Global Outlook 2018
Spatial Information Industry
Graeme Kernich, CEO CRCSI
Global Outlook 2018
Spatial Information Industry
Global Outlook 2018: Overview

Global Mega Trends
- Innovation
- Spatial Industry
- Space Industry

Space
- Satellites
- Location
- Critical Technologies

Connectivity
- Sensor Networks
- Visualisation and Interfaces
- Scanning and Mapping Systems
- Autonomous Transport

Setting the scene

Spatial Technologies

Social and human aspects
- Machine-human interactions
- Brain Computer Interfaces
- Health

Privacy

Spatial Information Industry

Enabling Infrastructure

Data and smart systems
- Spatial Data Initiatives
  - Open date
  - Globes
  - Geospatial Analytics
  - AI
  - Security
Geospatial Market Size

Trends in Impact of Geospatial Technologies

<table>
<thead>
<tr>
<th>Year</th>
<th>Geospatial Market Size</th>
<th>Impact on Economy</th>
</tr>
</thead>
<tbody>
<tr>
<td>2013</td>
<td>202.8</td>
<td>1,188.7</td>
</tr>
<tr>
<td>2017</td>
<td>292.2</td>
<td>2,210.7</td>
</tr>
</tbody>
</table>

In Billion US$

Adapted from Indecon International Economic Consultants, ACIL Tasman, BCG, AlphaBeta, Oxera, Natural Resources Canada and Geospatial Media Analysis.

Geospatial Technologies: Towards Creating High Value Impact

**Geospatial Technologies**
- GNSS & Positioning
- GIS/Spatial Analytics
- Earth Observation
- 3D Scanning

**Technology Drivers**
- Big Data
- Cloud Computing
- Artificial Intelligence
- AR/VR
- Automation

**Business Processes**
- Building Information Management
- Distribution Management System
- C4ISR
- Customer Relationship Management
- Supply Chain Network Management
- Environment Impact Assessment
- Analytics
- Asset/Facility Management

**Application Sectors**
- Transportation: $623.2
- Utilities: $603.9
- Construction: $244.9
- Mining: $222.7
- Agriculture: $111.7
- BFSI: $95.8
- Government Services: $90.7
- Manufacturing: $80.8
- Forestry: $32.9
- Fisheries: $9.8

**Value Impact (In bn US$)**

Source: Geospatial Media and Communications
Geospatial Market Size

Source: Adapted from Market Research Reports available in public domain (list available in the references section) and Geospatial Media Analysis
Expected growth and competitiveness by Australian industry sector

Source: PWC, 2013
Space Opportunities in the emerging Market

<table>
<thead>
<tr>
<th>Markets</th>
<th>Examples</th>
<th>Growth Trend</th>
<th>Required Per Venture Investment</th>
<th>Barrier to Entry</th>
<th>Significant Current Activity in Australia?</th>
<th>Prime Australia Growth Opportunity?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satellite Servicing</td>
<td>MDA/SSL, Orbital ATK</td>
<td>+</td>
<td>~$500M+</td>
<td>High</td>
<td>N</td>
<td></td>
</tr>
<tr>
<td>Suborbital Human Spaceflight</td>
<td>Virgin Galactic, Blue Origin</td>
<td>+</td>
<td>~$1B+</td>
<td>High</td>
<td>N</td>
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<tr>
<td>EO Smallsat Constellations</td>
<td>Planet, Spire Global</td>
<td>++</td>
<td>~$100M+</td>
<td>Low</td>
<td>N</td>
<td></td>
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<tr>
<td>EO-Driven Data Analytics</td>
<td>Orbital Insights, HexiGeo, GeoImage</td>
<td>++</td>
<td>~$10M+</td>
<td>Low</td>
<td>Y</td>
<td>✓</td>
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<tr>
<td>Ubiquitous Global Broadband</td>
<td>OneWeb, SpaceX</td>
<td>++</td>
<td>~$3B+</td>
<td>High</td>
<td>N</td>
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<tr>
<td>Commercial SSA</td>
<td>AGI, Schalter, EOS, US military infrastructure in Australia</td>
<td>+</td>
<td>~$10M+</td>
<td>Medium</td>
<td>Y</td>
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<tr>
<td>Dedicated Smallsat Launch</td>
<td>Vector, Virgin Orbit, Rocket Lab</td>
<td>+</td>
<td>~$100M+</td>
<td>Medium</td>
<td>N</td>
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<tr>
<td>Smallsat Manufacturing</td>
<td>Clyde, Pumpkin, Spaceflight Services</td>
<td>+</td>
<td>~$1M+</td>
<td>Low</td>
<td>N</td>
<td>✓</td>
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</tbody>
</table>

Source: Bryce Space and Technology, 2017
## EO Constellations

<table>
<thead>
<tr>
<th>Constellation (Ownership)</th>
<th>Launches Pre - 2017</th>
<th>Launches 2017-2026</th>
<th>Unit Mass (Kg)</th>
<th>Estimated Unit Cost (Million)</th>
<th>Const. Size (Max. units in-orbit)</th>
<th>Estimated Const. Cost (Million)</th>
<th>Prime</th>
<th>Launch Provider</th>
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<tbody>
<tr>
<td>Terra Bella (Planet)</td>
<td>7</td>
<td>14</td>
<td>120</td>
<td>$15</td>
<td>21</td>
<td>$450</td>
<td>SSL / Skybox</td>
<td>Ananescpec, Orbital, ISRO, TSSKB Kosmotras</td>
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<tr>
<td>Planet</td>
<td>178</td>
<td>586</td>
<td>5</td>
<td>$0.4</td>
<td>150+</td>
<td>$500</td>
<td>Planet</td>
<td>ULA, Orbital, TSSKB Kosmotras, SpaceX, MHI, Rocket Lab</td>
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<tr>
<td>Aleph (Satellogic)</td>
<td>2</td>
<td>24</td>
<td>37</td>
<td>$2</td>
<td>Up to 300</td>
<td>$150</td>
<td>Satellite</td>
<td>CGWIC</td>
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<td>1</td>
<td>120</td>
<td>50</td>
<td>$5</td>
<td>60</td>
<td>$750</td>
<td>Spaceflight Industries</td>
<td>ISRO, SpaceX</td>
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<td>UrtheDaily</td>
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<td>8</td>
<td>340</td>
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<td>8</td>
<td>$220</td>
<td>SSTL</td>
<td>SpaceX</td>
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<tr>
<td>Worldview Legion</td>
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<td>60</td>
<td>100 (est.)</td>
<td>$13</td>
<td>60</td>
<td>$780</td>
<td>MDA / SSL</td>
<td>-</td>
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<tr>
<td>Landmapper</td>
<td>2</td>
<td>30</td>
<td>10/20</td>
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<td>30</td>
<td>$90</td>
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<tr>
<td>Iceye</td>
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<td>21</td>
<td>50 (est.)</td>
<td>$7</td>
<td>20</td>
<td>$145</td>
<td>Iceye / York SS</td>
<td>Vector</td>
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<tr>
<td>Ciner (GeoOptics)</td>
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<td>13</td>
<td>10</td>
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<td>TSSKBISRO</td>
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<td>PlanetIQ</td>
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<td>$4</td>
<td>12</td>
<td>$50</td>
<td>Blue Canyon Tech</td>
<td>ISRO</td>
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<tr>
<td>Zhuhai-1</td>
<td>2</td>
<td>17</td>
<td>&lt;55</td>
<td>$2/$3/$4</td>
<td>19</td>
<td>$50</td>
<td>CAST</td>
<td>CGWIC</td>
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<tr>
<td>AxelGlobe</td>
<td>-</td>
<td>13</td>
<td>80</td>
<td>$8.5</td>
<td>60</td>
<td>$110</td>
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<td>HyperCube</td>
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<td>12</td>
<td>5</td>
<td>$0.6</td>
<td>12</td>
<td>$7</td>
<td>Harris</td>
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<td>-</td>
<td>12</td>
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**Source:** Euroconsult, “Prospects for the Small Satellite Market,” 2017
Communication Infrastructure

Data traffic grew 70% between Q1 2016 and Q1 2017

Source: Ericsson Mobility Report June 2017
Communication Infrastructure

www.nsr.com/news-resources/the-bottom-line/capturing-the-terabit-backhaul-opportunity
Disruptive Technologies

www.pwc.com/gx/en/industries/industries-4.0/landing-page/industry-4.0-building-your-digital-enterprise-april-2016.pdf
Drivers of Technology Acceleration

- Modular, Commercial Off-The-Shelf Components
- Miniaturisation
- Open Data and Platforms
- Standards
- Advances in Computing
Internet of Things

Internet of Things

Utilities
Smart metres, smart grids and energy demand response

Transport
Connected Vehicles

Consumer Electronics
Connected home

Smart Cities
Public Transport
Street lights monitoring, stops monitoring

Healthcare
Remote patient and personal health monitoring

Retail & Leisure
Wireless Payments

Intelligent Buildings
Automated monitoring of heating, ventilation and cooling

Manufacturing & Supply Chain
Supply chain tracking and tracing
Cognitive Computing/ AI
A simplified taxonomy of man-made RF threats to GNSS

GNSS Threats

- Denial of Service (Interferences)
  - Deliberate (Jamming)
  - Unintentional
    - Multipath
    - Others RFI
- Deception of Service (Spoofing)
  - Forged signal generation
    - Data Bits Generation
    - Spreading Sequence & Carrier Generation
- Replay attacks (Meaconing)
  - Real-Time Replica
  - Record and Replay

GNSS Disruption

Large Geomagnetic Storms Since 1859

Centra Technology, “Geomagnetic Storms,” 24-Jan-2011
GNSS Disruption

Average # of events/yr = 24.3
Average # of failures/yr = 2.5
Most events/failures are not attributed to space weather, but 46 of 70 in 2003 occurred during Halloween storms

GNSS Disruption (cont.)

Privacy

- Risks to Privacy stand out as the most perceived downside in the rise of personal technology - WEF survey
- In Australia, in February 2018 the Privacy Amendment (Notifiable Data Breaches) Act 2017 commenced
- The EU’s General Data Protection Regulation (GDPR) will come into effect in May 2018
- In 2017 the USA government voted to allow internet service provider companies to collect and sell web browsing, location and other personal details
Remote Piloted Aerial Systems

Drone application uses registered with CASA


Findings

PWC notes that the fourth wave of the industrial revolution comprises many digital technologies:

- mobile devices
- cloud computing
- augmented reality
- wearable technologies
- multilevel customer interaction and profiling
- big data analytics and advanced algorithms
- smart sensors

- 3D printing
- authentication and fraud detection
- advanced human-machine interfaces
- Internet of Things platforms
- block chains
- drones
- robots
- location-detection technologies

Can add: Artificial Intelligence, autonomous vehicles, cyber threats, advanced sensor technologies, space and satellite developments synchronised micro, nano and cube sat constellations)
Findings (cont.)

• In the next decade we will have positioning and location capabilities that are precise, and 'always on', and data used in real-time applications

• Spatial analytics capabilities will enable insights (predictive) and be shifting us towards being a smart society and dealing with issues in a proactive rather than reactive manner

• Once privacy concerns and safeguards against potential dangers are dealt with, the transformative capabilities will be enhanced
Findings (cont.)

Market Growth
- Global Geospatial market (comprising GNSS, GIS, EO, 3D Scanning) growing from USD $339 billion (2018) to USD $439.2 billion by 2020. [Geospatial Media]
- Allied markets are growing
  - The indoor Location Based Services market is estimated to grow over 43% between 2016 and 2020, reaching Euro 7.7 billion by 2020
  - In 2017, the Artificial Intelligence (AI) market was thought to be worth USD $16.06 billion, with a compound annual growth rate of 36% from 2018 to 2025 (MarketsandMarkets).

More Satellites and devices
- Number of functional satellites in all classes is around 1738 of which 803 are from the US, 204 are Chinese, and 142 are Russian (as reported August 2017 by UCS).
- When all satellites (communications, positioning, earth observations) are taken into account, it has been estimated that there will be up to 6200 smallsat’s launched up to 2026 worth over USD $30 billion (Euroconsult).
- There are 5.8 million devices with GNSS receivers, and this number is expected to grow to 8 billion by 2020 (European GNSS Agency).
Thank you! gkernich@crcsi.com.au

Global Outlook Reports Spatial Information Industry

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