

IAC-14-E1.5.8

SKILLS AUDIT OF THE AUSTRALIAN SPACE SECTOR

Michael Brett, Julia Leeson, Shaun Wilson

Aerospace Concepts Pty Ltd, Australia
support@concepts.aero

Aerospace Concepts Pty Ltd, supporting the Australian Space Coordination Office, recently conducted a skills audit of the Australian space sector, to develop a deeper understanding of the space skills base in Australia. The results of this audit revealed the skills required to support space activities in Australia, now and in the future in addition to the supply and demand for these particular skills. Additionally, the audit recognised the future skill sets required and the challenges these pose, and identified ways to address these challenges. The audit may also provide a comparative industrial model for other emerging space nations to consider.

I. DEFINING THE SPACE SECTOR

The definition of the space sector used in this audit leverages a commonly-used definition developed for The Space Report, an annual publication produced by The Space Foundation which aims to provide comprehensive reference information about the global space sector¹. This definition, which is further explained in Section 8, classifies space sector organisations as being involved in any or all of three groups of activities:

- Infrastructure used to launch into space, including launch vehicles and launch facilities, in-space platforms, satellites, ground stations and data-handling systems, and intuitional infrastructure such as research organisations.
- Products and services that are derived from space sector infrastructure (for example, mapping data) and in-space services (for example, space tourism and missile defence).
- Support services across a wide range of professions and other occupations including engineering, legal, finance, science and research, education and training, policy development and regulation.

II. SPACE SECTOR WORKFORCE

For the purposes of this audit, the space sector workforce is defined as that group of people who directly leverage space-related skills and knowledge in their occupations rather than merely work in a space-related enterprise. That is, those individuals who are required to be 'space literate' to undertake their work. For example:

- A geospatial analyst who uses a knowledge of how various space-based remote sensing systems produce data to create sophisticated mapping products would be considered part of the space sector workforce, whereas

- An electrical engineer designing feed systems for satellite ground stations may not need any space-specific knowledge to perform his or her tasks well and would therefore not be considered part of the space sector workforce.

These definitions cover those involved directly in space systems engineering, operations, policy and law, in space science, and in the 'downstream' applications that use space systems.

II. METHODOLOGY

To gather information regarding the skills required to support the Australian space sector, Aerospace Concepts developed two different databases, a survey and conducted interviews. The databases included one based on organisations belonging to the Australian space sector (per the definition) and another characterising the schooling and training courses used by these organisations (including specialist tertiary and short, non-award courses). A survey was developed and distributed to the organisations identified to capture the range of skills needed. Additionally, key people in industry, academia and government were consulted, providing insight into the space activities and skills required to support these activities. Open source research supported the consultations and survey.

Australian organisations operating in the space sector tend to specialise in communications services, geoinformatics, engineering services and ground station operations and a wide range of skills is required to support these activities. As the required skills listed by organisations responding to the survey were very specific, and often unique, to their particular business, the skills were classified into broader categories. These organisations highlighted the greatest need for telecommunications engineering, business skills, space engineering, trades and technicians, mechanical engineering and geospatial information systems and remote sensing skills to support the sector. Business

skills were cited as the most easily available, with telecommunications engineering, mechanical engineering and space operations the most difficult to hire.

Based on survey responses, approximately 2,500 people with space-specific skills are employed by, or otherwise involved in, organisations undertaking space sector activities in Australia and New Zealand. This indicates the workforce is smaller than other recent studies, APAC reported a workforce headcount of 6,453 across 456 organisations² while Brett Biddington and Roy Sach's Kokoda Paper estimated 'perhaps not more than 5000 people'³. However, the audit survey focused specifically on those roles which require 'space skills' and thus excluded those otherwise employed in the sector who do not directly need literacy on space issues to undertake their jobs. A limitation of the study approach is that latent skills are missed – that is, those professionals who may have space skills but who are not currently employed in roles which make use of skills have not been identified.

Australian space professionals typically work in organisations where their skills are considered unique. About one-fifth of organisations employ only one person with space sector skills and, collectively, almost two-thirds of organisations employ ten or fewer people with space sector skills. Only 12% of organisations surveyed employ 50 or more professionals with space skills.

This concentration of space sector skills towards quite small organisations or small specialist teams within larger organisations is consistent with the overwhelming sectoral bias towards services and products and not infrastructure given that specialised services and products are often the province of small organisations.

Furthermore, the prominence of small organisations correlates with the nature of organisations in the space sector shows privately-owned corporations to be the dominant type.

III. CURRENT SKILLS MATCH

This section describes match between the current supply and demand for skills in the Australian space sector including an analysis of the readily available skills, hiring challenges, how organisations address these gaps and any drivers for skills losses.

The demand for skills in the space sector was assessed by a combined analysis of market wage trends, organisation training methods, survey responses and feedback from industry leaders. Open source material included assessments of the current labour market, including unemployment and vacancy statistics, changes in graduate salaries over time.

The skills most readily available to the sector, as indicated by ease of hiring, are business operations, software engineering, space engineering and telecommunications engineering skills..

The survey asked organisations to self-identify which skills were most required to support their space-related activities. Responses indicate that skills related to telecommunications are currently the most crucial to ongoing support of Australian space sector activities. This matches the level of investment in satellite communications relative to other space-based utilities.

IV. FUTURE SKILLS OUTLOOK

Global trends in space applications are characterised by a need for higher throughput communications, and higher spatial and temporal resolution for earth observation data. These changes are already affecting the Australian space sector, and almost certainly will lead to changes in required skills. For example, a key finding of a recent Geoscience Australia report found that ...

“Australia's EOS requirements are expected to increase significantly over the next decade. To support a sample set of 91 operational government programs, the total annual EOS data storage requirements in 2015 were conservatively estimated at 1.2 PB per year. This represents a twentyfold increase on current annual EOS data storage”⁴.

Australia's policy focus on downstream activities, which typically require skills in data manipulation, is a reflection of these trends.

SingTel Optus, NBN Co. and NewSat Ltd are increasing their investments in communications satellite operations and infrastructure which is likely show as a small increase in demand for space operations skills. It is also likely that demand for satellite procurement skills may increase in demand in the short term.

Many Australian organisations will increasingly be required to do business in the global marketplace, with an emphasis in Asia. Consequently, surveyed organisations anticipate an increased demand for cross-cultural skills to complement space-specific skills.

Organisations were asked to forecast their future skills needs and the impacts this may have for their organisations. Of the survey respondents, 62% anticipated an evolution in skill requirements over the next five years.

The skills which were forecast to increase in demand are specialisations in space, mechanical, software and telecommunications engineering as being the most anticipated.

V. FINDINGS

Several key themes regarding the skills required to support the Australian space sector emerged from analysis of survey results and interviews:

- Australia's supply of university graduate skills is broadly adequate; however there are gaps in certain niche areas. For instance, undergraduate aerospace engineering courses are too focused on electrical hardware and mechanical streams whereas the sector would benefit from a greater emphasis on telecommunications and systems engineering.
- Australia's space sector faces particular challenges due to its small scale. In many organisations, there are only a few space-related roles available and this presents challenges to develop and retaining the space-related skills they require. Organisations cannot rely on there being a deep skill base in the sector and need to continue to invest in training staff in order to meet the need for niche roles.
- There is a strong skills overlap with adjacent industrial sectors. While some skills used in the space sector are wholly space-specific there is a large overlap to other high-technology sectors which may be easily leveraged to increase Australia's space sector competitiveness.
- As Australia's interests in the Asia-Pacific region, there will be a greater need for cross-cultural communications skills, particularly in understanding user needs, contract management and international investment. To thrive in an interconnected global space industry, more Australians in the space sector will need to acquire foreign language skills, or the sector will need to employ and train people who already possess

such skills – noting that this may present other challenges, especially where nationality requirements for security clearances may be an issue.

- Investing in network mechanisms is important. Mechanisms including networking, mentoring, exchanges and conference attendance help widen an individual's knowledge. For example, the International Space University (ISU) Southern Hemisphere Summer Program has provides a common link for individuals who also have context and awareness of the sector.

Many organisations predicted a change in the skills sets needed in the future. The sector indicated skills required into the future would have a stronger emphasis on software and telecommunications engineering knowledge.

Skill loss through attrition and retirement was a concern for the sector, particularly the loss of radio frequency engineering. Organisations also indicated the greatest barrier to growth for their space activities was ensuring consistency of market demand to justify hiring and retaining staff with niche skills.

As with any analysis of this type there are limitations. The Australian space sector is notoriously hard to define, which leads to constraints on the data able to be collected within the available timeframe and resources. For example, a small number of responses for some questions mean it's difficult to generalise to the entire sector, particularly across space applications domains which have very different workforce profiles. Future studies may wish to build on this report as a baseline focusing on each space applications area in turn.

¹ The Space Report - The Authoritative Guide to Global Space Activity 2013

² A Review of Current Australian Space Activities 2010

³ Biddington and Sach 2010

⁴ Continuity of Earth Observation Data for Australia - Operational Requirements to 2015 for Lands, Coasts and Oceans" 2011