Case study on CSIRO's Data61, Australia

Contribution to the OECD TIP Digital and Open Innovation project

Case study on CSIRO's Data61, Australia: Contribution to the OECD TIP Digital and Open Innovation project

Authors: Cheryl George, Adrian Turner, Peter Leihn, Kate Powl, Sandy Plunkett and Data 61 team

Table of contents

Abstract

This case study focuses on CSIRO's Data61, Australia's leading data innovation network which seeks to transform industries with data science research and technology development. It supports the country policy case studies conducted in the context of the OECD TIP project on Digital and Open Innovation (2017-18). Data61 is the new entity resulting from a merger of the Digital Productivity flagship unit of the hundred-year-old Commonwealth Science and Industrial Research Organisation (CSIRO), and the National ICT Australia (NICTA) an internet-era communications, data science and networking Centre of Excellence. The paper explores Data61's unique capabilities, ambitions and challenges at a time of deep structural change for Australia in the global data-driven and networked economy.

Executive Summary

CSIRO's Data61 is Australia's leading data innovation network. With 1,000 employees including 300 PhD students from 70 countries and a network of 30 university partners, it has sufficient scale and global reach to take on large-scale, multi-disciplinary research and commercialisation projects for Australia's government agencies, corporates and scalable growth companies.

Data61 was established July 1, 2016 to accelerate the nation's understanding of digital-era disruption and to forge new opportunities in the 21st century global data-driven economy. It is the resulting entity of a merger between the Digital Productivity flagship unit of the hundred-year-old Commonwealth Science and Industrial Research Organisation (CSIRO), and the National ICT Australia (NICTA) an Internet-era communications, data science and networking Centre of Excellence.

The merger followed a period of uncertainty in Australian innovation policy. Its intent was to create a culturally transformative and globally significant data science and analytics capability at a time of unprecedented structural change in the national and global economies. Despite 26 years of uninterrupted economic growth, Australia is adjusting to the end of its long mining and resources boom. Unemployment has risen, growth has slowed and within a nation that prides itself on the values of fairness and egalitarianism in its social contract, there are increasing concerns about inequality.

Data61 is dedicated to a dual mission: pursuing new-to-the-world fundamental and applied research; and by working collaboratively with others in the nation's innovation ecosystem, to reimagine and seed new industries in a data-led world.

As the world wrestles with the emergence of the Fourth Industrial Revolution, Data61's role is to help the Australian economy and society navigate a quantum shift.

Like preceding technologically-driven societal and economic shifts, the Fourth Industrial Revolution, or the Data Economy, is making new demands on the nation as digital technologies, platform business models and rapid advances in the biological and materials sciences are re-defining industries, labour markets and whole societies. The new internet-era global software giants are exploiting a powerful economic engine called the "data-network effect" and massive flows of data have created new infrastructure, new businesses, new monopolies, new politics and a new world of work. By ushering-in a globally competitive market for new networked, distributed services and knowledge based work, these technologies and trends threaten the loss of 40% of the nation's traditional jobs in the next 15 years.

As part of the CSIRO, Australia's globally recognised science and industrial research organisation, Data61 has access to deep domain expertise across all of the sectors most likely to be disrupted over the next 5-20 years. The combination of expertise informs the organisation's "Digital+Domain" strategic focus and its cultural "growth mindset". It is taking on larger scale, multi-disciplinary projects with global implications, in areas like cybersecurity, digital regulation, shared data and data privacy, personalised health and wellness, food provenance, biosecurity, pandemic response, and smart city initiatives, including geospatial modelling and storable renewable energy.

Data61 can be a primary catalyst for reform to accelerate Australia's needed diversification from an industrial-era, resources economy to a sustainable and globally relevant knowledge-based services economy.

Its vision is to see the scaling of existing industries and within the next five years, the creation of new industries directly underpinned by advances in data, science and technology and in the convergence, and advanced understanding of new cyber-physical systems.

The organisation focuses on applying its data science capabilities on market facing sectors and is testing the investment thesis around the ambition to create "industry utilities" for the nation. Data61's operating model is built entirely around partnering which can result in Digital+Domain expertise in the top 1% globally. It leverages the D61+ network and a unique platform approach. By deploying its global ecosystem of shared data, deep technology expertise and innovation capabilities, Data61's ambition is to disrupt the US$1.3 trillion global R&D market over time.

Data61 is a business unit of the CSIRO and is integrated with the CSIRO central systems. However, it has greater independence in how it is structured internally to allow it to succeed in its faster paced digital data domain. For instance, Data61's product management and engineering and design teams function with a "sandbox" approach and from setup, Data61 has organised for a market pull approach to data science solutions and scalable growth. Data61 continues to align its team and talent around ambitious "challenge" programs which seek to identify large scale societal and business problems while building new technology platforms and software to solve them.

Data61 is a single entry point to, and collaborative partner with, a range of government and private sector stakeholders. Its stakeholder/customer strategy is to leverage those that will provide a multiplier downstream benefit and accelerate digital transformation strategy and implementation. Data61 and the broader CSIRO, partners with leading public and private organisations around the world and are recognised internationally for applied research. Some of this international work ranges from monitoring biodiversity in the Amazon rainforests, simulating climate extremes over East Asian-Australian monsoon regions, and building privacy protecting open data platforms for governments and industry.

Data61 will continue to expand in international markets such as the United States, South-East Asia and Chile by building on the long-standing relationships that have been established by the CSIRO with universities, corporates, governments and non-government organisations and establishing new relationships underpinned by the application of its new technologies, software and services.

As Australia's data science institution, Data61 has to cement its collaborative intent and team approach while continually challenging others in the system to move faster and think bigger. Data61 is a non-profit organisation and is in a privileged position as a trusted advisor, sitting between academia, industry and government. This is a strong differentiating factor from most or all private sector corporations and high growth companies in Australia. It gives the organisation a unique vantage point to identify emerging needs in digital transformation and execute on those opportunities. This means building new technologies with the potential to scale new enterprises from them.

It also presents different operational and cultural complexities for the organisation, particularly in terms of striking the right balance between government and entrepreneurial "growth" mindsets while working at the speed the fast changing global digital economy demands. Together with government, industry, CSIRO business units and 30 university partners, Data61 is focused on helping to accelerate a change of trajectory for the country from within.

Part I. General overview of Data61

1. The process of creation

1.1. What are the main factors and background conditions that motivated the creation of Data61?

Data61 is a new entity resulting from the merger of National ICT Australia (NICTA) and the Digital Productivity Group of the Commonwealth Scientific Industrial Research Organisation (CSIRO).

The CSIRO's Data61 was established July 1, 2016. It is the resulting entity of a merger between National ICT Australia (NICTA), a communications, networking and data science research centre, and the Digital Productivity Group of the Commonwealth Scientific Industrial Research Organisation (CSIRO). NICTA was launched in 2002 as a research Centre of Excellence[1.] The near 100-yr-old CSIRO is the Australian Federal Government agency for scientific and industrial research. It is ranked among the top 1% of global research institutions in 14 out of 22 research fields.[2]

With more than 1,000 employees including 300 PHD students from 70 countries, combined with the talent embedded in 30 partner universities, Data61 represents one of the world's largest data-driven digital research and development teams.

Data61's singular focus on data science as an organising principle is unique.

The intent of the merger was to create a culturally transformative and multi-disciplinary 21st century data science capability pursuing new-to-the-world research (both fundamental and applied) and delivering sustainable commercial impact at global scale.

The international country calling code for Australia is 61. Naming and branding the new entity Data61 signals to the nation and to international markets that the focus of the organisation is on building the technologies, the platforms and the businesses that revolve around, are fed on, and deal with data in all its forms. When this data science expertise is combined with the domain expertise of the CSIRO research and business units, Data61 has the capacity to be an accelerant for Australia's diversification from an industrial-era, resources based economy to a 21st century knowledge-based one.

The merger decision followed a period of great uncertainty in Australian innovation policy and enterprise and was highly influenced by new leadership.

---

[1] In 2002, NICTA won a competitive selection process to be established as Australia's national Centre of Excellence in information and communication technology (ICT) research, under an Australian Government policy initiative to promote science and innovation called *Backing Australia's Ability*.

[2] CSIRO Annual report 2015-2016 : page 24 describes ranking methodology based on research citations relative to global performance.

Australian Federal Government funding for NICTA was due to expire in June 2016 and there was a concerted effort in securing a merger with the CSIRO. A key advocate of the merger, which was welcomed by many invested in shaping and growing the nation's 21st century innovation and entrepreneurship ecosystem, was CSIRO Chief Executive Officer, Dr Larry Marshall.

A successful Australian-born, Silicon Valley-based physicist, entrepreneur and venture capitalist, Marshall was appointed to lead the CSIRO in October 2014.

The transformation process and renewed national and global mission of the merged unit included the appointment of another Australian-born, successful Silicon-Valley based entrepreneur, Mr. Adrian Turner as Data61's Chief Executive Officer. Turner brings to the organisation deep technical, commercial and management expertise in digital-era transformation and enterprise. He leads the CSIRO data science business unit as a semi-autonomous organisation in the pursuit of advancing digital transformation understanding of industry disruption and skills development, both within the CSIRO and for the nation.

Data61's Digital+Domain strategy underpins data science capability for the CSIRO, State and Federal Governments and Industry

Data61 functions as the data science and analytics business unit to all CSIRO research domains – ranging from transport and logistics, agriculture and food, to mining, energy, the environment, medical technologies and health and pharmaceuticals. All research domains are aligned with national objectives.

Being part of the CSIRO gives Data61 access to deep domain expertise across all of the sectors most likely to be disrupted over the next 5-20 years. The combination of expertise informs the organisation's Digital+Domain strategic focus and its' cultural "growth mindset".

Data61 has sufficient scale and global reach to take-on large-scale, multi-disciplinary projects for Australia's government agencies, corporates, scalable growth companies and SME's. Outside the Federal Department of Defense, Data61 is also the nation's pre-eminent capability in cyber security research.

1.2. What are the major challenges that Australia faces related to digital transformation, and what is the role of Data61 in addressing them?

The Australian Government's National Innovation and Science Agenda (NISA) designed by the Department of Industry, Innovation and Science (DIIS), in collaboration with industry, academia and state and federal government agencies, committed an additional AUD$75 million over 3 years to the CSIRO's annual funding to be dedicated to Data61. (See funding below).

The NISA innovation policy framework was borne out of the Government's recognition that despite 26 years of uninterrupted economic growth, Australia, like most countries, is witnessing unprecedented structural changes in its economy, industries and labour markets. Digital technologies and platform business models are disrupting existing industries.

By ushering in a globally competitive market for new networked, distributed services and knowledge-based work, these technologies and trends also threaten the loss of 40% of the nation's traditional jobs in the next 15 years.[3]

Moreover, the additional convergence of increasingly connected information technologies with profound advances in the biological and materials sciences, will underpin even more global economic transformation over and beyond the next decade.

This new global and local reality is often referred to as "The Fourth Industrial Revolution" or "The Data Economy."

Whatever the label, the signs of the emerging data economy are everywhere and its present and ongoing impact still little understood by traditional business leaders and policy makers. The soaring market capitalisations, market creep and scope of ambition of 21st century software and technology giants - from Google to Facebook to Amazon, Alibaba and Tesla – are highly visible. But just how effectively, and arguably, ruthlessly these companies extract, mine and repackage networked data is often underweighted.

Internet-era software titans are exploiting a powerful economic engine called the "data-network effect": using data to attract more users, who then generate more data, which help to improve services, which attracts more users. Many commentators and economists claim data are to this century what oil was to the last one: a driver of growth and change. Flows of data have created new infrastructure, new businesses, new monopolies, new politics and—crucially—new economics.

Digital information is unlike any previous resource for it is extracted, refined, valued, bought and sold in different ways. The quality of data has changed, too[4]. The databases of old – those containing names, age, gender and income for instance - seem quaint compared to the analytics and algorithms deriving new meaning from the constant flood of unstructured data: the search activity and meta-data flowing from social networks, smart phones; and from hundreds of sensors in connected machines and devices used on the road, in the air; in retail outlets, hospitals, schools, banks and in industrial, manufacturing and mining sites.

These technological and network advances change the rules for companies, governments and markets, often resulting in a "winners-take-most" effect.[5] Many questions arise over who should own and benefit from, all this data and how it will be protected from misuse. It demands new approaches from regulators in competition policy, privacy and security, and from business leaders in every sector from finance to health, retail to mining.

---

[3]https://www.ceda.com.au/Research-and-policy/All-CEDA-research/Researchcatalogue/Australia-s-future-workforce

[4]https://www.economist.com/news/briefing/21721634-how-it-shaping-up-data-giving-rise-new-economy

[5]https://www.economist.com/news/briefing/21721634-how-it-shaping-up-data-giving-rise-new-economy

[6]https://www.bloomberg.com/news/articles/2017-10-02/miracle-economy-turns-mediocre-as-policy-drift-drags-australia)

Within this globally competitive context, Australian policy leaders recognise there is an urgent national imperative to gain a deep understanding of the new data-driven economy. Australia's adjustment to the end of the commodity and resources boom has not been painless and the nation's appetite for reform has waned since the turn of the century.

The impact is starting to show. Unemployment has risen, growth has slowed and within a nation that prides itself on the values of fairness and egalitarianism in its social contract, there are increasing concerns about inequality.[6]

Just when the economy needs growth drivers outside of mining, a slide in global rankings[7] for innovation and education suggest living standards could decline.

The NISA innovation policy framework is therefore a welcome impetus to further reform. As other countries have been improving their structural reform and policy settings in recent years, Australia's advantage seen most visibly during the resources boom of the last 20 years, has been eroded. Improving competition, new skills development, the commercialisation of new ideas and business models and other framework conditions that influence the acceleration, development and absorption of 21st century innovation is critical to the nation's productivity growth[8].

In order to both grow the economy and create jobs fit for quality of life for existing and new generations entering the new world of work, there is a need to modernise and scale existing industries and create new ones, in line with the new laws and mores of the data-driven global economy.

2. Main features of Data61

2.1. What are the mandate and the specific objectives of Data61?

Lead the development of Australia's digital and data science capabilities in research, government and industry

Data61's mission is to be a leading data R&D and commercialisation network globally and to lead in creating Australia's data-driven future at a time of unprecedented structural change across the nation. Data61 is thus dedicated to a dual mission: pursuing new-to-the-world fundamental and applied research; and by working collaboratively with others in the nation's innovation ecosystem, to reimagine and seed new industries in a data-led world.

Ensure Australian society and economy navigates successfully through the shift from traditional analogue economy to a global leader in the digital, knowledge economy

As the world is entering the Fourth Industrial Revolution, global digitisation, artificial intelligence (AI) and the connection of physical assets (cyber-physical systems) could

---

[7] https://www.globalinnovationindex.org/gii-2017-report

[8] https://www.oecd.org/eco/surveys/Australia-2017-OECD-economic-survey-overview.pdf

have a $15 trillion global GDP impact by 2030 according to research conducted by PricewaterhouseCoopers (PwC)[9], with an estimated 40% of Australian jobs potentially displaced in the next 10-15 years.

Data61 is helping the Australian economy and society navigate this quantum shift. Its role is to leverage its data expertise and network scale to be a primary catalyst for reform and accelerate Australia's needed diversification from an industrial-era and resources based economy to a 21st century data-driven, knowledge-based services economy.

The focus is on domains where Data61 has a deep science and technology competitive advantage to ensure the nation's prosperity and independence. It is taking-on larger scale, multi-disciplinary projects for the country, with global implications, in areas like cybersecurity, digital regulation, shared data and data privacy, personalised health and wellness, food provenance, biosecurity, pandemic response, and smart city initiatives, including geospatial modeling and storable renewable energy.

Pursue new-to-the-world fundamental and applied research and to reimagine and seed new industries

Every historic economic shift in the global economy has been driven by new industries born from technological advances. Data61's vision is to see the digital transformation of existing industries and, within the next five years, identify the creation of new industries that will grow the economy and create jobs for present and future generations.

Data61 fully recognises that none of this will be possible however, without strong collaboration and partnership across the nation and internationally to build the collective ambition, capabilities and platforms needed to take on this challenge.

This is why Data61 partners equally with industry, government and academia to accelerate the national development of core technology plans that will be the foundation of emerging industries and for which Australia has a sovereign need to develop capability all underpinned by "Trust" which is a core pillar outlined in Data61's Science Vision.10 Areas of focus include Artificial Intelligence and Machine Learning; Privacy Preserving Data Sharing; Cybersecurity; Robotics and Sensors; Distributed Ledger Technology and Computational Law.

2.2. What are Data61's main areas of action?

Data61 is working on breakthroughs and new technologies in all data-led research and development domains, programs and platforms. It provides a network of capabilities focusing on every aspect of data R&D for a digital and network-centric world. These include:

- Data Capture and Data Consumption
- Communications and Networking
- Data Infrastructure

---

[9]https://press.pwc.com/News-releases/ai-to-drive-gdp-gains-of--15.7-trillion-with-productivity--personalisation-improvements/s/3cc702e4-9cac-4a17-85b9-71769fba82a6

[10] https://www.data61.csiro.au/en/Who-we-are/Our-Science-Vision

- Sensors and Robotics

- Cybersecurity

- Data Statistics Modelling and Analytics

- Decision Sciences

- Behavioural economics

2.3. Do the activities of Data61 focus on specific sectors or technologies? Are there mechanisms in place to ensure interdisciplinary approaches to research and innovation?

Emerging and Disruptive Technologies

Data61 recognises that platform business models are disrupting many existing industries globally and will underpin further global economic transformation within the next decade. The organisation focuses on applying its data science capabilities on market facing sectors and is testing the investment thesis around the ambition to seed "industry utilities", based-on technologies that can be modified and applied across a range of sectors, for the nation.

The *Industry Utility* thesis is essentially a new economic model to counter the prevailing vertically integrated platform model exploited by Facebook, Google, Amazon, Alibaba and others and has the potential to be game-changing for Australia. Historically and today, Australia has globally recognised ingenuity in specialty science and research, but this has been not matched with commercial outcomes.[11] In seeding new technology-led industries for Australia, Data61 sees opportunity to retain equity ownership with annuity based revenues tied to R&D from these entities.

The underlying technologies and Data61 capabilities that can seed new "Industry Utilities" include:

- **Artificial Intelligence & Machine Learning:** AI and machine learning will become as fundamental to economies and industries as electricity is today. It is accelerated due to Moore's Law (the exponential gains in networked computing power at reduced cost) and improvement in algorithms over the last 40-50 years. The technological advances have been accelerated by increased funding in the domain. AI will accelerate automation and disrupt traditional jobs and labour markets. According to PWC, $15.7 trillion will be added to global GDP through AI by 2030. Data61 was appointed by the Australian Federal Government in the 2018-19 Budget to develop a national AI roadmap and strategy that will guide future national investments, AI and machine learning PhD scholarships as well as a national AI Ethics Framework.

- **Robotics:** By 2025 McKinsey Consulting estimates the global impact of AI and robotics will be as much as $50 trillion fuelled by rapid advances in and from, the automation of knowledge-work, Internet of Things (IoT) deployment and 3D printing technology and services. Australia is recognised internationally as a

---

[11] https://industry.gov.au/Innovation-and-Science-Australia/Documents/ISA-system-review/Performance-Review-of-the-Australian-Innovation-Science-and-Research-System-ISA.pdf

global leader in robotics and has deep experience in large scale application and deployment of robotics in the mining sector. Data61's opportunity exists in the software and network services dimension of robotics and in the area of cyber-physical systems where digital devices connect to the physical environment via sensors and smart networked software.

- **Distributed Ledger Technology (DLT):** These technologies (which underpin new digital currencies like Bitcoin) provide a neutral, secure method for recording and executing transactions.

  The best known distributed ledger technology is Blockchain. Distributed Ledger Technologies have the potential to be as disruptive as the web browser for they can displace or make redundant traditional trusted entities, like banks. DLT will also underpin non-finance centric domains like personalised health and food provenance, smart contracts and new supply chain efficiencies.

Australia and Data61 are well respected globally in the emerging area of DLT and continue to build credibility in the domain. In the past year, Data61 has engaged extensively with industry and government (including Australian Treasury and other banks) to deliver two reports on the regulatory, technical and societal implications of using blockchain-based systems across various industries. The reports, *Distributed Ledgers: Scenarios for the Australian economy over the coming decades*; and *Risks and opportunities for systems using blockchain and smart contracts*, provide decision makers in business and government guidance on matters they need to consider in developing a system that uses blockchain technology.

- **Privacy Preserving Data Sharing**: Open data initiatives hold much value for businesses, governments and society. McKinsey estimates $5-7 trillion of economic value will be unlocked across seven industry sectors through open data.[12] However, cyber security and regulatory drivers will force a different architectural approach to analytics, to derive insight without exposing the underlying private and sensitive data across corporate and jurisdictional boundaries. Data61 has world leading capability in privacy-enhancing technology and has been commissioned by the Australian government to build out this technology for investigative analytics for law enforcement. (See Part 2: Insights from Selected Projects)

- **Cybersecurity:** There is a strong sovereign need to create a vibrant domestic cyber security sector that is globally competitive. Data61 has established itself as a leader in cybersecurity research and has world leading capability in the emerging cyber-physical systems that underpin the next wave of the Fourth Industrial revolution. Data61 initiated the establishment of The Australian Cybersecurity Growth Network (ACSGN) which is co-chaired by Data61 CEO Adrian Turner and a former IBM Corporation Group Executive, Doug Elix. Data61 has entered into a $9.3 million partnership agreement with Defence Science & Technology (DST) Group, (part of the federal Department of Defence) for multiple projects including the development of Cross Domain Desktop

---

[12] https://www.mckinsey.com/business-functions/digital-mckinsey/our-insights/open-data-unlocking-innovation-and-performance-with-liquid-information

Compositor (CDDC) technology. CDDC allows isolated computer networks to be securely accessed and viewed through a single user interface.

Data61 has also established collaborative cybersecurity research projects with nine Australian universities as part of the DST Group partnership.

- **Steering Committees:** Data61 has also been appointed as a data expert on steering committees for nationally significant programs aimed at reinventing existing industries and creating new ones. Data61 has been appointed to perform the role of a Data Standards Body for the Federal Government's Consumer Data Right, which will give Australians greater control over their own data, Data61 will develop open standards that enable consumers to safely access data about them held by businesses, and direct this information to be transferred via APIs to trusted, accredited third parties of their choice. The Consumer Data Right is intended to apply sector by sector across the whole economy, beginning in the banking sector. The energy and telecommunications sectors will follow. In addition, the $500 million Australian Genomics Health Futures Mission is the centrepiece of the Government's $1.3 billion National Health and Medical Industry Growth Plan announced in the 2018-19 Budget. Data61 was invited to join the Steering Committee to provide data science insights and expertise. The 13–member Genomics Health Futures Mission Steering Committee brings together experts including eminent researchers and clinicians, legal, ethical, consumer and community, and data. The Steering Committee will develop an operational plan for the Genomics Health Futures Mission.

Scalable Technology Platforms

A key plank in Data61's strategic ambition to help scale existing industries and seed new industries is to create the new technology and digital service platforms that will be foundational to the networked markets of the future.

- **Regulation as a Platform (RaaP):** Compliance checking and audit costs the Australian economy more than AUD$250 billion annually and is the fastest growing employment sector in Australia.[13] Regulatory burdens are also a handbrake for the nation's innovation ambitions. Data61 is working with government stakeholders to streamline the regulatory system by transforming their rules into digital logic. This digital logic can then be made available through Application Programming Interfaces (APIs) for third party companies to develop software and services. Data61's patented technology underpins the organization's Regulation-as-a Platform project and aims to maximise the value of regulation, as the key data set of government. (See Part 2: Insights on Selected Projects below.) www.data61.csiro.au/RaaP

- **N1 Confidential Computing:** Data61's patented N1 Analytics software enables insights to be learned from data in a confidential and encrypted manner. A recent

---

[13]   https://www2.deloitte.com/au/en/pages/media-releases/articles/rules-eat-up-250-billion-a-year-271014.html

KPMG survey has revealed 82 per cent of respondents are no longer comfortable to trade their personal details for free services online.[14]

Data61 scientists have developed a way to analyse data without seeing all the data, in such a way that preserves privacy and confidentiality while enabling richer data insights to be derived.

N1 Analytics software, which it claims will allow data scientists to analyse and act on the behaviour of their customers without an individual's data ever being exposed. It allows a bank's data scientist, for example, to know the average income of a pool of customers without knowing any of their underlying incomes or allow governments to analyse citizen data without having to build vulnerable and unwieldy databases. N1's patents are around the application of cryptography to machine learning and data analytics. It can reduce large databases to synthetic "data objects", whose inter-relationships can then be studied for insights. www.n1analytics.com

- **Workspace:** Data61's Workspace platform offers scientists, researchers and businesses an easy way to analyse, model and visualise scientific data with a low-cost path to commercialisation of the resulting software. Workspace's versatile plug-in architecture allows researchers and developers to bring their own capabilities in to the Workspace platform. One example of the application of the Workspace platform is SPARK, a wildfire simulation toolkit for researchers and specialists in the disaster resilience field. https://research.csiro.au/workspace

- **Determinant - Smart Data Acquisition**: Data61 has developed a software platform that uses a technique called active learning, to make accurate predictions by estimating the information content of new data before it is acquired, so that each new data-point provides the maximum possible improvement to making predictions. The technology can be applied to many industries: financial services, mining, government services, agriculture. In 2017, Data61 built these algorithms into a cloud-hosted software service.[15]

2.4. How does Data61 interact with different actors in the innovation ecosystem?

As a global innovation network focused on data-driven structural change and industry growth, Data61 is a single entry point to, and collaborative partner with, a range of government and private-sector stakeholders. All stakeholders are critical to its success: the more Data61 partners succeed in seeding and scaling new 21st century data-driven platforms, business models and projects, the more the organisation succeeds. In contrast to a "one and done" contract R&D approach, Data61's stakeholder/customer strategy is to leverage those that will provide a multiplier downstream benefit and accelerate strategy implementation for individual customers and the nation as a whole.

Together with government, industry, CSIRO business units and 30 university partners, Data61 is focused on helping to accelerate a change of trajectory for the country from within. In support of this strategy, Data61's persistent action is to build, manage and

---

[14]   https://home.kpmg.com/sg/en/home/media/press-releases/2016/11/companies-that-fail-to-see-privacy-as-a-business-priority-risk-crossing-the-creepy-line.html

[15] https://data61.csiro.au/en/Our-Work/Safety-and-Security/Understanding-Risk/Determinant

nurture a global R&D network, called 'D61+' in which the world's best aspire to be a part. This network is branded D61+, denoting that each stakeholder group is additive to Data61.

Data61 has built a searchable database called Expert Connect which contains profiles of 45,000 research and engineering experts from research organisations in Australia.

Expert Connect, now in beta, is hosted on the Data61 website and is designed to boost industry-researcher collaboration and will be the primary directory for access to global expertise in the D61+ network. It is continually evolving with additional data sets such as global patent data provided by an agreement with IP Australia.

The organisation's partner network (Table 1) is initially focused on the following domestic stakeholder groups with ambition to scale the partnership network globally over time.

Table 1 Organisation's partner network

STAKEHOLDER/ PARTICIPANT	HIGH-LEVEL RELATIONSHIP OVERVIEW
CSIRO Business Units	Data61 partners with other CSIRO business units (BUs) to provide multi-disciplinary R&D and data science expertise across domains, share knowledge and strategically go-to-market. This leverages Data61's Digital+Domain strategy and priority is determined by alignment with national interests and potential for large scale deployment of digital transformation projects. Priority areas include: Food Provenance and Logistics; Advanced Manufacturing; Cybersecurity; Open and Shared Data and Data Privacy; Robotics and Artificial Intelligence; Sustainable Energy Systems; and Environmental Protection.
Corporates	Data61 provides the business sector with access to deep digital-era disruption insights, analytic capabilities, outsourced R&D and the opportunity to shorten their innovation cycles. Data61's expertise and forward investment in underpinning technologies also provides corporates with an opportunity to build new business streams based on protected IP. Data61's innovation ecosystem linkages also serve as a feeder system for traditional businesses wanting to access deep-technology start-ups and digital transformation project expertise. Currently, Data61 is working with more than 90 national and global corporate partners including Boeing, Rio Tinto, Minetec, Cisco, General Electric (GE), PricewaterhouseCoopers (PwC), Unisys, George Weston Foods and Sydney Water Corporation.
Universities	Deep and enduring relationships with universities are central to Data61 and 30 universities are signatories to Data61's University Collaborative Agreement (DUCA). Through this fast-growing network, Data61 expands Australia's total research and innovation capabilities in digital and data related technologies and creates a growing cohort of ICT/Digital researchers for government and industry. Underpinned by DUCA, university staff and postgraduate students contribute to Data61 projects. These include:

- **Co-supervision and co-funding of PhD students:** primarily in the computer science discipline and now expanding into psychology and social science, business and law schools.
- **Adjunct Appointments:** Data61 encourages all its researchers to do some university teaching and PhD student supervision and typically have adjunct appointments at their local university
- **Joint Research Grant Funding:** Data61 and universities may jointly bid for research funding from various sources.
- **Strategic Joint Appointments:** Data61 and universities may partner to jointly fund outstanding senior candidates where the combination of resources and reputations makes a more attractive proposition.
- **Partnership Platforms:** The web-based platforms such as "Expert Connect" and "Ribit" are designed to better connect researchers with industry, and students with business.

The 3A Institute: Data61 is a joint founding partner with the Australian National University (ANU) in the new "Autonomy, Agency and Assurance Institute (3A)," a multidisciplinary digital-era research entity with global ambitions. The 3A Institute will bring together global domestic and global researchers in a range of disciplines, to build a new applied science around the management of artificial intelligence, data and technology and of their impact on humanity. By 2022, the 3A Institute aims to have set a new intellectual framework combining both theory and praxis and to have built a curriculum to start training the first generation of certified practitioners of this new applied science.

Government

Australian state and federal government agencies are embarking on digital transformation initiatives for better service delivery and to gain new policy insights for better policy development. Data61, as a neutral, independent entity, is the trusted advisor for many of these projects particularly around critical areas of data sharing, sensitivity, privacy and security as governments move to an open data setting. It provides technology development, contract R&D assistance and technical and strategic assurance to support government-led digital transformation.

Data61 collaborates with senior government decision makers (Deputy Secretaries/Executive Director level non-technical leadership) who have been charged with program goals with Ministerial support.

Current department engagements include: Federal Treasury; Department of Industry Innovation and Science (DIIS); Prime Minister & Cabinet (PM&C), Department of Immigration and Border Protection (DIPB); Australian Bureau of Statistics (ABS); Australian Digital Health Agency (ADHA); Australian state governments. (See Insights on Selected Projects)

Start-ups and high Growth SMEs

Digital transformation can be a great accelerator for start-ups and small to medium sized businesses (SMEs) with regional and global ambitions. Data61 provides transformative SMEs with collaborative and contract R&D and new technology licensing opportunities and, via its ecosystem network linkages, pathways to commercialisation and market expansion. Data61 has taken equity in 14 of its spin-out companies in return for intellectual property rights and actively manages this investment portfolio with commercial returns re-invested into research. Through SME Connect, our team works with SMEs to understand their business needs and

identify research-opportunities, facilitates connections into the research sector and is on hand to manage the partnership from start to completion.

The CSIRO's ON Program provides acceleration services for turning research into innovative ventures. Data61 provides mentoring expertise to participants in t various ON programs around product management, business models, commercialisation strategies and the value of digital and data in different contexts and how this can be leveraged for success. Several Data61 research teams have also participated in the ON program, including Hovermap[16] and Coviu.[17]

---

[16] https://www.wsj.com/articles/miners-aim-very-sci-fidrones-at-dark-dangerous-places-1509886805

[17] https://www.afr.com/technology/csiro-spinout-coviu-brings-the-doctor-to-you-20180418-h0yx98

2.5. What is the annual budget allocated to Data61? What are the sources of funding?

The principles of the Data61 funding model seek to balance the funding between public government sources and commercial private sector sources.

Data61 seeks a funding mix that ensures that the organisation doesn't become an incremental "work-for-hire" (consulting type) entity. The goal is to attract profitable, high margin revenues and strategically aligned client projects to provide additional capacity to do ambitious world-leading, self-directed research and product and technology development. Data61's operating budget is approximately AUD$110 million annually with funding and revenue drawn from the following sources:

- Core public funding from Federal Government for long term investments in research and development capabilities, and expertise to carry out fundamental and strategic research. This funding, generally not tied to project deliverables, will include: appropriation from CSIRO, some parts of Federal Innovation Programmes (NISA), State Government programs and other CSIRO programs funded from Government including Future Science Platforms (FSP's).

- Funding, often tied to project deliverables, for applied research, technology and product projects from public and private sectors. This may include research grants, some deliverable-driven NISA projects, new policy proposals (NPP) or pan deployment of internal CSIRO projects.

- Competitively-won funding for Industry and government R&D projects with deliverables.

- Revenues generated by IP licensing, products or spin-out equity returns.

Data61's approximately AUD$75 million in NISA-allocated 3-year funding commenced on 1 July, 2016 with the first tranche of $24.5 million. Such funding is to drive:

- Engagement with government agencies to support data analytics and connection of disparate government datasets to enable publicly release on open data platforms;

- Improved connectivity across Australia's cyber security industry and drive the development of new cyber security architectures; and

- Develop a Data Research Network able to link businesses with data researchers; and data analytics training to businesses, and data skills opportunities to the public sector

2.5.1. How is funding allocated to different activities of Data61?

Data61 adopts a **portfolio approach** to its investment and utilisation of capability over three main types of project activities. The portfolio approach effectively means different units (programs, groups, teams) may have very different % allocations due to development stage, strategic focus and demand timing. The three main types of project activities are:

1. Fundamental and Strategic Research:
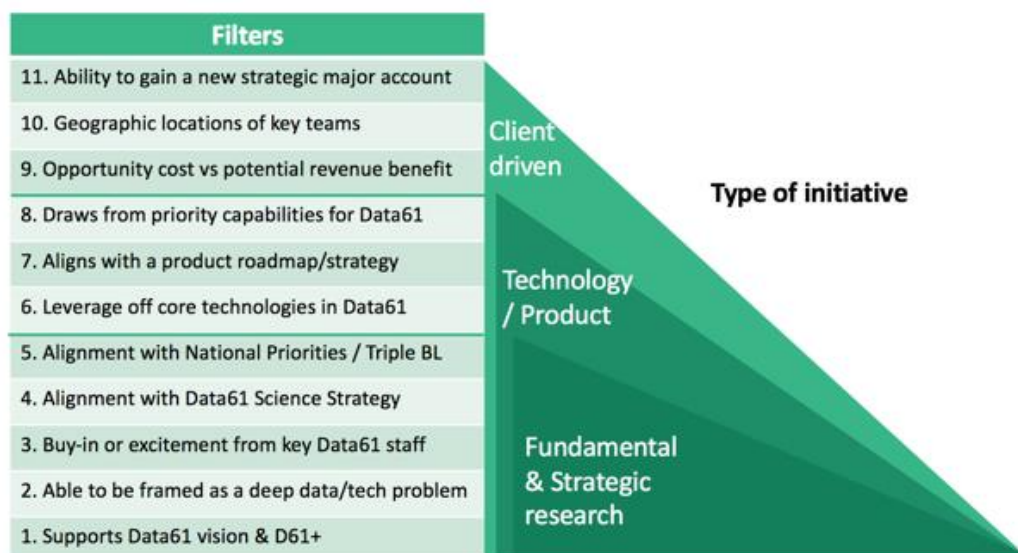
2. Technology and Product Projects

3. Client projects

The distribution of funds across Data61 organisational units (programs, groups, teams) uses an **effort-based resource planning model** to ensure that Data61 capability and resources can deliver against three major project types. Within five years, Data61 aims to balance the resources across these three types in equal third proportions as the sources of funding mix changes.

In addition to acknowledged differences across project units, Data61 also considers the following factors when it uses the % effort allocation to understand demand and capacity constraints:

1. Higher-than-expected % effort allocation to Type 3 (Client) projects may be the result of a unit's co-investment because the client project is highly aligned with goals in other types of projects.

2. Lower-than-expected % effort allocation to Type 3 client projects may be the result of securing high margin projects (earning significantly more than cost recovery) rather than low demand. Some units may prefer redirecting "saved" effort to Type 1 and Type 2 projects rather than doing more Type 3 projects.

3. Lower-than-expected % effort allocation to Type 3 client projects may also be the result of a high % effort allocation to Type 2 (technology/product) projects which should be encouraged.

To help guide its investment and de-investment decisions within this portfolio, the executive team has developed a series of "filters" to help determine the relative value of incoming opportunities. These are not intended to be prescriptive, but rather a framework of questions to help align investment in various activities with Data61's market strategy. A summary of these filters is outlined below.

2.5.2. What is the rationale behind this funding model?

The funding model has been designed to allow for flexibility and to adapt to internal and external demand. It also enables the organisation to better balance limits in capacity and resources, for example head count.

3. Data61 in practice

3.1. What type of organisational structure does Data61 have?

Data61's operating model is built entirely around partnering which can result in Digital + Domain expertise in the top 1% globally. It leverages the D61+ network and a unique platform approach. By deploying its global ecosystem of shared data, deep technology expertise and innovation capabilities, Data61's ambition is to disrupt the US$1.3 trillion global R&D market over time.

Data61 is part of the CSIRO, which, including students is an 8,500-person government entity focused on scientific research in some 22 domains from agriculture to health, energy and the environment. What sets Data61 apart is its deep data science expertise and its application to traditional and new research and commercialisation domains.

While technically a business unit of the CSIRO, Data61 has been given far greater latitude to operate differently and with greater independence to allow it to succeed in its faster paced digital data domain. The approach of Data61 is that in a data-driven and globally networked world, leading edge work, problem-solving and scale dynamics cannot thrive with a linear process model. Success depends on harnessing myriad interdisciplinary and multidisciplinary linkages and identifying scalable commercial application with and without external ecosystem partners. Data61's operating model is therefore structured to ensure that it is in the best position to deliver on its strategies and operational plan and to maximise the national and global impact of its research.

Market Pull Approach

Historically, neither NICTA nor the CSIRO had fully recognised the need for a market pull approach. From its inception, Data61 has organised for it and has quickly achieved strong brand recognition externally since July 2016. This organisational "market pull" design means a flatter structure with less middle-management and giving more autonomy to staff. Research leaders are also given scope to identify and resource new opportunities; Group leaders have the scope to decide priorities and the latitude to develop workarounds to centralised system processes and constraints where appropriate for faster outcomes, while still maintaining full alignment with the strategic goals of the organisation and the broader CSIRO.

Data61 has also aligned its team and talent around ambitious "challenge" programs which seek to identify large scale societal and business problems and build new technology platforms and software to solve them.

The market focus is fuelled by expertise in the Business Development & Commercialisation (BD&C), Product Management and Insights teams - all looking for market shifts and building programs to capitalise on the opportunities arising from those market shifts. All key business functions directly report to the Data61 CEO, Adrian Turner to enable deep functional knowledge and decision-making at a speed.

The increased emphasis on markets and commercialisation is supported structurally by:

- **Separation of Research Programs (RP) and Engineering and Design (E&D)**: Enables focus on core technical research capabilities, and accelerates the transfer of research and technology to product development for commercialisation.

- **Dedicated Product and Business Development and Commercial (BD&C) teams**: Builds structure and methodologies for capturing market context globally and to enable clear definition of D61+ partnering programs and consistent market-facing communications.

- **Data61 Challenge Model:** In order to better apply its data and domain expertise to solve the national and international 21st century challenges borne from digital-era complexity, in December 2017 Data61 introduced its "Challenge" model. This approach challenges the organisation to organise into multi-disciplinary teams – technical and commercial – to identify and develop new-to-the-world technology solutions for globally relevant problems and societal transformation and inclusiveness. These include challenge projects in AI and trusted analytics; open data, sharing and privacy.

- **Independent Advisory Board:** With globally experienced and recognised members drawn from industry, academia and government. The Advisory board is chaired by Doug Elix, a former IBM Corporation Vice President. The role of the advisory board is provide a global perspective to collaborative research and commercial market opportunities and to advise the CEO. The varied expertise on the advisory board also provides input on Data61's key competitive differentiators and risk impact in a global sphere where it competes for major investments and contracts.

- **Emphasis on Team & Talent:** Data61's value proposition emphasises fostering and showcasing team and talent: "Data61 is where you can do the best work of career working on national and world shaping problems". The organisation is making additional investment in its marketing capability to evolve its profile as an alternate and preferred 21st century workplace for best-of-breed talent over other large, branded technology and software companies.

3.2. What challenges have been faced during the process of design and/or implementation of Data61 and how are these being (or planning to be) addressed?

Cultural Challenges

As part of the CSIRO, Data61 is in a trusted, privileged position, sitting between academia, industry and government. This is a strong differentiating factor from most or all private sector corporations and high growth companies in Australia. It gives the organisation a unique advantage point to identify emerging needs in digital transformation and execute on those opportunities. This means building new technologies with the potential to scale new enterprises from them.

It also presents different operational and cultural complexities for the organisation, particularly in terms of striking the right balance between government and entrepreneurial "growth" mindsets while working at the speed the fast changing global digital economy demands. While Data61 continues to progress its integration with the CSIRO's centralised systems, its culture also encourages Data61 scientists and engineers to innovate with workarounds to internal processes and systems, when appropriate, to accelerate the effective transition of its science and technology into the market.

Data61's scale and multi-sector access capability can also be perceived by some external ecosystem partners large and small, as a competitive threat. Data61's challenge is to continue to build collaborative trust with ecosystem participants in both word and action,

and to foster its role as a catalyst for collective scale growth and benefit for the national innovation ecosystem as a whole.

Talent Recruitment

Attracting and retaining the best global talent to challenge its internal and external teams to do globally differentiated work is critical and an ongoing challenge for Data61. The organisation is relentlessly focused on creating a work environment where its science, technology and operations talent can do the best work of their careers and has put in place a structured international recruitment program to target and approach specific researchers who were leaders in their areas of speciality. Each of the Data61 science teams had surfaced people that are doing world-leading, renowned work and have a program to reach out directly to those target researchers. The value proposition is that they would work either directly with Data61, or they would work with Data61 in combination with one of its university partners on bold, ambitious projects.

Data61's 1,100 staff including its 300 PhD students are sourced from more than 70 countries. However recent federal government changes to the 457 Visa program for foreign workers,[18] have introduced some added complexity. Data61, like others in the innovation ecosystem continues to work with government and advocates for the introduction of special visa classes for science and technical personnel and to promote Australia as a serious research and development destination.

Building Digital-Era Management Capability within the Ecosystem

Importantly, as Australia's data science specialist, Data61 has to cement its collaborative intent and team approach while continually challenging others in the system to move faster and think bigger. This challenge is further heightened by the recognition that the leadership ranks of Australian business and government entities have only recently begun to focus their attention on building digital-era management capability within their own entities, technically and strategically. Australian companies also have a low relative percentage of embedded scientific researchers and data scientists. To accelerate digital-era literacy and preparedness among Australia's business executive class and foster a greater collaborative mindset between participants, Data61 is trialling executive education programs with the Australian Institute of Company Directors (AICD) focused on cybersecurity; as well as digital-era preparedness programs targeted at senior executive and board level audiences.

Balance of Fundamental Research versus Applied Research

A healthy innovation and research system features a balance of public good research, pure basic research and applied research. But even with the additional resources of the NISA, achieving the right balance of funding and focus between pure research and applied research is a constant challenge. Data61, with its mission to seed new industries, fully recognises Australia's need for better engagement and commercial impact of science and technology research. But cautions against an over-emphasis on short term, commercially-applied research at the expense of pure basic research which is the feedstock for applied and commercial outcomes.

---

[18] https://www.border.gov.au/Trav/Work/457-abolition-replacement

4. International dimension

4.1. Does Data61 have an international dimension? Does it engage in cross-country collaborations for innovation or other mechanisms for international outreach?

Data61's ultimate measure of success is international expansion of the D61+ network and the application of its technologies, software and services. Data61 also sees opportunity to earn a greater share of the USD1.3 trillion global R&D spend.

The CSIRO and Data61 partner with leading public and private organisations around the world and are recognised internationally for quality, specialised research. This work ranges from monitoring diversity in the Amazon rainforests, simulating climate extremes over East Asian-Australian monsoon regions, to building a Blockchain-for-trade platform to advance trade between Pacific-region partners.

Data61's current global work is supported by the organisation's Insights Team which analyses trends, risks, and scenarios related to the digital economy, knowledge based industries, and technological change and bridges a gap between science and technology, policy, and strategy. The Insights team conducts original research and delivers consulting and advisory services to international client organisations, both public and private. Data61's analytical toolkit offers capabilities in scenario planning, emerging and complex risk analysis, decision support, strategic planning, horizon scanning, project appraisal, benefit cost analysis, multiple criteria analysis, megatrends analysis, statistical forecasting, technology impact assessment and policy design.

The following sampling of projects, by no means exhaustive, indicates the range and scope of Data61's global work in data-driven specialities and sectors:

USA

Data61 is collaborating with several public and private entities in the USA, including:

- **DARPA**: Alongside our partner Rockwell Collins, Data61 was selected by the US Defence Advanced Research Projects Agency (DARPA) to develop methods to secure platforms for the US Navy (as well as land and air services) against cyber-attacks.

  Data61's *seL4* secure microkernel has since been demonstrated on a Boeing unmanned helicopter, a small unmanned air vehicle, and an enhanced soldier vision helmet. Data61 been asked to participate in DARPA's CASE programme to help build cyber resiliency into Defence programmes at a systems level.

- **Boeing:** Data61 is partnering with a leader in the global aerospace industry to provide an R&D pipeline of emerging data-driven technologies in areas such as autonomous systems, on-board health monitoring analytics and federated machine learning techniques for improved efficiency of manufacturing and expansion into space related activities.

- **Intel:** Partnering with the global leader in semiconductors, that specialises in data conversion and signal processing to secure IoT devices at the edge and provide advanced data filtering techniques in applications including smart cities, autonomous systems and automotive.

Chile: Monitoring, Prevention and Environmental Analysis of Bushfires/Floods

Chile, like Australia, experiences the devastating economic and environmental impact of bushfires and flooding. Following Chile's significant bushfire events in 2017 and recognition of the deep knowledge acquired from Data61's long involvement with the Powerline Bushfire Safety Program in the Australian state of Victoria since the Black Saturday fires in 2009, Chile's Forestal Arauco S.A. sought-out Data61 to better understand the risk associated with bushfires.

The work in the flood space followed a large flood and mudflow event that occurred in the Copiapo Basin (part of the Atacama Desert region in Chile) in March 2015. Data61's task is to develop a custom software capability that is able to simulate flood and mudflow scenarios in this region and use this as the basis to recommend flood mitigation options going forward. The project includes expertise and knowledge transfer and data extraction techniques from Data61 to Chilean researchers and practitioners.

China: Monsoon Climate Extremes over East Asian-Australian monsoon regions

The CSIRO and China have 40 years of collaborative history which began with an agricultural research partnership with the Chinese Academy of Science. Data61 continues to build on the relationship to embrace commercial and research partnerships centred in the areas of Big Data and data science.

- The Centre for Southern Hemisphere Oceans Research brings together researchers from Australia and China to further scientific understanding of the southern hemisphere oceans and their role in global and regional climate. A collaboration between the CSIRO, Data61 and China's Qingdao National Laboratory for Marine Science and Technology, and the universities of Tasmania and NSW has attracted $20 million in funding over 5 years to investigate southern hemisphere oceans stretching from the tropics to Antarctica looking at melting Antarctic ice shelves, along with investigating the influence of the El Nino climate phenomena.

- Data61 researchers partnered with the Chinese Academy of Applied Sciences to develop a software tool that could offer early identification of illness and track success of treatment.

- China faces a pneumonia crisis every year[19] Data61's machine learning technology, applied to lung scans could offer early identification of illness and track success of treatment.

  This technology is also used for early tumour detection in blood vessels and was funded by CSIRO-Chinese Academy of Sciences Collaborative Fund.

Brazil: Monitoring Biodiversity in the Amazon

A team of scientists from Australia, Brazil and Spain have joined forces to develop the most sophisticated remote monitoring system ever used to track the diminishing biodiversity of South America's Amazon Jungle. The project, called Providence, will revolutionise the way biodiversity is monitored by creating a distributed, wireless sensor

---

[19]   https://www.asianscientist.com/2016/04/topnews/mycoplasma-pneumoniae-capital-institute-pediatrics-china/

network throughout the jungle with autonomous nodes that continuously monitor wildlife under the canopy of the Amazon Forest.

The team has been granted nearly $2 million by the Gordon and Betty Moore Foundation, a philanthropic funding body established by Gordon Moore - the founder of Intel - to carry out the first stage of this biodiversity monitoring project.

Vietnam Sunrise Industries Project

In Nov 2017, Australia and Vietnam declared innovation as a new pillar in their strategic partnership, contributing to strengthening bilateral relations and highlighting four priority areas in agriculture, health, the environment and marine research. Data61, in collaboration with Australia's Department of Foreign Affairs and Trade (DFAT) and Vietnam's Ministry of Science and Technology will be examining how digital technology will enable the rise of new 21st century industries and transform the Vietnamese economy.

The Aus4Innovation program[20] will provide AUD$10 million in support for targeted activities aimed at promoting Vietnam's potential and developing and piloting projects in fields of Australia's strength. The programs will help key Vietnamese sectors modernise and grab economic benefits while securing employment opportunities for the Vietnamese workforce.

Robotics Challenge: Data61 and the International Atomic Energy Agency (IAEA)

Industries around the world are evolving at the intersection of digital technologies and physical environments. CSIRO's Data61 is working closely with a network of government, corporates and academia — including the IAEA and Australia Safeguards and Non-proliferation Office (ASNO) — to apply world class robotics technologies to advance these industries and make them safer and more efficient.

A nuclear-focussed International Robotics Challenge was held in Australia November 2017 to demonstrate the important role robots can play in monitoring nuclear sites and capturing important data to prevent their misuse for the development of nuclear weapons. It aims to demonstrate how robotics can be used to reliably undertake repetitive measurements of nuclear material in parts of nuclear facilities that may be difficult or unsafe for humans to access. The IAEA uses these important measurements to verify that countries are not misusing nuclear materials and facilities to develop nuclear weapons.

The Internet of Stings: Capturing swarm sensing data from Australia and Brazil

Bees are the world's most prolific pollinators of food crops. With one third of the food that we consume each day relying on pollination, bees contribute billions of dollars every year to the global economy. Healthy bees are a sign of a healthy agricultural industry. Data61, through its association with the Global Initiative for Honeybee Health (GIHH) and in collaboration with industry partners such as Hitachi, Intel and the Vale Institute of Technology, has developed a power-efficient micro-sensing system to monitor hive conditions. It is leveraging existing Data61's IoT technologies to forecast bee health and develop prediction tools. Thousands of honey bees have been fitted with tiny sensors as part of a world-first research program to monitor the insects' movements. The teams are working with Brazil's Vale Institute of Technology to take the technology to the Amazon.

---

[20] http://ven.vn/australia-to-boost-vietnams-innovation-capacity-29720.html

5. Impact and process of evaluation

5.1. Has Data61's impact already been evaluated? If so, what have been the outcomes?

Data61 achieved and surpassed its key milestones in what was a transition year for the newly merged entity. It stabilised and integrated operations and systems with the CSIRO and has quickly rebuilt stakeholder confidence and executed well on all of its third-party delivery obligations for government and corporate clients. Data61 secured more than AUD$135 million in new multi-year contracts in 2016-2017 with 51 patents granted and 72 applications filed. It continues to relentlessly focus on attracting and retaining the best global talent and to challenge its internal and external teams and partners to do globally differentiated work.

In addition to the national and global collaborative work outlined above, key achievements for Data61 in 2016/2017 include:

- **Partnership for Accelerating Cyber Capacity:** Data61 entered into a $9.3 million partnership agreement with Defence Science & Technology Group on cybersecurity and established collaborative research projects with nine Australian universities around jointly identified priorities.

- **Blockchain Technology Review:** In its first year, CSIRO's Data61 has engaged with industry and government to deliver two reports on the regulatory, technical and societal implications of using blockchain-based systems across various industries. The first report, *Distributed Ledgers: Scenarios for the Australian economy over the coming decades*, explores four plausible adoption scenarios of blockchain technology in Australian in 2030. The second, *Risks and opportunities for systems using blockchain and smart contracts*, selects three use cases to examine how blockchain systems can support new markets and business models. These include: agricultural supply chains, government registries and remittance payments.

- **N1 Confidential Computing launched:** N1 Analytics confidential computing software platform enables insights to be learnt from data in a confidential and encrypted manner. Data61 won AUD$16 million in new funding for that research to establish an Investigative Analytics Programme in conjunction with law enforcement agencies to improve the detection of suspicious activity.

Capital raised for portfolio companies includes:

- Bionic Vision Technologies secured an AUD$24 million capital raise, enabling the company to continue with trials of the first Australian bionic eye implant. Data61 and partners' vision processing research is a key component of the bionic eye, transforming high resolution images into a set of stimulation signals on a retinal implant.

- Saluda Medical developed a breakthrough neuromodulation platform technology based on sensing and adapting to the body's neural response to stimulation. They have developed the first and only intelligent closed loop spinal cord stimulator (SCS) system for the treatment of chronic pain. The system delivers and monitors the dose of electrical therapy to the patient in real time on every pulse. As of

2017, the therapy is currently in clinical stage. Saluda Medical spun out of Data61 in 2013 and has recently secured an AUD$53 million capital raise.

- Audinate provides professional audio systems that allow for the transport of high-quality media over standard data networks. Their ground-breaking audio networking technology, Dante, provides improved sound quality and simplified wiring - replacing expensive recording, mixing and editing hardware. Audinate was founded in 2006 and recently secured an AUD$21 million capital raise at IPO; a great success for what was Data61's first start-up company.

5.2. Process of evaluation

Data61 benchmarks its science against the best in the world. While the CSIRO has always planned its research and evaluated its impact, it is only since 2010 that the organisation has taken a consistent, organisation-wide framework approach to plan, monitor and evaluate the impact of its research. This approach allows for a more comprehensive and complete view of the impact being delivered and supports the management of impact of a large portfolio of research and increasing commercialisation.

Impact and evidence based planning, monitoring and evaluation is an intrinsic element of the CSIRO's Planning and Performance Framework and Management Cycle. CSIRO's approach to impact management assumes that in order to understand the value of research, it must be possible to track the process by which research translates into benefits in the real world. Planning, monitoring and evaluating impact is based on a "theory of change" model called program logic. The CSIRO's Impact Framework is based on the hypothesis that the process of creating impact begins with deploying inputs, to conduct research activities and produce outputs, which themselves are translated through short to medium term outcomes into long term impact.

As part of its internal science reviews each team was required to identify who are the world leading groups in their field and then to realistically compare their methods, their outcomes, and their strategy in comparison to these world leading groups. In recognition that there are varying degrees of scientific maturity among our projects, and also assess whether there is a realistic potential for early stage science to become world leading in the future based on established metrics, researchers in different fields are assessed using metrics that are considered appropriate and acceptable in that field globally.

These metrics may include, but are not limited to, total academic outcomes (publications, presentations, awards, positions on committees and boards); scientific adoption (users downloading codes, for example); as well as commercial uptake in their industry. The track record of individual high performing researchers, while not a perfect indication of future potential taken in isolation, is considered in addition to project team performance, since studies have shown that excellent science is strongly correlated to the inclusion of excellent scientists (which is consistent with the observations from internal science reviews, and past NICTA science reviews).

Part II. Insights on selected projects

6. Project 1: Platforms of open data (PFOD)

As part of the National Innovation and Science Agenda (NISA), Data61 is working with Australian government agencies on R&D projects that aim to increase the number and availability of high-value datasets between government agencies and to the public, while preserving sensitive data and privacy. These projects use an iterative approach to develop new technologies based on the needs of the partner agency, ensuring that the technologies are applicable across multiple agencies.

The projects under the Platforms for Open Data program will:

- Facilitate more use of public data by providing better search and discovery

- Make more high-value datasets available ensuring a high level of privacy protection, and

- Lead the use of public data by performing advanced analytics on data

Data61's Open Data Tiger Teams are working with government agencies to assist them in making their high-value datasets available from open data platforms such as data.gov.au and, where applicable, accessible from the National Map (nationalmap.gov.au). A key need is to provide open data while preserving data sensitivity and privacy. To improve the quality of public datasets available through data.gov.au, the Tiger Teams will help agencies use best practice standards, formats and workflows to produce best-in-class machine readable datasets, and develop methods for accessing, analysing and displaying these datasets. These workflows and artefacts, discoverable through data.gov.au will share the knowledge openly with others and drive interest in datasets, building a portfolio of exemplar projects and approaches, including the following:

6.1. Making Open Data Accessible

Partner Agency: Department of the Prime Minister and Cabinet (PMC)

Data61 is expanding the existing data.gov.au and NationalMap.gov.au infrastructure to maximise the discoverability and reuse of high-value open data in government, industry and the community sectors. Its technology streamlines publishing and improves data quality, enabling better search, discovery and insight to be drawn from the data. In March 2017, Data61 released the first version of its new approach to making more government data discoverable. The new architecture and interface makes searching easier and faster by moving from a *data catalogue* approach to a *data search engine* approach, and giving users the option to limit their search results by publisher, location, date-range and file format.

6.2. Secure API Access for the Multi-Agency Integration Project

Partner Agency: Australian Bureau of Statistics (ABS)

Data61 is developing prototype software that will allow public data platforms to interactively access aggregated data which is "confidentialised" on-the-fly from unit record datasets. The prototype API is being developed initially to provide secure access to the Multi-Agency Data Integration Project (MADIP) dataset.

The MADIP dataset is being developed in a partnership between the Australian Bureau of Statistics, Department of Human Services, Department of Social Services, Department of Health, Department of Education and Training, and the Australian Taxation Office.

The MADIP project creates an enduring, linked, research dataset to help government agencies and researchers respond to nationally important policy and service delivery questions. The Secure API Access for the MADIP project aims to demonstrate how customised queries can be produced from public datasets using standard systems while maintaining privacy. The prototype API will enable data to be made more openly available to policy makers, academics and researchers, and reinforce the 'open by default' principle of access to data.

6.3. Open Data Access Infrastructure & Synthetic Social Security Payments Dataset

Partner Agency: Federal Department of Social Services (DSS)

Data61 is developing prototype software and a user interface for data researchers to access large sets of de-identified government data at the unit record level and to access longitudinal survey data. The project will optimise the value of the Department of Social Services' Priority Investment Approach data by enabling auditable data extraction and delivery into a secure environment for policy and research purposes by authorised users.

Data61 is developing algorithms that enable the safe release of a synthetic representation of a dataset covering 15 years of social security and family payments with the aim of delivering meaningful analytics for policy development to enable more equitable social outcomes. This synthetic dataset could be made openly available, as it removes the connection between real individuals and their data, alleviating confidentiality risks while retaining the overall characteristics of the original dataset.

6.4. Improving understanding of Australian Firms

Partner Agency: Federal Department of Industry, Innovation and Science (DIIS)

Data61 is working on new technologies to improve the accessibility of the Business Longitudinal Analytical Data Environment (BLADE), and thereby provide data to better understand economic activity in Australia, building up from firm-level data. The project will perform research and technology development to enable mediated access to researchers and prevent spontaneous recognition of entities within the data. BLADE is not a data set, but a statistical asset and methodology for linking business datasets through a common identifier, such as the Australian Business Number (ABN) which identifies individual businesses.

It is designed to help researchers unlock important insights on matters of importance to Australia and Australians. Integrating administrative data with directly collected survey data increases the capacity of the research community to undertake firm-level analysis and improves the evidence base for policy development and evaluation. Through combining separate datasets, BLADE provides a holistic look at firms and industries. It is

useful for analysing business performance and dynamics, business demography and characteristics.

7. Project 2: Regulation as a Platform (RaaP)

Data61 is building an open platform based on a machine-readable version of current laws, acts, policies and other regulatory documents. Its patented technology automatically checks business process compliance against legislative and contract obligations and provides feedback on risks for businesses. This builds on ten years of research and development and the goal is to enable the birth of a new "RegTech" industry powered by digital legislation.

Rules and regulations are necessary in any functioning, fair and inclusive society. They cement the key foundations of our society, protecting the rule of law and a wealth of standards in everything from health to safety and the environment. They can help businesses to reduce risk and plan for the future.

Regulatory creep can also be a choke-hold on innovation and other risk-based enterprise.

Compliance checking and audit costs the Australian economy AUD250 billion annually according to Deloitte Access Economics[21] and the compliance sector is the fastest growing employment sector in Australia, currently employing around one million professionals. By way of comparison, there are already more compliance workers across Australia than there are people working in construction, manufacturing or education roles. In fact, one in every 11 employed Australians now works in the compliance sector. Deloitte Access Economics concluded:

- AUD$250 billion – annual burden on the national economy of administering and complying with the rules set by both governments and businesses

- AUD$155 billion – annual cost to administer and comply with rules the private sector imposes on itself

- 8 weeks – time spent each year by the average employee just to pay for the cost of administering and complying with rules

- 1 million people – employed in 'the compliance sector' – the fastest growing sector in Australia.

To turn burden into opportunity, Data61 is currently working with a range of government and private sector stakeholders to transform their rules into digital logic which can then be made available through Application Programming Interfaces (APIs) for companies to develop software and services. Regulation as a Platform (RAAP) is a project that aims to maximise the value of regulation, as the key data set of government. The technology is developing with government agencies to reduce overheads for new small businesses and has been used by industry groups to provide decision support for compliance.

---

[21]   https://www2.deloitte.com/au/en/pages/building-lucky-country/articles/get-out-of-your-own-way.html

For regulators and auditors, the RAAP technology automates low-value transactions to improve efficiency.

Datata61's Proof-of-Concept and prototype RAAP projects and partners include: the Department of Industry, Innovation and Science (Small businesses and SMEs), Australian Taxation Office and AusTRAC.

Additionally, [PaidRight](#) is a joint venture between Data61 and PricewaterhouseCoopers (PwC) that has capitalised on that background, allowing Data61 to meet the market in record time. PaidRight is an application that is used to check if organisations are paying their employees correctly, it automates the process and uses analytics to cross check enterprise agreements, payslips and employer data. Working collaboratively with partner PwC, Data61 was able to take the PaidRight application from development to commercialisation stage in just sixteen weeks. PwC's global client list will be among the first companies able to run PaidRight alongside their in-house payroll systems: within its first year on the market, PaidRight will likely help 100 companies ensuring their employees are being paid correctly.

Data61's RAAP platform technology depends on world leading processing and understanding of logic. This logic naturally models legal concepts, such as obligations, ongoing commitments and permissions and mathematically models business rules, transactions and legal requirements. It has been applied to contracts, legislation and consumer credit applications.

In the life cycle of a business there is a high number of a events which would cause a change in the their regulatory requirements – moving to a new location, offering a new type of service, importing or exporting goods, reaching a new threshold in number of employers – would trigger an interaction with government and regulators. These are time consuming and complex and different government agencies require businesses to require the same information over and over again by completing multiple forms by mail or online.

Conversion of English-language legal text into machine-readable logic is an enormous challenge. The law is incredibly tangled with different acts policies and regulations built on each other, applying in different contexts or different types of entities. Further complexity arises with the added requirements of protecting private and sensitive data. Data61's RAAP "logic" is written in the same way one might explain rules to a child. It avoids vague concepts such as "best practice" or "what's a reasonable thing to do?" and instead it is designed around provable truths: things you are permitted to do;

things you obliged to do; and things you must not do. This set of rules, added to a reasoning system, forms the Data61's *Defeasible Deontic Logic technology*, which can then be used by a computer or an application.

Data61's "Parse-IT" web-based application takes existing legislation, reads its content and understand somewhere between 50-80 per cent of its intent, and automatically translates it into pure maths logic. To make sure the algorithm accurately conveys the legislation's original intent Data61 researchers and developers collaborates with policy experts to review and endorse the new logic-based sets of rules. These rules are stored in a main database which then feeds different applications.

It is not unrealistic that in the future, legislation may be written as logic even before it is written in English. Data61 is working on a new application called, "Write-IT" which

allows regulators to draft and write future rules in logic first, which also feed the database.

Once this is endorsed, Data61 can develop tools and applications around it to streamline interactions with the government. The ultimate goal of the platform is to create a large ecosystem with the tools, standards, project exemplars and the necessary guidance to enable anyone, from the public and private sectors, to start building their own applications and solve their own compliance issues.

8. Project 3: NationalMap

NationalMap is a map-based visualisation and access tool for Open Government Data and the first map of its kind in the world. It is a website for map-based access to spatial data from Australian government agencies. It is an initiative of the Department of Communications and the Arts now currently managed by the Department of the Prime Minister and Cabinet and the software has been developed by Data61 working closely with the Department of Communications and the Arts, Geoscience Australia and other government agencies.

The aim of the initiative is to bring together dispersed information which has been collected and produced by governments at all levels and in all functions, into an easily searchable, viewable and fully customisable spatially-represented view. The type of searchable data that is available is varied and includes data about Australia's broadband internet access coverage, location of surface water and waste management facilities, infrastructure developments such as gas lines, and electoral boundaries. As it evolves, NationalMap website could assist with the visualisation management of environmental and ecosystem issues, salinity and air quality.

The Map itself does not store any data. It is a tool for visualisation and access of data pulled from sources such as data.gov.au where government agencies upload their own data. When users access data through the national map, they are accessing it directly from the government department or agency who owns the data. The web front-end uses Data61's TerriaIS software, and connects directly with data servers at each government agency using open protocols and open data formats.

NationalMap is a fully open architecture and has more uses than just showing data. Users can also upload their own data sets. It helps with evidence-based decision making and can be used to unlock economic potential and support both commercial and non-commercial information.

The NationalMap initiative has been in development for several years and leveraged Data61's predecessor, NICTA's expertise in geospatial visualisation. The software called, *Cesium* is an open source WeBGL virtual globe and map engine, which Data61 is co-developing with international community developers.

A key collaborator for extending the functionality and application of the NationalMap is Geoscience Australia, the pre-eminent public sector science and technology advisor on the geology and geography of Australia. The collaboration provides current and historical satellite imagery of the Australian continent via the Australian Geoscience Data Cube (AGDC) and NationalMap. This extends the platform so that it can access data from the AGDC to view 30 years of remote sensed imagery from the entire continent. This is a

response to requirements from agencies such as the Department of the Environment, to be able to have a direct visual comparison, through time, of any location of interest such as a paddock, lake, or city. The project will provide an open API to provide easy access to visualise data from the AGDC.