Submission to House of Representatives Inquiry into Developing Australia's Space Industry

Geoscience Australia

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Contents

Terms of Reference

The House of Representatives Standing Committee on Industry, Innovation, Science and Resources inquire into and report on developing Australia's space industry, including:

- Development of space satellites, technology and equipment;
- International collaboration, engagement and missions;
- Commercialisation of research and development, including flow on benefits to other industry sectors;
- Future research capacity, workforce development and job creation; and
- Other related matters.

The Committee will focus on how the Australian Government can support and encourage the space industry while preserving and protecting the space environment.

About Geoscience Australia

Geoscience Australia (GA) is the national geoscience public sector organisation.

Our mission is to be the trusted source of information on Australia's geology and geography for government, industry and community decision-making. Our work covers the Australian landmass, Australian marine jurisdiction and responsible jurisdictions in Antarctica.

As part of the Australian Government, we support the space industry to grow. We do this by ensuring the benefits of satellite imagery and positioning, navigation and timing technology are available to Australians in line with the *Australian Civilian Space Strategy 2019* and in support of our Strategic Plan: *Strategy 2028*.

Further background on our role in supporting the Australian space sector is at Appendix A, and a summary of the current and future economic benefits of satellite imaging and positioning, navigation and timing technologies to Australia is outlined at Appendix B.

Introduction

This submission provides our perspective on the development of Australia's space industry, within the framework of the Inquiry's Terms of Reference.

Consistent with the Australian Space Agency, we promote a broad view of the space industry. The space industry comprises a set of space-related activities along a space value chain that forms part of the broader space economy[1]. This definition encompasses the following components of the space value chain:

- Manufacturing and core inputs, including ground and space segment manufacturing
- Space operations
- Enablers, such as research and development and
- Space applications.

Space applications are those products and services that exploit the data generated by space systems, such as GPS signals and satellite images. Space data is 'big data' and space applications that support productivity and economic growth across our economy, including in our agriculture, mining, financial services, and transport sectors.

The space applications component of our space industry is positioned to drive a significant proportion of overall space industry growth. There are opportunities for new space applications across almost every sector of the economy. The market for those applications is global as well as local. The volume and variety of space data available to power new space applications is growing. Barriers to entry for start-ups and Small, Medium and Micro Enterprises (SMMEs) are typically lower than they are in other parts of the space value chain. Australian innovators already have a strong track record as leaders in this area. Moreover, we already have programs such as Digital Earth Australia and Positioning Australia providing our space application developers with the infrastructure they need.

[1] Definition of the Australian Space Sector. https://www.industry.gov.au/data-and-publications/definition-of-the-australian-space-sector/defining-the-australian-space-sector The Australian Space Agency. Accessed 17 January 2021.

Response to Terms of Reference

Sustained and targeted investment in research and development is key to the growth of Australia's space industry, and we note the range of investments the Government is already making in this area, including through the programs and activities we deliver in areas such as geodesy and Earth observations. With this in mind, this submission focuses on opportunities to reduce barriers to the growth of the space applications component of our space industry, drawing on our national leadership of:

- Positioning, navigation and timing (PNT)
- Satellite imaging of the land
- Exploitation of the data from these systems, including integration with other spatial information.

In this submission, the following barriers to growth are identified:

- Risks to ongoing access to critical satellite data
- Ability to assure customers of product quality
- Support for export of space applications
- Shortages of local skills in specialist areas
- Access to innovative space data tailored to local and regional needs.

Overcoming these barriers will support the growth of the space applications component of our space industry. Growth in this downstream component of the space industry will, in turn, drive demand for the products and services provided across the space value chain including the manufacture of satellite systems and the operation of satellite ground stations. The greater the customer demand for applications that use space data, the greater the demand will be for the space systems that generate that data.

The following table highlights opportunities set out in this submission to overcome the identified barriers.

Table 1: Summary of opportunities

Barriers	Opportunities
Risks to ongoing access to critical satellite data	• Maintain an open data policy for any satellites Australia supports using public funds, thereby encouraging other nations to continue or adopt similar open data policies • Encourage and support the development of space applications that are not entirely reliant on data from any single foreign satellite system • Promote the interoperability of data from different satellite operators, including through ongoing engagement in the multilateral technical fora that establish standards • Strengthen key international partnerships, including through participation in collaborative satellite development projects that will generate data of importance to us • Develop a targeted suite of small satellites that help address key data supply vulnerabilities.
Ability to assure customers of product quality	• Establish an ongoing national capability to coordinate and drive the development of a national network of quality assurance facilities for space applications • Promote the capability to international space applications developers and designers and manufacturers of satellite sensors.

Barriers	Opportunities
Support for export of space applications	• Establish an ongoing program that supports Australian innovators to tailor products and services developed for local markets to meet the needs of export markets • Establish an initiative to work with likeminded partner countries to ensure there are infrastructures for satellite applications available in priority target markets.
Shortages of local skills in specialist areas	• Explore opportunities to encourage those seeking a career in STEM to enter courses in areas including spatial sciences, geodesy, remote sensing and sensor engineering • Highlight that such skills will provide opportunities to establish new high-tech digital businesses.
Access to innovative space data tailored to local and regional needs	• Support the establishment of satellite ground stations in Australia's Antarctic territory, and promote the establishment of a network of 'space parks' on the Australian mainland.

Risks to ongoing access to critical satellite data

Australian companies are more likely to invest in the development of new space applications when they are confident of having reliable access to the space data on which those applications will depend. They need to know that new satellite images will arrive on a regular schedule, and that nobody has interfered with PNT signals. However, as a nation we currently:

- Rely entirely on foreign-owned satellite systems for access to satellite imagery and positioning signals, exposing us to technical failures over which we have no control and the risk of abrupt policy changes by foreign governments and companies
- Have no capability in place to systematically monitor interference (whether deliberate or accidental) with PNT signals.

Australia could ameliorate these risks by:

- Where appropriate maintaining an open data policy for satellites Australia supports using public funds, thereby encouraging other nations to continue or adopt similar open data policies
- Encouraging and supporting the development of space applications that are not entirely reliant on data from any single foreign satellite system
- Promoting the interoperability of data from different satellite operators, including through ongoing engagement in the multilateral technical fora that establish standards
- Strengthening key international partnerships, including through participation in collaborative satellite development projects that will generate data of importance to Australia
- Developing a targeted suite of small satellites that help address key data supply vulnerabilities.

Key priorities for such a targeted suite of small Low Earth Orbit satellites would be:

- Enabling application developers to compare images collected by different satellites, reducing reliance on data from any one foreign supplier by making it easier to switch sources if needed
- Detecting interference with PNT signals, helping identify targets for possible compliance action by regulators

- Monitoring the ionosphere to support identification of space weather conditions that may impact satellite operations
- Acquiring data that is not otherwise available, but that provides an edge to our application developers (such as bushfire fuel loads and inland water quality information).

Australia could develop these satellites in partnership with key, likeminded international collaborators, with data made freely available to them as they provide it to us. This approach would further strengthen our most important relationships, provide our space industry with access to mentoring and advice from world-leading space agencies and companies, and help open doors for industry for future opportunities.

We assess that the development of such a suite of small satellites is feasible given our current level of technological capability and industry maturity, and would be far less costly than the development of a sovereign suite of satellites that could meet all our data needs. Such an initiative would also showcase the credibility of our space manufacturers on the global stage, and engage them in projects that tackle globally recognised technical challenges. The niche nature of the satellites in question also creates opportunities for our industry to develop technologies with potential to be commercialised and exported to other nations interested in having access to these new types of data and managing the same types of risks.

Ability to assure customers of product quality

Industry must be able to show current and potential customers that their space applications meet a suitable level of quality. For example, a lack of trust in underlying satellite data is considered a key factor in under-adoption of space applications in the Australian agricultural sector. As a nation we have a range of facilities that can support the quality assurance processes required to address these concerns, but:

- Some are available only to a limited range of users or for particular purposes
- Some are not available on a reliable operational basis
- Some are funded from non-ongoing funding sources
- There is no overarching framework to coordinate their development or operation, or to support their use by application developers.

Australia could establish an ongoing national capability to coordinate and drive the development of a national network of quality assurance facilities. Such facilities would be openly available to our space application developers. The centre capability would leverage existing activities across government and research sectors, promoting consistency and best practice. It would also make targeted investments to improve the reliability of existing facilities, fill priority gaps in the network, streamline data access, and promote interoperability and standards compliance. The capability could also foster a virtual ‘centre of excellence’ that connects application developers with experts in quality assurance of space applications.

Supporting our space application developers to better demonstrate the quality of their products and services will give them a competitive advantage against those from other nations also struggling with this issue. Moreover, as a nation we are uniquely positioned to do this. From our extensive land, marine and Antarctic territories we can observe a diverse range of satellites collecting many different types of data. We also have a broad range of geographies under sovereign control: from the tropics to Antarctica, from desert areas to fertile farmland. These advantages mean that we can support quality assurance of the widest possible range of space applications.

As well as supporting our own application developers, such a capability would likely attract inbound investment from overseas application developers who would be increasingly keen to ensure that their products and services carry the same quality mark as those being developed by Australians.

Support for export of space applications

As an economy with a modest-sized domestic market, being able to export to regional and global markets is important to the growth of the Australian space industry. Australian companies are more likely to invest in

the development of new space applications if they feel confident that they can reach both local and global markets. Incubator programs and toolkits, like our Digital Earth Australia Labs program and Ginarn Positioning Toolkit, help these innovators commercialise research outcomes and prepare their products and services for the local market. However:

- These programs are not currently funded to support international engagement or to support application developers to tailor products for the needs of overseas markets
- Building international businesses takes considerable time, effort and resources, which is often beyond the capacity of many innovative Australian space application start-ups and SMMEs
- End user uptake of products or services based on satellite data depends on the level of technical proficiency, an appreciation of how the product/service can improve business outcomes, and thedegree to which the end user trusts the data upon which the product is based
- Existing international networks such as AusTrade and Industry Counsellors have an important role to play, but may not have the necessary technical expertise or backup to support application developers engage with the specific technical challenges of entering new markets.

The 2019 report on the current and future value of Earth and marine observing to the Asia-Pacific region[2] highlights that the greatest growth opportunities for technology based on Earth observations is in the emerging economies of South-East Asia. Increasing Australia's participation in this regional market has the potential to be worth US$70 billion to the Australian economy by 2030, an increase of US$3.12 billion realised through regional cooperation.

Australia could establish an ongoing program that supports Australian innovators to tailor products and services developed for local markets to meet the needs of export markets, leveraging the government's networks and relationships in the Indo-Pacific and beyond to provide insight into customer needs. In doing so, Australia could promote approaches that exploit open standards. These approaches are attractive to users (and governments) wishing to avoid being locked-in to data or services from particular countries or satellite operators.

Australia could also establish an initiative to work with like-minded partner countries to ensure there are reliable, secure and open infrastructures for satellite applications available in priority target markets. Just as Digital Earth Australia and Positioning Australia make it easier for our satellite application developers to bring products to the Australian market, appropriate infrastructure in other regions would reduce the costs and risks for them to take their application to new markets. Such an initiative should be fully consistent with, and supportive of, Australia's foreign policy and international development objectives and priorities.

Skills in specialist areas

Australia's space application developers depend on access to people with specialist skills. However, when people think about the space industry their thoughts typically turn to satellite engineers and rocket scientists. There is also a substantial deficiency of skills of relevance to space application development.

Key gaps we have identified, in our own recruitment activities and in discussion with stakeholders in industry and the research community, include:

- Global Navigation Satellite Systems experts
- Geodesists
- Remote sensing scientists

[2] Australian Government | Asia-Pacific Economic Cooperation, Current and future value of earth and marine observing to the Asia-Pacific region, 2019

- Sensor designers and engineers
- Big space data skills (including Artificial Intelligence, Machine Learning, data analytics and automation).

Although overseas talent can play an important role in filling these gaps, the proportion of Australian graduates in some of these areas is very low with little sign of increasing. This exposes our space application developers to international economic disruptions such as that resulting from COVID-19. It also creates challenges around security, particularly in relation to space applications relevant to national security, critical infrastructure and sensitive industries.

Australia could explore opportunities to encourage those seeking a career in STEM to enter courses in areas including spatial sciences, geodesy, remote sensing and sensor engineering. Australia could better showcase: its global profile in areas such as satellite imaging and positioning; the diverse range of sectors for which space applications can be developed; the links to other sectors including the big data and tech sectors; and the local and international opportunities that skills in these areas provide. This effort could also highlight the opportunities that such skills will provide to establish new high-tech digital businesses.

Access to innovative data sources that meet local and regional needs

Growth in satellite applications development will also drive demand for new types of satellite data. It is important that our satellite application developers can access new types of data as quickly as possible and that, where relevant, the data is tailored to meet the specific needs of consumers in Australia and the region. This demand will create opportunities for Australian satellite manufacturers and operators who are well placed to engage with those consumers and build the space systems that meet their specific needs.

Agencies such as CSIRO and the Australian Space Agency are best placed to comment on the broad set of challenges Australian satellite manufacturers face when bringing new satellites to market. However, based on our experience in the operation of satellite ground stations we know that satellite developers and operators will require access to cost-effective ground station facilities located in the right places, including during the sensitive early stages of satellite operations. Fortunately, our geography gives us an opportunity to help overcome this challenge: our extensive land, marine and Antarctic territories provide us with the vantage point from which to see and communicate with many satellites. However, currently:

- Australia does not have a strategy or framework that proactively supports the establishment of satellite ground stations on our territory to support land imaging satellites. This makes it more challenging for players looking to establish the new facilities that would increase competition
- Although critical to spacecraft command and control, there are limited commercial options for access to ground station facilities located in the Arctic or Antarctic. All existing facilities are controlled by foreign interests.

Australia could lower these barriers by supporting the establishment of ground stations in our Antarctic territory, and promoting the establishment of a network of ‘space parks’ on the Australian mainland.

A satellite ground station facility located on Antarctic territory would not only support local satellite developers and operators but would also be attractive to international satellite operators, both commercial and government, seeking to manage risk by ensuring they have access to a range of alternative ground station providers. Such a facility would also help highlight Australia’s presence on its Antarctic territory. Moreover, given the global scarcity of such facilities, it would also provide Australian innovators and companies with an asset to leverage in their engagement with international space partnerships and programs.

The logistical challenges of operating a satellite ground station in Antarctica are significant, with a major challenge around communications. Imaging satellites, for example, generate very large volumes of data and depend on high-speed reliable communications. Overcoming this challenge and establishing these links to

Antarctica would, in itself, be a world-leading technological leap for Australia and its industry with potential export opportunities.

Australia could also establish a network of space parks across the Australian continent. Such parks provide ground station operators with access to land, assurance of access to radio spectrum, security services, and access to high speed communication links. This helps streamline the establishment of new facilities, while also making it easier to manage a range of risks including the possible use of ground station facilities in a manner contradictory to Australia's national interest. Typically located in remote and regional areas, such parks could also provide employment opportunities for Aboriginal and Torres Strait Islander People and communities.

Appendices

Appendix A: Geoscience Australia's support for the space industry

Launching and operating imaging and PNT satellites is a major technological achievement that, even taking into account advances in small satellite technology, requires significant investment. Deriving a return on this investment depends not only on what happens in space, but on what happens on the ground. The data generated by these satellites needs to be collected, distributed, quality assured and then used. Our spatial and tech sectors (including agtech and fintech) are the engine room of this key part of the space value-chain: they combine the data generated by these satellite systems with other data to create products and services, like digital 'apps', that are usable by businesses, governments, communities and individuals.

This is where Geoscience Australia contributes. As Australia's spatial agency, we work to improve access to imaging, PNT and other spatial data. Our work makes this data easier for spatial, tech and other innovators to exploit. Our work helps ensure that what happens in space gets put to work on the ground for the benefit of all Australians.

We are responsible for delivery of two of the Australian Government's flagship space programs:

- **Positioning Australia**. The Australian Government is investing around $225 million to establish a world-class satellite positioning capability in Australia through the delivery of a Satellite Based Augmentation System (SBAS) and the construction of a National Positioning Infrastructure Capability (NPIC). This program is supporting Australians to make better use of satellite positioning technologies such as GPS. The program will make positioning data accurate to 10 centimetres available in every corner of Australia, through a satellite-based augmentation system that we will deploy. Areas with mobile coverage will have access to data accurate to 3-5 centimetres.
- **Digital Earth Australia**. This program is supporting Australians to make better use of satellite imagery to monitor our farms, coasts, waterways, cities and regions. The program provides high-quality data and tools that support improved policy and investment decision-making, and enables businesses to develop value-added applications and services for sectors across the economy.

Through these programs we take advanced satellite technologies and put them to work for the benefit of our businesses, communities and environment.

We are currently working closely with the Australian Space Agency on a series of roadmaps that align with the Advancing Space: Australian Civil Space Strategy 2019-2028[3]. Given our role and expertise we are particularly focused upon the Australian Government Satellite Earth Observations Roadmap and the Australian Government Positioning Roadmap.

We also operate observatories that facilitate the exploitation of this data, and support the broader space industry:

- **The Alice Springs Satellite Ground Station Facility.** This facility supports communications with imaging satellites allowing download of data collected over Australia and the upload of command and control signals. The facility is valued by international partners including NASA and the United States Geological Survey.
- **Geomagnetic Observatories.** These facilities, located around Australia and its territories, support the Bureau of Meteorology to warn Australians about major space weather events. Space weather events have significant potential to damage spacecraft and interfere with communication signals.
- **Geodetic Observatories.** The infrastructure at these observatories are used to measure the dynamic Earth and define the reference frame we use to position ourselves in four dimensions. The

[3] Australian Space Agency (2019), Advancing Space: Australian Civil Space Strategy 2019-2028, Canberra: Commonwealth of Australia, April; available at: https://www.space.gov.au

reference frame provides an accurate and reliable foundation on which we can align spatial data including satellite imaging data.

As well as our domestic activities, we also support the Department of Foreign Affairs and Trade to help other nations benefit from satellite imaging and PNT technologies, consistent with foreign policy and international development objectives. For example, through the Digital Earth Africa initiative we are working with the US-based Helmsley Charitable Trust to help businesses, governments and communities across Africa benefit from satellite data. We also support our Pacific Island neighbours to take advantage of satellite imaging and PNT data and services through Australian Aid projects such as the Pacific Sea Level and Geodetic Monitoring Project.

In delivering on our space-related responsibilities, we work closely with a range of other Australian Government agencies, under the coordination of the Australian Space Agency and the Space Coordination Committee, in support of the Australian Government's Civil Space Strategy.

Appendix B: The benefits of satellite imaging and PNT to Australia

Satellite imagery and positioning, navigation and timing data underpin many of the services we take for granted in our daily lives. Data generated by these systems support most sectors of the Australian economy including agriculture, resources, financial services, transport, and tourism. In Gross Domestic Product (GDP) terms, conservative estimates indicate that:

- Satellite imaging delivers between $5.3-8 billion per year to the Australian economy[4], with that contribution potentially being as high as US$20.2 billion when combined with other forms of Earth and marine observation[5]
- Positioning, navigation and timing delivers between $2.3-3.7 billion per year to the Australian economy, with potential to grow by an additional $6.2 billion over the next 30 years.[6]

Data from these satellite systems are also a key input to the broader suite of products and services that use geospatial, or location, information. These products and services include the location-enabled "apps" that ride-share drivers use to navigate safely and efficiently, the vibrant view of our planet provided by tools like Google Earth, and the datasets that farmers use from within their machinery to target application of water, fertilisers and pesticides. A 2016 study[7] into the global geospatial services sector found that:

- As an industry, geospatial services generate US$400 billion in revenue per year
- They generate consumer benefits worth over US$550 billion by saving people's time and fuel when travelling
- They improve revenues and costs by at least 5 per cent in sectors contributing approximately 75 per cent to global GDP.

Figure 1 (below) provides an overview of the global economic impact of geospatial services in 2016[7].

Importantly, the international market for these products and services is not just significant, but growing rapidly. The value of Earth and marine observing (which includes satellite imaging) to Asia-Pacific Economic Cooperation (APEC) economies was conservatively estimated at US$37B in 2019 and conservatively predicted to be worth US$1.35 trillion to the regional market by 2030[5]. Australia has a strong track record of exploiting satellite and spatial data here at home, and our innovators and businesses are well placed to capitalise on these international market opportunities.

[4] The value of Earth Observations from Space to Australia. Report to the Cooperative Research Centre for Spatial Information. Prepared by ACIL Allen Consulting. 2015.
[5] Australian Government | Asia-Pacific Economic Cooperation, Current and future value of earth and marine observing to the Asia-Pacific region, 2019.
[6] SBAS Test-bed Deomstrator Trial – Economic Benefits Report. Prepared by Frontier SI. 2019. https://frontiersi.com.au/wp-content/uploads/2018/08/SBAS-Economic-Benefits-Report.pdf.
[7] The economic impact of geospatial services: how consumers, businesses and society benefit from location-based information. Prepared by AlphaBeta for Google. 2016.

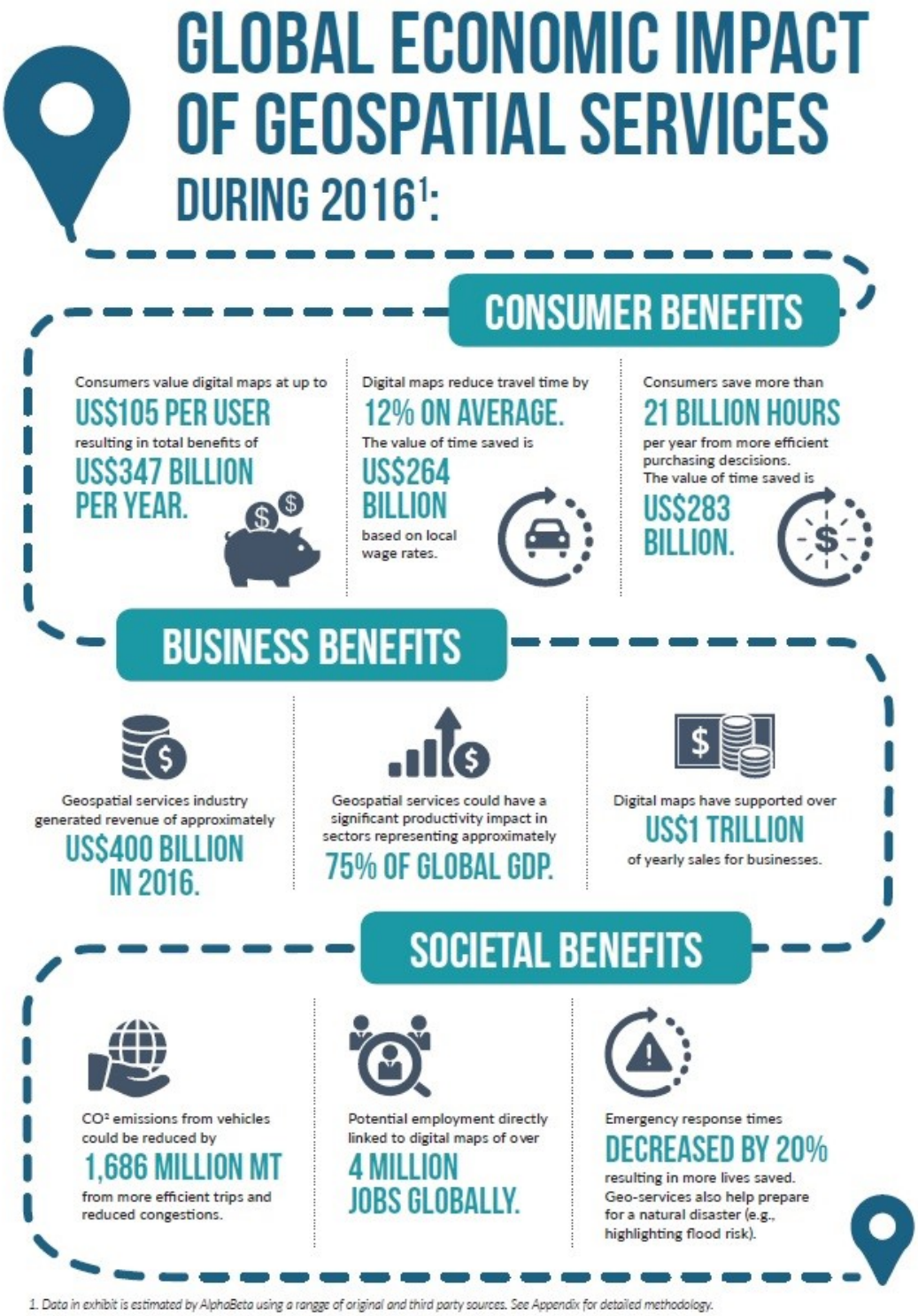

Figure 1. The economic impact of spatial services. From Alpha Beta Strategy & Economics (2016)[8].

[8] The economic impact of geospatial services: how consumers, businesses and society benefit from location-based information. Prepared by AlphaBeta for Google. 2016.