Geospatial Council of Australia

Economic impact of geospatial services in Australia

PRELIMINARY FINDINGS

www.geospatialcouncil.org.au

We acknowledge and respect traditional owners as the original custodians of Australia's land and waters, as well as their unique ability to care for the country and deep spiritual connection to it. We honour elders past and present, whose knowledge and wisdom have ensured the continuation of culture and traditional practices.

Acknowledgements

Thank you to the following organisations for their generous support, which has made this study possible:

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About Geospatial Council of Australia

This assessment of the value of geospatial information in Australia in 2023-24 and projections to 2033-34 was commissioned by the Geospatial Council of Australia. The Geospatial Council of Australia is the peak body representing the interests of organisations and individuals, including new and emerging professionals working in the vast range of occupations for surveying, space and spatial in the digital world.

Today's geospatial professionals are leaders and innovators, advancing our industries with technologies using located based services, drones and autonomous vehicles, 3D modelling, robotics, artificial intelligence, machine learning, virtual reality and the Internet of Things.

Our members are professional individuals – established and emerging – or organisations including public and private sector businesses, not-for-profits, universities and training organisations.

With a commitment to diversity and inclusion, mentoring emerging talent, raising profile and advancing the economic benefits of our industry, we welcome new members to Australia's most forward-thinking geospatial community.

Our purpose is to sustain a vital, diverse and thriving geospatial community for the benefit of the nation.

About this report

This report is the pre-cursor to a more detailed report that will be released by 30 June 2024. The overall study has been commissioned by the Geospatial Council of Australia having identified the need after consulting with both our members and the wider geospatial industry and key government stakeholders. We are extremely grateful to the organisations listed above that have supported this work by contributing funding, and also through their participation via a steering committee, without which this work would not have been possible.

The study aims to highlight the critical role of geospatial information in enhancing national productivity, showcasing its significant direct economic impact on our national economy. Additionally, it seeks to explore opportunities for expanding its usage further. The study is not just an analysis of our current industry value – it's a forward-looking initiative projecting the potential impact of the geospatial industry on the Australian economy in 2034. While there is a very strong focus on the economic and productivity benefits that geospatial data and technology deliver, we are also interested in capturing some of the other benefits (non-financial) including various societal benefits from the day-to-day use of geospatial information, such as tackling climate change, environmental management, sustainability and emissions reduction monitoring, resilience planning, emergency and national disaster response and management, along with defence and security. By understanding where we stand today and envisioning our potential influence on the national economy over the next decade, we are aiming use this report to shape the future policies that will not only foster growth but, also position the geospatial sector at the heart of Australia's broader narrative and economic growth.

Geospatial Council of Australia

What is geospatial information and technologies?

This assessment of Geospatial information comprises all information with a location. The geospatial sector describes the organisations and professionals that acquire, integrate, manage, analyse, map, distribute, and use geographic, temporal, and geospatial information and knowledge. The industry includes consulting knowledge professionals, fundamental and applied researchers, technology developers, educators, and the applications developed and used to address the planning, decision-making, and operational needs of people and organisations of all types. Many of these activities are carried out by members of the wider geospatial information 'sector', which includes numerous government or semi-public agencies, universities, and other not-for-profit institutions, as well as private sector actors.

The geospatial sector is critical to the economy. Few, if any, industry sectors are not using geospatial technologies in their operations. Government is one of the biggest users of geospatial products, supporting critical activities including biosecurity and emergency management; defence; environmental and natural resource management; planning and property development approvals; all forms of primary industry; space, air, sea, and land transport; aspects of the retail sector; finance and insurance; many forms of health, education, and community services; and virtually all aspects of public administration. Geospatial information is at the heart of big data, and it is considered that about 80% of the world's information can be depicted and or analysed spatially.

By knowing where things are, geospatial information enables us to make sense of the world and is a fundamental and important element of everyday life.

The most used geospatial spatial technologies to visualise, manipulate, analyse, display, and record spatial data include:

- Earth observation and remote sensing technology that collects data from satellites, aircraft, UAV/drones and scanners.
- Positioning Navigation and Timing solutions that depend on Global Navigational Satellite Systems (GNSS including GPS) that tell us where we are.
- Various surveying and hydrography technologies including Total Stations that measure, distance, direction and position to very high accuracy, GNSS, multi-beam scanners, terrestrial laser scanners, unoccupied aircraft (drones) equipped with imaging and/or laser scanning sensors.
- Geographic Information Systems (GIS) that create, manage, analyse, and map all types of data in 2D, 3D or 4D. This provides a foundation for mapping and analysis that is used in science and almost every industry. GIS helps users understand patterns, relationships, and geographic context.
- Land surveyors underpin the property system within the nation. By creating and maintaining accurate boundaries that define land parcels, it defines the land title of property which ultimately secures current and future value of property.

ACIL ALLEN

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Introduction

Geospatial information and services are critical to increasing productivity, managing natural resources and the welfare of all Australians.

Every one of us uses geospatial information and services on a daily basis to help make our lives easier.

The sector in 2023-24 will contribute an additional $39 billion to Australian gross domestic product (GDP) and over 12,000 jobs.

By 2033-34, it is projected that the contribution could be an additional $81 billion in GDP and an additional 22,000 jobs.

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Background and findings

This assessment of the value of geospatial information in Australia in 2023-24 and projections to 2033-34 was commissioned by the Geospatial Council of Australia (GCA). Geospatial information is critical to the productivity of the Australian economy, the sustainable management of its natural resources and environment and to the ongoing standard of living for Australians.

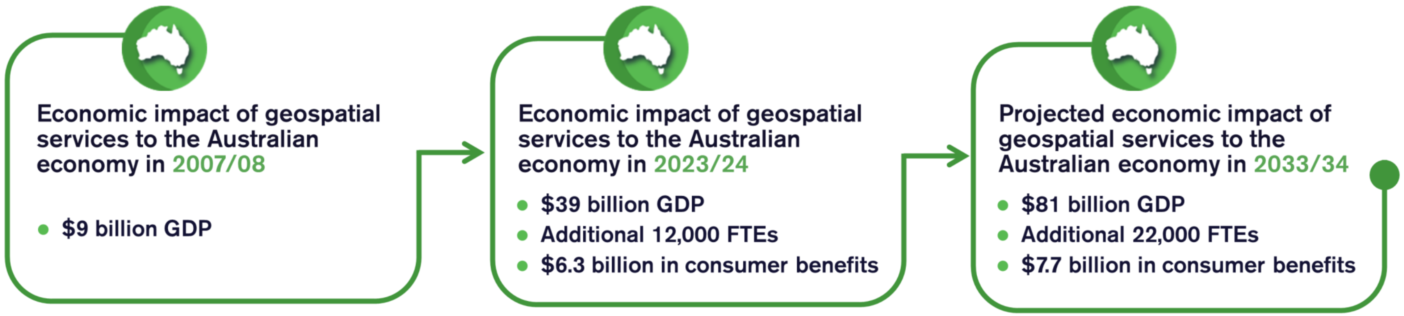
However, the public is often unaware of the benefits that geospatial information brings to their daily lives. This study aims to build upon an initial assessment conducted in 2008 by reassessing the economic contribution to the Australian economy. Additionally, it seeks to contextualise the value of the geospatial industry in terms of its potential for further societal benefit.

This report aims to readjust the perception of the geospatial sector. It also seeks to support advocacy for policy and program initiatives at a national and state level. The goal is to enable the sector to provide further productivity gains to the benefit of all Australians.

Social benefits are equally valuable, although they are often not recognised. Much of the geospatial information and the services available to the general public are freely accessible, and many of us do not even realise that we make use of geospatial information on a daily basis, let alone the value it adds to our lives in terms of more efficient decision-making, time savings, and costs avoided. To demonstrate industry and societal benefits beyond headline figures, a series of case studies are presented to illustrate the diverse nature of the impact delivered by geospatial services.

Key findings – national contribution

ECONOMIC IMPACT OF GEOSPATIAL SERVICES TO THE ECONOMY



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The business-as-usual scenario assumes a slower uptake of geospatially supported technologies and systems.

The favourable operating environment scenario involves an improved uptake of geospatial supported technologies and systems.

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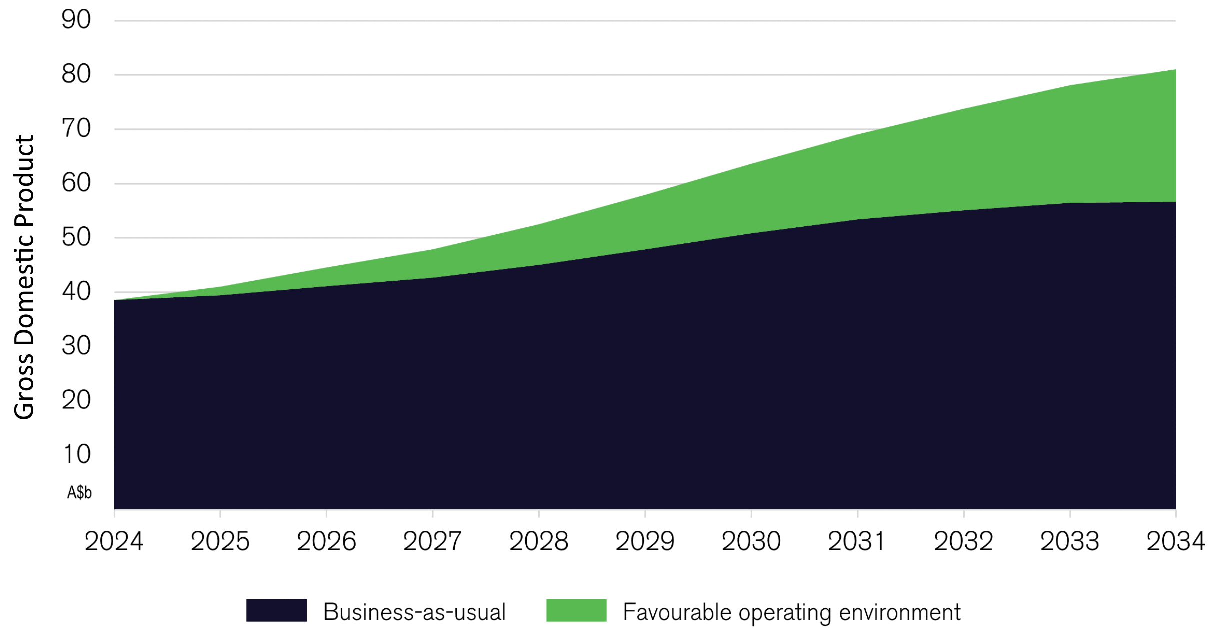
IMPACT OF GEOSPATIAL SERVICES TO THE ECONOMY UNDER BUSINESS-AS-USUAL AND FAVOURABLE OPERATING ENVIRONMENT SCENARIOS (2024 – 2034)



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Economic impact of geospatial services

The current and potential impact of geospatial services was estimated using a model of the Australian economy (Tasman Global). This model is a high-level representation of the Australian economy that enables measurement of the wider effects of changes in economic activity in key industries and regions due to geospatial services.
Economy-wide models like Tasman Global are widely known and have been used by the Productivity Commission, the Commonwealth Treasury and other government agencies to evaluate economy-wide impacts of industry and policy changes.

Geospatial services have a range of economic and other impacts. Some other impacts can be difficult to quantify and monetise. These are articulated in a series of sector-based case studies that showcase how geospatial services add value across the Australian economy.

The economic analysis only captures the direct and indirect economic impacts of geospatial services in Australia and in each state and territory.

Over the next decade, the economic impacts in terms of economic activity, economic welfare and the employment opportunities generated are significant (shown below).

More details of the methodology used to estimate the impact of geospatial services are provided at the end of this document.

We present these impacts, nationally, and by state and territory and describe how geospatial services add value to a range of important sectors in the Australian economy.

GENERATES SUBSTANTIAL ECONOMIC ACTIVITY	RAISES AUSTRALIA'S ECONOMIC WELFARE	GENERATES EMPLOYMENT OPPORTUNITIES
$650 billion total increase in economic output for Australia over the period	$540 billion total increase in Australia's real income over the period	Employment is higher by 17,000 FTE jobs on average over the period
This was $39 billion in 2024 and is projected to be $81 billion in 2034, delivering a cumulative gain of $650 billion over the period.	This was $29 billion in 2024 and is projected to be $72 billion in 2034, delivering a cumulative gain of $540 billion over the period	Employment is 12,000 higher in 2024 and is projected to be 22,000 higher in 2034.

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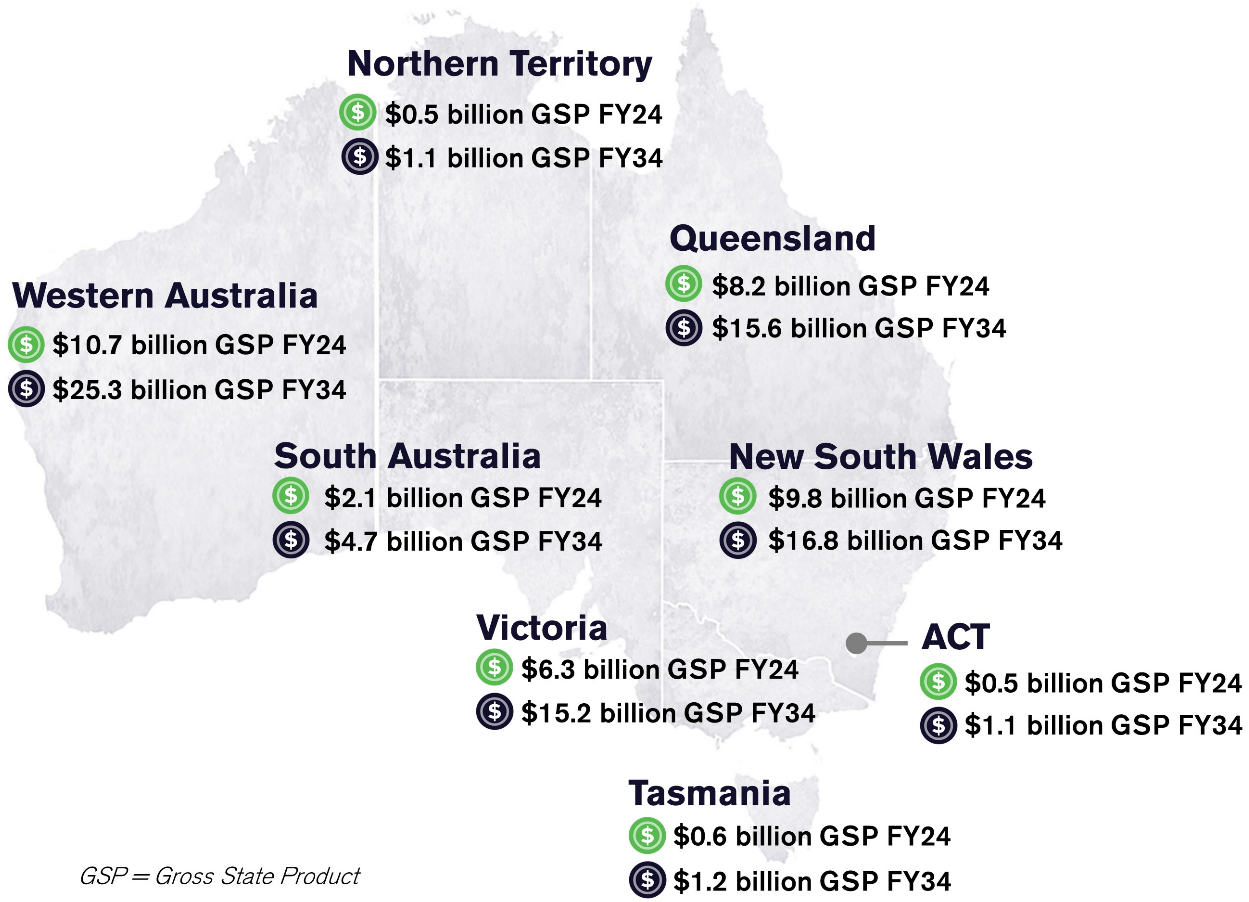
Economic impact by state and territory

The impacts have been calculated for each state and territory.

Geospatial services and information deliver economic benefits to a broad range of end-users and beneficiaries in each Australian state and territory.

Each state and territory's economy is structured differently. This means that economic impacts are not evenly distributed across Australia but are proportionate to the size of the economy in each state and territory.

IMPACTS BY STATE AND TERRITORY UNDER THE FAVOURABLE OPERATING ENVIRONMENT



GSP = Gross State Product

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Economic impact by industry

Geospatial services could increase industry value add by more than $600 billion over ten years from 2024 to 2034.

Geospatial services and information significantly contribute to industry value add across a broad range of industries that are important to the Australian economy.

A selection of case studies are presented to illustrate how a range of key industries are benefiting from geospatial services and information, and how these increase industry productivity and non-economic impacts and social goods, which are highly valuable but more challenging to quantify in monetary terms.

	Under the business-as-usual scenario increases GDP by	Under the favourable operating environment scenario increases GDP by
Mining	$112 billion	$128 billion
Government services	$61.2 billion	$70.6 billion
Construction	$41.3 billion	$49 billion
Manufacturing	$34.8 billion	$46.3 billion
Financial services	$31.2 billion	$41.2 billion
Agriculture, forestry and fishing	$30.3 billion	$48.9 billion
Transport	$23.2 billion	$28.5 billion
Utilities	$21.6 billion	$25.4 billion

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How geospatial services create impact

While we may not be aware of it, everyone uses geospatial information on a daily basis to make our lives easier, and geospatial information and services are even used to save lives.

Contribution to industry and consumers is not only economic but also has broader benefits, many of which cannot be easily quantified.

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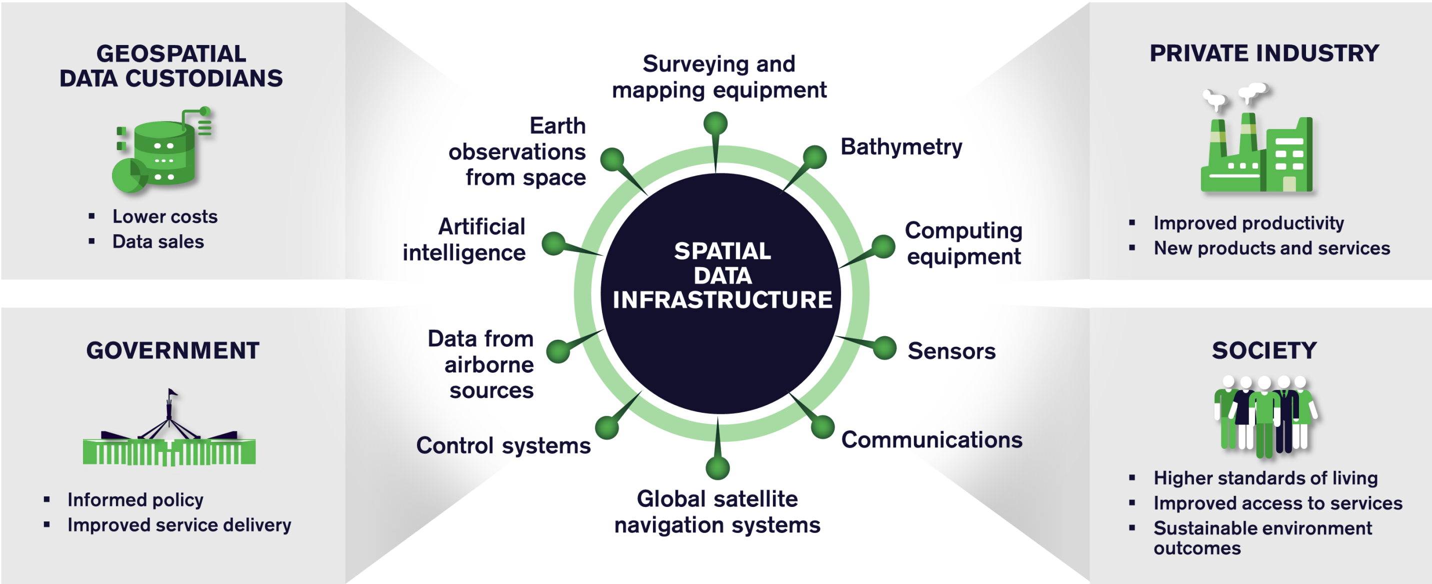
Understanding the value that geospatial services brings to industry and society

Beyond the headline value and contribution to employment, it is challenging to quantify the aggregate social, environmental and other impacts of geospatial services and information, which have been delivered to a wide range of beneficiaries and end-users. Geospatial services and information are a broad offering and have a variety of different uses and users. The use and application of geospatial services and information are determined by what end-users demand, by the physical and technological infrastructure available, and by the policy settings and regulatory environment that the data and service delivery rely upon.

Specific industries make use of geospatial information in different ways, but the benefits it brings to our national economy are undeniable. Geospatial information is responsible for significant productivity gains and efficiencies for a wide range of industries, helping Australia to become more competitive.

Much of the geospatial information and the services available to the general public are freely accessible, and many of us do not even realise that we make use of geospatial information on a daily basis, let alone the value it adds to our lives in terms of more efficient decision-making, time savings, and costs avoided. Geospatial information and services can even save lives. To demonstrate industry and societal benefits beyond headline figures, a series of case studies are presented to illustrate the diverse nature of the impact delivered by geospatial services diverse nature of the impact delivered by geospatial services.

BENEFITS OF GEOSPATIAL SERVICES



Case studies

These case studies show major benefits for Australia, including for important sectors such as:

- mining
- planning, construction and infrastructure
- agriculture.

In addition, we examine the impacts of geospatial services to society more broadly including the benefits to the public:

- emergency services
- bathymetry
- biosecurity
- managing climate and natural resources
- consumers
- Foundation Spatial Data Framework
- land project development.

Each case study highlights how industry make use of a range of geospatial services across sectors and deliver impact to a broad range of end-users and beneficiaries.

Mining

Mining accounts for 13.4% of Australia's GDP (Minerals Council of Australia, 2023), with an export revenue of $455 billion per year. Spatial information has been a fundamental enabling technology for all stages of mining, from exploration through to production and ultimately site closure. The economic benefits of the use of spatial information in the mining sector are significant, including but not limited to:

- increased productivity due to greater ability to identify minerals quickly
- increased productivity due to more efficient site and resource management
- improved processes for environmental monitoring and management
- reduced cost to enter hydrogen production, as prospective investors can assess the viability of locations and methods
- reduced haulage costs via automation, providing fuel, maintenance, and labour savings.

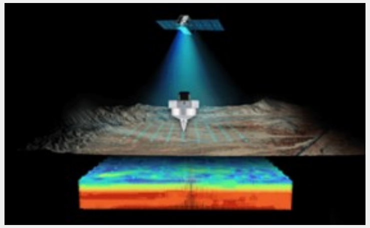
In addition to the immense economic importance of mining to Australia, the importance of mining is emerging in new ways, notably the need to respond to the renewable energy transition by developing sovereign sources of critical minerals. Although our land contains many of these minerals (Geoscience Australia, 2022) the ability to benefit from this is dependent on our industry's productivity and efficiency.

Therefore, the harnessing of geospatial solutions is not only a matter of economic importance, but has become increasingly important to national sovereignty and our ability to meet net-zero emissions targets.

ExoSphere is an example of how innovation in exploration techniques could radically transform the mineral exploration process. Mineral exploration is a key function of the mining industry in Australia, with $4 billion spent on exploration in the 2023 (ABS, 2024). The importance of spatial information in mineral exploration in the coming decade cannot be understated, now being increasingly adopted in the mining industry.

CASE STUDY

ExoSphere by Fleet Space



WHO BENEFITS: Over 40+ global exploration customers, including Rio Tinto, Barrick Gold and Core Lithium.

CHALLENGE: Mineral exploration involves considerable seismic investigation, geoscience, and exploratory drilling activities to identify and assess mineral deposits, all of which draw on geospatially supported technologies. However, this takes resources and time. Improving the targeting of exploration activities has the potential to deliver productivity and sustainability benefits to the minerals exploration process.

SOLUTION: Fleet Space's end to end solution ExoSphere is the first to combine satellites, smart seismic sensors and AI to accelerate mineral discovery while also reducing environmental impact. Fleet Space's smart seismic sensors (Geodes) gather 3D seismic data which is then transmitted to satellites in low Earth orbit and processed by an AI engine to deliver real-time 3D subsurface insights up to depths of 2.5km with near-zero environmental impact. The Geodes are hand-deployed and non-invasive, using Ambient Noise Tomography (ANT) to gather naturally occurring seismic noise from Earth's subsurface. The Geodes are up to 10 times more sensitive than other seismic instruments on the market, collecting high quality 3D ANT data which is significantly more important to AI model creation than other data types for AI model creation. The system delivers 3D, AI-powered subsurface insights with near-zero environmental impact, cutting data collection and processing down from months to days. Fleet Space's AI foundation model is a world first for critical mineral exploration such as copper, lithium, nickel and more.

> *Fleet Space's ExoSphere technology aims to accelerate mineral discovery while also reducing the cost and environmental impact of exploration - enhancing decision making with real-time insights at every stage of an exploration project. Over 400 ExoSphere surveys have been completed across five continents.*

Source: Fleet Space

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Construction

A thorough understanding of the locations and characteristics of existing assets and utilities is integral to ensuring safe and efficient development of infrastructure. This is especially relevant in the need to account for underground utilities in dense, urban areas, such as our capital cities.

The management of underground assets is a critical consideration in the delivery of major civil and infrastructure projects, as seen in the delay in the delivery of the Sydney light-rail, which was caused by the need to relocate unforeseen service utilities to make way for the track.

Three dimensional models of the digital build environment can solve the problem of coordinating new construction with existing infrastructure and other physical assets. The concept of a Digital Twin of the build environment encapsulates and extremely important development in planning design and construction of major building and infrastructure projects.

Through the use of 3D digital models, designers, engineers and constructors can realise major productivity savings from design to construction, speeding up construction process and realising significant savings and delivering better outcomes for metropolitan and regional Australia.

This case study shows how these considerations have been implemented in the design and construction of Sydney Metro's Integrated Station Development (station and above-ground quarters, including residential, retail and office spaces), that is being delivered by John Holland and Mirvac. Veris were engaged by John Holland to provide surveying for the metro station and above ground development.

CASE STUDY

Waterloo Integrated Station Development

WHO BENEFITS: Planning, development and construction industry.

CHALLENGE: Sufficient knowledge of the location of pre-existing and new assets is integral to ensuring smooth delivery of infrastructure. This can be especially challenging in dense urban areas and with complex designs.

SOLUTION: Veris utilised an innovative 3D scanning technology to capture data within the station box, which was then georeferenced (related to coordinates). The solution allows for a complete accounting of the pre-existing characteristics of the site, and exact records of the changes made during construction. Not only does this ensure that the assets used for the construction in question are well organised, but also that assets and utilities can be located with certainty in the event of future infrastructure projects, delivering benefits for decades to come. Veris note the following outcomes of their innovative approach:

- *Updating of the design model and a dynamic digital twin in Revit showing all locations of the 1000+ bolts.*
- *Providing a comparison works of protruding bolts verses the maintenance and construction operations (MCO) line and the cutting required as highlighted by red and green items and to then be shown in a visualisation timeline format for programming.*
- *Developing heatmap comparisons showing shore wall verses MCO to understand grinding and infill for quantities.*
- *Submission of station-box as-built in 3D BIM, using Navisworks, which can be combined with upcoming construction works to develop a single BIM model for the project and minimise Digital Engineering processing requirements.*

The geospatially enabled approach has delivered cost savings, as well as providing an increased degree of clarity, reducing programme risk.

The value of a geospatially enabled approach if applied across all construction activities could deliver productivity benefits of 1 to 2 per cent (ACIL Allen, 2017). If applied at 1 per cent over the construction sector this would amount to savings for the construction industry of the order of $450 million per year.

Source: Veris. (2024). Waterloo Integrated Station Development, Case Study.

Agriculture

Australian agriculture plays a crucial role in the country's economy and national food security. With its vast landscapes and diverse climates, Australia is able to produce a wide variety of agricultural products, ranging from grains and livestock to fruits and vegetables. This diversity allows Australia to not only feed its own population but also to export a significant amount of food and agricultural products to other countries.

Agriculture plays a crucial role in rural communities, providing employment and supporting local economies. According to the Australian Bureau of Agricultural, and Resource Economics and Sciences, the agriculture, forestry, and fishing industries employed around 266,300 people in 2022-23, representing around 2% of Australia's total employment. In rural and regional areas, agriculture is often the primary source of employment and economic activity, making it essential for the livelihoods of many Australians (DAFF, 2023).

Agriculture accounts for 2.7% of Australia's value-added GDP, with an export revenue of $80.4 billion in the 2022-23 financial year.

The economic benefits of the use of spatial information in the agriculture sector are varied, but significant, including but not limited to:

- increased productivity due to precision agriculture through controlled traffic farming, variable rate technologies and yield monitoring
- improved traceability and mapping
- improved processes for environmental monitoring and management
- reduced farm costs via automation, providing fuel, pesticide, maintenance, and labour savings.

Therefore, the harnessing of geospatial solutions is not only a matter of economic importance, but has become increasingly important to national sovereignty and our ability to meet net-zero targets.

In addition to its economic value, Australian agriculture also plays a crucial role in national food security. While Australia is a net exporter of food, domestic production still plays a vital role in ensuring a stable and secure food supply for the country. By producing a significant portion of its food domestically, Australia is less reliant on imports and less vulnerable to disruptions in global food supply chains.

This case study demonstrates the role that geospatial information enabled technologies are playing in growing productivity in the Australian grains industry.

Use of precise positioning for grain growers

WHO BENEFITS: Australian grain growers.

CHALLENGE: Productivity is crucial to maintaining Australian agriculture's competitiveness in global markets.

SOLUTION: Precise positioning services support technologies such as remote sensing, auto-steer and yield monitoring systems.
Control traffic farming (CTF) is an important support for precision agriculture. CTF aims to achieve spaced permanent 'traffic lanes' for use in sowing and harvesting to minimise soil compaction and overlap of tyre tracks. CTF requires good guidance systems and relies heavily on precise positioning technologies.

Benefits of CTF include:

- *enhanced crop productivity*
- *resource efficiency*
- *improved application of farm inputs.*

Precise positioning can also improve the application of farm inputs based on analysis of field conditions. This is known as variable rate technology (VRT), as inputs are applied at varying rates depending on field conditions.

Variable rate fertiliser application increased the economic benefits of wheat production by $5-50/hectare due to cost savings of reduced agrochemical use.

CTF generated increased profits of $46.8/hectare due to avoiding unnecessary use of agrochemicals from reduced overlap, and labour reduced labour costs.

CTF may decrease the global warming potential of soil emissions by 30-50%.

Source: ACIL Allen (2023)

Emergency management

The World Meteorological Organisation's estimation of economic losses from natural disasters found Australia to be the most-impacted country in the Southwest Pacific (World Meterological Organisation, 2021). When considering both financial and social impacts, the total impact of natural disasters in Australia was estimated to be $38 billion in 2021 (Deloitte Access Economics, 2021). As we look to the future, compounding factors presented by climate change are predicted to continue to worsen the severity and increase the incidence of extreme weather events such as extreme rainfall, heatwaves and droughts (International Actuarial Association, 2022). Over the next 40 years, the cumulative cost of natural disasters is estimated to total $1.2 trillion (Deloitte Access Economics, 2021). Geospatial information systems can help reduce the average annual damage costs of natural disasters in four ways:

- Reducing the size of damage occurring from extreme weather, fires and flooding by preventing the spread of damage through early response such as in fires and floods.
- Reducing the impact on communities and assets by greater preparedness through controlled burns, flood mapping and identification of vulnerable areas.
- Improving the response phase with common operating platforms for emergency managers, ambulance, police and firefighters, greater geographical data on the location of fires, location of vulnerable people and assets and location of responder in the field.
- Facilitating recovery processes through geospatial data on location of affected citizens and recording of geocoded data on the extent and location of damage for compensation programs as well as feedback future action.

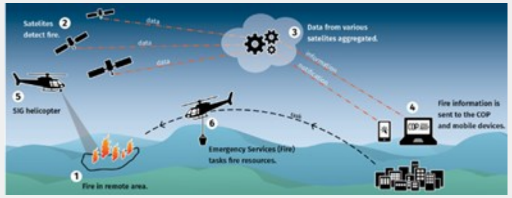
This case study illustrates how use of geospatial data and systems is being enhanced to provide real time warnings of remote bushfires that have the potential to cause significant economic, social and environmental damage. The image shows the results of the Specialist Intelligence Gathering helicopter platform helicopter fitted with infrared sensors, identifies spot fires in the vicinity of Port Latta, Tasmania in March 2024. Port Latta is an important export port and a fire threat to the port could affect exports of minerals produced in Tasmania.

CASE STUDY

Early warning system to attack remote bushfires in Tasmania

WHO BENEFITS: Tasmanian State Emergency Services use the platform to reduce the damage to homes and businesses.

CHALLENGE: Locating and quickly extinguishing remote bushfires before they can escalate.



SOLUTION: The Tasmanian State Emergency Services utilise real-time satellite-based bushfire detection and notification for their Common Operating Platform (COP). The introduction of the early warning system means that new fire starts are detected in near real-time by a growing constellation of satellites, and automated alerts are sent out within minutes, rather than hours (or in some cases days). Within ten minutes of receiving the alert, the fire start locations are shown in the Land Information System Tasmania's COP. The COP combines these alerts with contextual mapping layers to give the fire agencies, emergency services and police full situational awareness, enabling them to decide where and when to deploy their available resources and equipment and coordinate responses. Developments in infrared sensing also mean that potential fire risks can be detected from 20 kilometres from a sensor mounted on a Specialist Intelligence Gathering helicopter platform. This data can be transferred into the COP in real time providing planners and operational response teams with early bushfire location data to plan early responses to bushfire starts.

The 2018-19 Tasmanian bushfire season cost $60 million to bring under control and incurred at least $100 million in insured losses.

The new fire regime of more extreme, frequent, and longer fire events will have profound impacts for the response capacity of Tasmanian fire agencies. Improved situational awareness will be instrumental in efficient deployment of the available response capability.

Source: Tasmanian Department of Natural Resources and the Environment Tasmania

Bathymetry (Seabed Mapping)

Bathymetry, also known as seabed mapping, is a field of study that aims to measure characteristics of the ocean floor, such as depth, contour, and hardness. Positioning is a key enabler of bathymetry.

Bathymetry was conducted manually (using a line hanging off a boat) until the early 1900s when acoustic sounding systems (and later optical and LiDAR systems) were created. Modern bathymetry began when laying early telecommunications lines on seafloors and with scientific ocean dredging (Dierssen H, 2016). With advancements in aviation, satellites, and computing, the applications of bathymetry have expanded significantly. The different methods of bathymetry include sonar (single beam echo sounder, and multi beam echo sounder), airborne LiDAR, and multispectral satellite imagery.

These methods of bathymetry provide seabed data to numerous industries, from navigation, defence, and energy (offshore renewable energy and oil/gas exploration) to marine research and environmental protection (Deloitte, 2021; Admiralty, 2020).

Bathymetric information is essential to navigate waterways with sufficient Under Keel Clearance (UKC), the distance between the seabed and a ship's keel. The measure can be used to ascertain the likelihood of a ship grounding (impacting the seabed). UKC requirements are determined and enforced by ports or regulatory authorities, as UKC is an important consideration when travelling in shallow waters.

To determine UKC requirements, authorities must consider numerous factors, such as the waterway's depth, tide, waves and other hydrographic data. By incorporating accurate bathymetry (the depth of the water), authorities can create UKC requirements that increase shipping volume while maintaining safety of the vessels.

This case study demonstrates how accurate seabed mapping is delivering productivity benefits to the shipping industry involved in exporting ores and minerals in North Western Australia.

CASE STUDY

Port Hedland Hydroid

WHO BENEFITS: Resource industries involved in shipping from Port Hedland.

CHALLENGE: Under Keel Clearance (UKC) requirements can be a limiting factor in a port's shipping volume, constraining the movement of goods in and out of Australian ports.

SOLUTION: Port Hedland is one of three major iron ore ports in the Pilbara, Western Australia, and the largest bulk export port in the world. The Pilbara Ports Authority developed a Hydroid, or Lowest Astronomical Tide Model, which is a model to better understand sea levels and depths of a particular area. The use of the Hydroid has delivered considerable improvements to the port's productivity.

The use of the Hydroid extends the tidal sailing window by an hour (the times in which ships can travel through the port), with the port seeing potential to increase the number of vessels from 6 to 8 per tide, which equates to a 33% increase.

The port also reports a reduced unit cost, by allowing ships to increase the volume of goods onboard, while maintaining safety. The success of the Port Hedland Hydroid has resulted in action for the creation of a national hydroid model, referred to as AUSHYDROID.

MMA Offshore estimate that the technology could generate $240 million per annum in savings from increased ship movements in the port.

Source: (Pilbara Ports Authority, 2019). (ICSM, 2019)

Biosecurity

Australia operates a complex biosecurity system with many different stakeholders.

It has been estimated that damages from pests and diseases over the next 50 years would decline by approximately $325.26 billion due the operation of Australia's biosecurity system, at a cost of $10.45 billion (Dodd, Stoeckl, Baumgartner, & Kompas, 2020).

Australia's biosecurity activities encompass pre-border, border, and post-border measures to manage the risks associated with pests, diseases, and contaminants. Early detection of, and a rapid, effective response to biosecurity incursions can have a large impact on limiting their damage.

It has been identified that Australia's system is largely reactionary, with investment and collaboration occurring during times of crisis but less so during stable periods. The future system will require enhanced data sharing, national coordination of activities, and investments in new technology applications.

The economic benefits of the use of spatial information to biosecurity are varied, but significant, including but not limited to:

- use in biosecurity risk assessments
- data sharing and information exchange across industry, government, and research
- detection of environmental changes for early signs of potential threats
- to create detailed maps and models that aid in planning and executing biosecurity responses
- to optimise the allocation of resources by targeting areas with the highest risk or vulnerability
- to create visualisations and maps that communicate biosecurity risks and measures effectively to stakeholders, policymakers, and the public
- for ongoing monitoring and evaluation of biosecurity measures and their effectiveness.

This case study illustrates how geospatial information and artificial intelligence is supporting the Red Imported Fire Ants Eradication Program.

CASE STUDY

Red Imported Fire Ants (RIFA)

WHO BENEFITS: General public, native biodiversity, and agriculture and tourism sectors.

CHALLENGE: Developing a remote sensing solution to efficiently detect and destroy new RIFA nests to prevent further spread.

SOLUTION: RIFA has several methods of dispersion and can survive in almost any environment, so there is no real way of determining its existence or absence except through surveillance. Historically, surveillance has completely relied on ground surveillance methods which physically search areas, which is time consuming and expensive. Infestations can remain undetected for significant periods and accuracy of these methods is difficult to confirm. The continued spread has further increased costs and time taken for on-ground inspections.

As part of the setup of the Program, Biosecurity Queensland commissioned Outline Global to deliver a broad scale remote sensing solution to locate Fire Ant Nests more efficiently and effectively. The result was a world-first ultra-high resolution surveillance system that records the spectral signature of RIFA nests, distinguishing them from other features such as rocks, manure, wood, and bare earth. An associated Artificial Intelligence model was developed to process and interpret the imagery, and ultimately increase accuracy by matching remote sensing images against validated field data.

The National Red Imported Fire Ant Eradication Program (NRIFAEP) estimates that if RIFA spread remained unchecked, annual impacts could amount to $2 billion.

Source: (Scott-Orr H, Gruber M , Zacharin W, 2021)

Climate change and the environment

As scientific understanding of climate change increases, there is recognition of its complexity and urgency. The impacts of climate change are becoming more evident and severe, affecting communities, economies, and ecosystems worldwide.

Rising land and ocean temperatures are prompting shifts in rainfall distribution and the occurrence of severe weather phenomena, impacting the health of our soils, water sources, and vegetation, as well as the wide range of species dependent on these ecosystems. The environment is humanity's most valuable asset.

Approximately half of Australia's gross domestic product (GDP) is moderately to highly dependent on nature and its services (PWC, 2022).

The potential economic damages from climate change to Australia at current global emissions levels are quantified as $584.5 billion in 2030, $762 billion in 2050 and more than $5 trillion in cumulative damages from now until 2100 (Kompas, 2019).

Geospatial information can play a key role in providing vital information in the response to climate change and environmental protection. Geospatial information enables a greater understanding of both temporal and spatial dimensions of climate change and the environment, providing a holistic view of our planet. This becomes particularly crucial in understanding the dynamic nature of environmental shifts. Key use cases of geospatial information in relation to climate change and the environment include:

- spatial analysis
- monitoring and assessment
- early warning systems
- public engagement
- natural resource management
- cross sectoral integration.
- International collaboration.

CASE STUDY

A Shared Environmental Analytics Facility (SEAF)

WHO BENEFITS: Government, industry, community and researchers.

CHALLENGE: Efficient utilisation of environmental and spatial information will improve and sustain environmental outcomes.

SOLUTION: The Western Australian Biodiversity Science Institute (WABSI) and the Western Australian Marine Science Institution (WAMSI), alongside other partners, are leading efforts to establish a Shared Environmental Analytics Facility (SEAF) in Western Australia. The SEAF would be a progressive, innovative and independent data analytics facility which will create a sustainable environmental information value chain.

Benefits of the SEAF include serving as a shared access point to environmental data that is equitable and transparent, providing dynamic cumulative impact assessment with independent regional assessment reports, as well as providing access to fit-for-purpose data and environmental reporting which enables holistic view of environmental conditions. A five-year pilot program has been proposed in Western Australia. The SEAF would be underpinned by a single central geospatially enabled hub and initially feature two regional spokes, one in the Pilbara and another in Cockburn Sound.

The Pilbara regional spoke is expected to deliver $1.4 billion NPV in quantified direct regional benefits over 10 years.

The Cockburn Sound regional spoke is expected to deliver $227m NPV in quantified direct regional benefits over 10 years.

Source: Western Australian Biodiversity Science Institute (WABSI) and Western Australian Marine Science Institution (WAMSI). A Shared Environmental Analytics Facility (SEAF)

Consumers

Geospatial technologies offer a broad range of benefits to consumers, so much so that their use is now ubiquitous in everyday life. On the inventory of apps on a smartphone there are several applications which harness geospatial information.

From finding the nearest, and nicest, café to navigating unfamiliar streets, consumers rely heavily on navigation apps which leverage geospatial data to provide real-time directions. These technologies not only save time but also enhance safety by reducing congestion and warning drivers about road closures.

Weather applications and services, such as the BoM radar, use geospatial data to provide local forecasts, alerting consumers to upcoming weather events such as storms, heavy rain, or extreme temperatures. This information allows individuals to plan their activities accordingly, whether it's adjusting travel plans, or ensuring the safety of outdoor activities. Moreover, geospatial weather information contributes to public safety by providing early warnings for natural disasters such as hurricanes, tornadoes, and wildfires. By alerting consumers in at-risk areas, authorities can mitigate risks and ensure that residents have enough time to evacuate or prepare for emergencies.

There are also numerous health benefits to consumers. Through mobile apps and wearable devices, consumers can monitor their physical activity and track health metrics. These technologies provide individuals with valuable insights into the impact their behaviours have on their health. Geospatial data enhances the accuracy and relevance of personal health information, empowering individuals to take proactive steps towards improving their health and lifestyle.

A study undertaken for Google aimed to place a value on the economic benefits to consumers from the use of their products. It did this in an earlier study by asking consumers how much they would value the service if it was no longer free, also known as their 'willingness to pay'. This study estimated the value of digital maps to consumers to be $6.3 billion per year in Australia as of 2022 (Alpha Beta, 2022).

CASE STUDY

Reducing traffic congestion

WHO BENEFITS: Australian road users.

CHALLENGE: In 2017, Australia had 1,225 road-related fatalities, with associated costs of approximately $30 billion, including costs from injuries, loss of life, reduced quality of life, and property damage. Costs of urban road congestion are estimated to cost Australia $39 billion by 2031.

SOLUTION: Traffic congestion arises when the demand for travel exceeds the capacity of existing roads. Connected Autonomous Vehicles (CAVs) are unlikely to change the physical capacity of roads but can impact congestion by increasing vehicle throughput.

To address this, governments in Australia are exploring strategies to reduce crashes and improve road safety. The Queensland Department of Transport and Main Roads has explored the use of Cooperative Intelligent Transport Systems (C-ITS) through a pilot program. Intelligent transport systems can benefit from Satellite-Based Augmentation Systems (SBAS) signals. SBAS signals can improve the accuracy of vehicle positioning, enabling better demand management options such as real-time road pricing. The implementation of CAVs and C-ITS with SBAS signals is expected to result in significant benefits. These include improved travel time reliability, reduced emissions, and increased economic productivity.

Over a 30-year period, it is estimated that there will be $760 million in productivity gains in the road sector due to reduced travel times across Australia and New Zealand.

Additionally, it is anticipated that 45 fatalities and 2,800 serious injuries will be avoided, resulting in an economic saving of $277 million 30 years. The economic impact of travel time savings from C-ITS signal priority applications is estimated to be around $46 million over the same period.

Source: (Infrastructure Australia, 2019), (EY, 2019)

Foundation Spatial Data Framework

The Foundation Spatial Data Framework (FSDF) is the authoritative geographic information that underpins and supports evidence-based decisions across government, industry and the community. It provides a common reference for the assembly and maintenance of Australian foundation level spatial data in order to serve the widest possible variety of users. It delivers national coverage of the best available, most current, authoritative source of foundation spatial data which is standardised and quality controlled.

FSDF data covers a variety of themes, endorsed by the Australian and New Zealand Land Information Council (ANZLIC) and supported by the Commonwealth Government through Geoscience Australia and the states and territories through a range of agencies (ANZLIC, n.d.).

FSDF delivers significant value to people, organisations, and the wider Australian society. The case study of the application of FSDF data themes from the NSW Department of Customer Services illustrates some of the applications. This spans several areas including, land parcel and property activities, emergency services, electoral systems, and biosecurity. Most importantly the FSDF is a tool for national collaboration on the maintenance and ongoing curation of this data across Australian governments.

CASE STUDY

NSW Foundation Spatial Data Framework

WHO BENEFITS: Governments, industry, property owners, developers.

CHALLENGE: To provide geospatial infrastructure of authoritative foundational spatial data to support government services and national collaboration.

SOLUTION: Along with the Commonwealth Government and other states and territories, Spatial Services in the NSW Department of Customer Services supports the maintenance and development of FSDF themes, drawing on approximately 300 spatial datasets.

The cadastral system, in combination with the land registration system, is a powerful economic lever. It assembles, manages, and shares information that defines and reinforces property rights. In turn, these property rights translate into economic development, social stability, and physical well-being.

The system also supports the maintenance of electoral boundaries for the NSW Electoral Office and provides consistent geospatial information in support of emergency services and biosecurity response.

The cadastral and land registration systems allow people, businesses, and governments to leverage and manage property assets. There is over $2.2 trillion in housing loans secured against real property in Australia with an estimated value of $10.4 trillion in 2023. At the national level the authoritative and consistent data provided by the cadastre creates confidence and improved decision making for land management and development.

At the state and territory level it increases productivity by reducing transaction costs and eliminating duplication across the land and utility sectors.

Source: (Department of Customer Services, 2023), ABS

Land and project development

With concerns over affordable housing there is an imperative to improve the efficiency of housing supply. Economic development is dependent on efficient delivery of new infrastructure and projects.

Due to these pressures, there is an increasing need to improve the efficiency of planning and approvals processes – the use of geospatially enabled technology is integral to achieving this goal. Geospatial data held by governments is particularly important to this agenda.

The development of geospatial infrastructure by governments in Australia provides a way forward in the digitisation of government data and the appropriate sharing of data across different agencies.

Digital transformation of government processes and services is one of the key priorities of governments in Australia. The Commonwealth Government's digitisation strategy states that digital technologies are critical to the Australian Government's activities (Department of Finance, 2023).

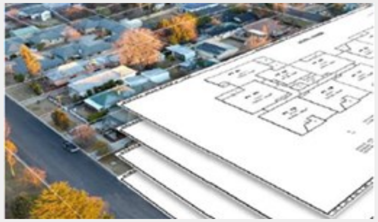
The goal of this strategy is that by 2030, the Commonwealth will use data and digital technologies to deliver connected, accessible services centred around the needs of people and businesses.

Departments and agencies concerned with delivery of geospatial information are at the forefront of the digital agenda. Through development of geospatial infrastructure governments have addressed the challenges of capturing and storing geospatial data and sharing across agencies and with the public.

This use case outlines the work that the Victorian Government is pursuing through its digital cadastre modernisation project. The Digital Cadastre modernisation project will be a major contribution to the Digital Transformation Program and is expected to deliver significant benefits to government and industry.

CASE STUDY

Victoria's Digital Cadastre Modernisation (DCM) and Digital Transformation Program



WHO BENEFITS: Utility, construction and asset managers, property and land developers.

CHALLENGE: Limitations of the existing Victorian cadastral mapping and its need to improve the accuracy of land parcels to meet spatial standards.

SOLUTION: Victoria's DCM undertook a major project to address its current accuracy challenges. The project, delivered by Spatial Vision, featured four stages: Digitalisation, Adjustment, Integration and Automation. The project required the team to collaborate, and the process of automation was challenging, however, the result of underpinning the new adjusted digital cadastre allows for a more efficient flow of data.

The project has effectively employed industry-leading software to adjust 4.2 million land parcels over 250,000km2.

This has helped address a series of complex challenges that were considered too hard to solve. The project succeeded in combatting issues such as: defining quality measures for output data, developing highly automated multistage processing, and delivering quality assurance verification into the production process. The project's technical team worked in conjunction with local surveying experts to build the adjustment engine using open-source software components. The project has proven to be innovative to both the teams involved and the tools they used.

The value of such digitisation actions could ultimately be up to $1 billion for Australia, based on the value to the construction sector and from the ability for government and private sector staff to be able to make virtual site visits (ACIL Allen estimate).

Source: (Victorian Department of Transport and Planning, 2023),. (Spatial Vision, 2023)

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Economic modelling

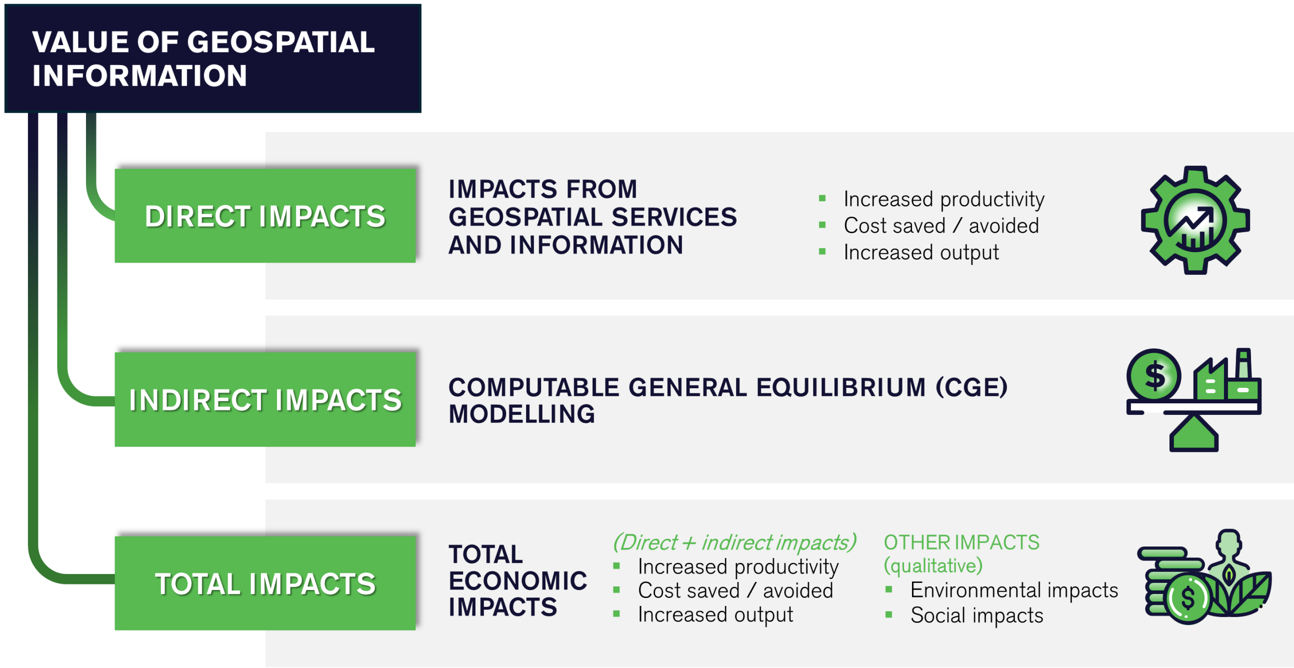
The economic impact of geospatial services includes:

- Direct impacts attributable to geospatially supported services.
- Economy-wide impacts, which refer to the indirect impacts of geospatial services on the economy. As the direct impacts flow through the economy, this stimulates investment, jobs and economic growth.

The analytical framework used to assess the impact of geospatial services on the Australian economy is summarised on right. This shows the main channels through which geospatial services impact the Australian economy. It has been successfully used in many economic impact studies undertaken by ACIL Allen over the past decades.

Economy-wide impacts were estimated using ACIL Allen's Computable General Equilibrium (CGE) model of the Australian economy, *Tasman Global.* This compares a *Business-as-Usual scenario* with scenarios utilising geospatially enabled technologies and services.

Two scenarios are examined. The first is a scenario based on a favourable operating environment. The second scenario is based on a business-as-usual environment.



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Glossary

GDP:	Gross Domestic Product
GSP:	Gross State Product
FTE:	Full-time equivalent
NPV:	Net-present value
AI:	Artificial Intelligence
CGE:	Computable General Equilibrium
ANZLIC:	Australian and New Zealand Land Information Council
SBAS:	Satellite-Based Augmentation System
FSDF:	Foundation Spatial Data Framework
MCO:	Maintenance and construction operations
CTF:	Controled traffic farming
VRT:	Variable rate technology
COP:	Common operating platform
UKC:	Under Keel Clearance
RIFA:	Red Imported Fire Ants
WABSI:	The Western Australian Biodiversity Science Institute
WAMSI:	Western Australian Marine Science Institution
SEAF:	Shared Environmental Analytics Facility

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