ranging from asset health/condition monitoring data to production-critical process control data. Integration of this connected, real-time data with a digital representation of the operation (digital twin) will allow for data-driven decision-making approaches that consider implications across the entire value chain.

Research Focus Area 1.2: Communications and Data Transfer

Value chains in the Mining and Energy sector can be large in both the physical and geographical sense. As such, reliable high-speed data is critical to achieving an efficient and responsive operation. To manage these challenging physical and geographical characteristics, operations must possess mature communication capabilities. Without fast and reliable communications and data transfer,

operational decision and response times will not achieve the required level, leading to reductions in the effectiveness of the whole value chain.

Research Focus Area 1.3: Automation, Robotics and Artificial Intelligence

Innovations and R&D-based programs focused on key technologies such as automation, artificial intelligence, data analytics, deep learning, edge computing, machine learning and robotics will offer significant improvements along the value chain. Innovations in these technologies will enable value creation through improved efficiency, optimised digital twins and increased safety. Further, innovations will enable the creation of new value chains: mining will be able to go deeper underground, difficult geographies will be able to be traversed and complex resources will be able to be extracted both effectively and safely, all of which will enable the creation of value by previously unavailable means.

4.2 Need 2: Reducing Sector Risks

The Mining and Energy landscape is consistently evolving to meet changing demands. As the industry evolves, new threats emerge. Enabling digitisation is necessary to exploit increasingly complex resources, but this increasing complexity produces a reliance upon digitisation, which in turn creates vulnerabilities. To combat evolving risks, cybersecurity measures must improve, security of remote operations must increase and development of new methods to explore, identify and extract resources must be developed.

Research Focus Area 2.1: Cybersecurity

As reliance on digitised operations and communications grows, so will the threat of cybersecurity breaches and failures. Cybersecurity must encompass defence against nefarious activities and resilience in the face of loss of service caused by natural or accidental means. To manage this increased threat, cybersecurity capabilities will need to be developed to ensure data, security, integrity, and safety is maintained. Cybersecurity must also consider risks associated with the use of technology developed by various nation states. For example, conflict or competition between the origin technology nation and deployment nation has potential to impact elements such as offshore data routing, data storage systems or positioning technology, which could in turn disrupt operations.

Cybersecurity is relevant beyond the Mining and Energy sector. As the movement towards digitisation grows and the need for secure, assured, and safe data expands, cybersecurity has become prevalent in a wide range of industries.

Research Focus Area 2.2: Enhanced Remote Operations

Resource extraction is frequently a remote operational activity with site-based workforces. The extent to which workforces operate remotely is set to increase as resources are discovered in increasingly challenging geographies that do not lend themselves to on-site workforces. To manage these operations and mitigate the associated risks, technologies such as remote asset health diagnostics will need to be developed to support remote operations capability growth. In many cases, conventional on-site workforces may be less viable, however, remote operations technology will enable workforces to control and conduct operations from remote locations such as central offices or from their homes and mitigate the risks of having on-site workers.

Research Focus Area 2.3: Resource Identification

To meet worldwide demand for resources, the Mining and Energy sector requires continuous exploration to discover new deposits. The continued application of historically proven exploration

techniques will likely become less fruitful as resource quality diminishes and/or resource indicators become more subtle. To avoid the risk of stalling, the Mining and Energy sector will need new methods to discover the current suite of in-demand minerals and, potentially, innovative methods to discover resources that become necessary as economies transition to a low-emissions future. This represents an opportunity to employ novel exploration and detection methods, for which Earth Observation coupled to AI and Machine Learning will offer benefits.

4.3 Need 3: Social License to Operate

Social License to Operate (SLO) is a challenging aspect of operational management and is not limited to the Mining and Energy sector. SLO requires the balancing of needs and expectations of stakeholders under the unwritten social contract between companies and communities. With growing public awareness on global challenges, there has been increased scrutiny on companies within the Mining and Energy sector to manage their SLO. Accordingly, there is increased focus upon emissions reductions through clean energy technology integration. Furthermore, environmental management throughout asset lifecycles is required as well as a focus on health and safety programs that do not compromise a work environment's profitability.

Research Focus Area 3.1: Clean Energy Technology Integration

Emissions reduction is a key challenge in the eyes of both the public and industry given the danger imposed by climate change. Further, technology capable of reducing emissions is currently commercially available. To fulfill their corporate social responsibility, Mining and Energy sector participants must be transparent about their efforts regarding emissions reductions and decarbonisation and, where appropriate, must adopt and integrate technologies into current and future operations. Increased operational electrification, electricity derived from renewable energy sources and carbon capture techniques are all means by which clean energy technology can be integrated into current and future operations.

Research Focus Area 3.2: Environmental Threat Management and Rehabilitation Transparency

Environmental threats are created at every step of an operational asset's lifecycle, from resource exploration to decommissioning. Social and technological capabilities must grow to accommodate the increased focus that the Mining and Energy sector should place upon the mitigation of such threats. Transparency regarding commitment to the management of these threats must be enabled and visibly pursued through technologies such as Earth Observation. For example, with the help of real-time imagery captured by Earth Observation satellites, rehabilitation and revegetation initiatives can be implemented strategically to demonstrate and ensure commitment to full life-cycle environmental threat management. Furthermore, to foster social and community trust, cultural heritage sites, waterway and environmental sites must be visibly maintained.

Research Focus Area 3.3: Health and Safety

Increased scrutiny from the public has led to increased focus being placed upon workforce safety and wellbeing across a wide range of industry sectors. Investment in employee safety, training and wellbeing should become a focus over the coming years to ensure that the Mining and Energy sector continues to be a safe and attractive work environment. Development in the fields of connected condition monitoring, whereby a supervisor may monitor a worker's hydration, heart rate and so on, as well as mental health observation stand to offer significant benefits for the sector and will promote increased workforce productivity. It is vital that technologies are developed to protect both on-site and remote workforces against the risks posed by the inherently dangerous workplaces attributed to the sector.

5 Concluding Remarks

The Mining and Energy Sector Priorities were developed with the aim of identifying priority industry needs and associated research areas that can be targeted by the SmartSat space community. Similar activities within the Agriculture and Natural Resources EUAB and Defence and National Security EUAB have resulted in similar sector priority documents being developed. Across each of these sectors, common problems have been identified which further highlight the need for strong and robust cross-sector collaboration and the need for the space industry to pivot their technology and capability to service multiple sectors.

The priority areas identified here and in other sectors lay the foundation for developing project focused plans for establishing projects that provide maximum impact and benefit within the sector and enhance cross-sector collaboration to leverage capability and investment and avoid duplication.

SmartSat will continue to invest in and establish early concept research projects while the Sector Plans are being developed. As such, the priorities identified here should also be used by SmartSat partner organisations to help guide development of project proposals and identify priority areas for further research and development (R&D).



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