DIGITAL EARTH AUSTRALIA AND
THE URBAN PLANNING SECTOR

# PLANNING TO
# BENEFIT FROM
# EARTH OBSERVATION

OCTOBER 2022

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# FOREWORD

Digital Earth Australia was established by the Australian Government to take advantage of the rapidly increasing availability and accuracy of satellite image data. It is a world-class digital infrastructure that places intelligence from Earth observation (EO) satellites in the hands of more Australians and equips policy and decision-makers with powerful insights. Providing access to this rich and high-quality set of data and tools enables new applications and services to be developed that will boost the efficiency and productivity of Australia's economy.

The opportunities for EO data to drive improved planning outcomes and efficiencies within Australia's urban planning industry are extensive. Its potential as evidence for decision making is transformative, there are significant operational efficiencies to be gained, and it can benefit the entire cohort of professionals who work to plan, design, and construct our future cities. However, there is currently a gap in knowledge and awareness between technology providers and potential users which inhibits adoption of EO-derived knowledge and applications. This report is a step towards bridging this gap and encouraging urban planning and EO professionals to explore together the new opportunities which EO data and analytics make possible. We welcome planners, communities, businesses, educators, innovators, and individuals into this conversation, and we look forward to hearing from you.

## ABOUT DIGITAL EARTH AUSTRALIA AND FrontierSI

Digital Earth Australia (DEA) is program of Geoscience Australia. DEA makes analysis-ready satellite data and data infrastructure accessible to industry, government, and researchers.

Geoscience Australia has engaged FrontierSI to conduct exploratory research into the potential application of Earth observation data across key sectors, including agriculture, mining, finance and insurance, and urban planning.

This report reflects insights sourced from industry research, interviews, focus groups, conferences, and workshops conducted over 2021. It was funded by DEA and published in 2022.

# EXECUTIVE SUMMARY

Urban planning plays a significant role in ensuring the future sustainability of cities and regions as population grows and urban areas evolve. In Australia, over 80% of people live in urban areas. Further, the total value of the residential real estate in Australia has reached 8.1 trillion dollars, supported by a $360 billion dollar construction sector.[1] Considering the needs of the current and future population, urban planners make decisions about how to allocate limited resources for the well-being of people and the environment, as well as optimising the asset base and investments of Australian home owners, businesses and investors. To make the most informed decisions quality data is critical.

This report aims to identify the urban planning industry's critical business problems, operational activities, and diverse user groups, informing both technology companies, government organisations, and the broader urban planning industry as to how investment in EO solutions can drive business returns.

## OPPORTUNITIES

Notable opportunities for the growth of EO in the industry include:
• Expand access to EO across the urban planning value chain.
• Significant opportunities exist to inform the design of future cities.
• EO can help to enable capital to flow.
• Increasing use of AI and ML with EO unlocks new possibilities for automation of processes.
• Urban analytics providers are beginning to utlise EO.
• EO can be a core part of digital transformation and automation.

## CHALLENGES

Several significant challenges have been identified in increasing the uptake of EO products and services within the urban planning industry. These are:
• Specialist knowledge is required in EO data application to problems in the urban planning industry.
• The development of EO solutions requires organisational buy-in.
• High cost of high-resolution data limits adoption for applications in the industry.
• Overcomming the multiple often disconnected systems

## RECOMMENDATIONS

In response to these opportunities and challenges, recommended actions for EO providers are:
• Provide a single source of standardised products that local and state governments.
• Support a common platform for visualisation and analysis of EO.
• Invest in increasing EO awareness.
• Invest in increased education & training.

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1   ABS (2021) Media Release – Total value of residential dwellings exceeds $8 trillion https://www.abs.gov.au/media-centre/media-releases/total-value-residential-dwellings-exceeds-8-trillion
    Australian Industry Skills Committee (2022) Construction Industry https://nationalindustryinsights.aisc.net.au/industries/construction

# CONTENTS

# PART 1: INTRODUCTION

## BACKGROUND AND PURPOSE

Urban planning plays a significant role in ensuring the future sustainability of cities and regions as population grows and urban areas evolve. In Australia, over 80% of people live in urban areas. Australian cities are world-renowned as some the most liveable places[2] and urban planners are tasked with future proofing this liveability. To do so urban planners need to reconcile a myriad of evolving environmental, economic and social factors. These factors include environment sustainability and climate change, COVID19 management, population growth and importantly, planning how these pressures will manifest in terms of increases in congestion, waste and rising housing prices. Considering the needs of the current and future population, planners make decisions about how to allocate limited resources for the well-being of people and the environment.

To make the most informed decisions quality data is critical. The growing volume of high-quality data available from Earth Observation (EO) satellites have the potential to radically transform the evidence-base used to plan, construct and maintain our cities, towns and regions. Central to this transformation is understanding the challenges faced by urban planning sector.

EO data also presents significant benefits for communities, Governments and industries associated with urban planning. For example, the construction industry depends on urban planning outputs and generates over $360 billion in revenue and produces 9% of Australia's Gross Domestic Product.[3]

While EO data is valuable across all stages of the urban planning process, its use is not currently a uniform practice. This presents an untapped opportunity that requires EO service providers to understand the needs of users.

This report sets out the needs of the urban planning community for EO data producers to help shape the EO product offerings for urban data users. It also highlights the emerging opportunities to increase the use of EO in urban planning. By doing so, this report assists in enabling EO to be a tool of choice to address the challenges to strengthen urban decision making. The intended audience is companies operating within urban planning whose business could benefit from EO as well as spatial companies looking for opportunities to develop new product and service offerings for the urban planning industry.

The report draws on a series of interviews with urban planners across the broad spectrum of urban planning disciplines including urban designers, property developers and practitioners of property law and financing. These interviews highlighted the importance of using data to understand the relationships between places, communities and the economy now and into the future.

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2   *Economist Intelligence Unit (2022) The Global Liveability Index 2022 https://www.eiu.com/n/campaigns/global-liveability-index-2022/*
3   *Australian Industry Skills Committee (2022) Construction Industry https://nationalindustryinsights.aisc.net.au/industries/construction*

# PART 2: THE URBAN PLANNING SYSTEM

## THE AUSTRALIAN CONTEXT

Planning is the process of making decisions to guide future action. The planning profession (which is also referred to as 'urban planning' or 'town planning') is specifically concerned with shaping cities, towns and regions by managing development, infrastructure and services.[4]

Over the past decade, Australia has had one of the fastest population growth rates in the developed world. A significant amount of this growth is from people living at the edges of our largest cities. Ensuring that Australian cities retain high levels of liveability is clearly an imperative which is reflected in recent state and national government planning policies. However actually planning for communities is a complex task which requires a data-driven evidence base to underpin the planning process.

Considering events over the last year people living in and planning for Australia's cities and regions have had to respond to numerous shocks and stressors. The 2019-2020 bushfires decimated rural towns and resulted in Canberra and Sydney recording an air quality index more than 25 times the hazardous level. Shortly after in February 2020 the Sydney metropolitan area received its heaviest rain in 30 years. The storm brought vast flooding and strong winds that caused commuter chaos and left over 100,000 homes without power.

From mid-March 2020 the Global COVID19 pandemic caused lockdown restrictions to be progressively implemented restricting people's movements to within their neighbourhoods. While the long-term impact of COVID19 on our cities is unknown, planners are increasingly looking for data to provide an evidence base for predicting scenarios and monitoring change. This data is needed to inform the economic recovery. As well as catering for the changes in behaviour with a large proportion of the workforce shifting to working from home, potentially changing the distribution of jobs and transport in the major cities as a growing number of people move to the country and coast, placing growing stresses on those locations.



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4   *Planning Institute of Australia (2021)* Become a Planner – Planning Institute of Australia *https://www.planning.org.au/becomeaplannerarchive*

## URBAN PLANNING

The heart of urban planning is the creation of inspiring places that are liveable, resilient and attract and support economic development. Quality urban planning requires a responsive planning process with well-developed guidelines for government and community consultation that then allow related industries such as architecture, engineering and development companies to partner and respond to market forces and community drivers.

The role of an urban planner is to develop and implement plans and policies for the controlled use of land, and advise on economic, environmental and social factors affecting land use. **Figure 1** sets out the general division of responsibilities for Urban Planning in Australia. The states are responsible for the overarching planning and development policies, such as the broad objectives of and purposes for land use (whether residential, business, agricultural, recreational or other), with which State or Local approval authorities must comply. Local Governments are responsible for developing and implementing land use plans at the local level, with local plans expected to be consistent with metropolitan strategic plans or regional plans and applicable State planning policies.[5]

## THE ROLE OF GOVERNMENT

Although the role of state and territory governments differ, the structure of their planning systems and the economic forces which shape the cities and towns within their jurisdiction are common. These systems need to accommodate population growth, promote economic development, and preserve and/or enhance social and environmental wellbeing. In doing so urban planners are also responsible for considering community needs including culture, economic growth or business development, improving health outcomes and conserving the environment and in doing so respond to climate change. The responsibility for planning, funding and delivery of infrastructure, transport and human services in Australia's major cities is shared between all levels of government.

## THE ROLE OF THE PRIVATE SECTOR

It is important to recognise that although land-use and infrastructure planning is largely the responsibility of state and territory governments, thousands of private sector organisations are engaged in urban planning.

The role of these organisations is diverse; covering planning, engineering, construction, and operations. The relationship between industry and government

### FIGURE 1: SIMPLIFIED PLANNING FUNCTIONS AND RESPONSIBILITIES

| | |
|---|---|
| **Minister** | Request development and rezoning assessments if required. <br> Approve major changes and initiatives |
| **State Government** | Development of state planning policies <br> Development of strategic plans for the metropolitan areas or regional areas <br> Releasing land for new developments <br> Make provision for major infrastructure |
| **Local Government** | Develop the local plans in accord with regional state plans. <br> Process the vast majority of development approvals <br> Initiate local land use plans (planning scheme amendments) <br> Create regulatory instruments including land use zones, overlays and specific local government planning laws (usually within the guidelines set by the state). |

(a) Responsibilities may be spread across the Minister. Planning Department/Commission, Supra-council decision making bodies, State Government Developers, and State bodies with specific planning/development responsibilities. Source: Adapted from Productivity Commission (2021)

5  Productivity Commission (2021) Information Paper Plan to identify planning and zoning reforms.
   Access https://www.pc.gov.au/research/completed/planning-zoning-reforms/planning-zoning-reforms.pdf

in urban planning is an important one which needs to be balanced between the different needs for the community, environment, and return on investment. For example, industry often need fast returns, which may not always align with the long-term nature of the urban development project. This can also lead to tension with different parties wanting the most profitable projects or land, leaving the more undesirable land for public activities or social good.

**THE ROLE OF THE COMMUNITY**

Urban planning is a dynamic process; how people live and use the space around them changes over time. The community has an important role in planning. They do this through the way they engage with the planning process as well as shaping the market forces such as preferences for a certain housing type or choice of transport. Access to data can enhance community education and engagement throughout planning processes and create changes

in the level of demand for housing types, land-use patterns and transport options. Active engagement in the early stages of planning can improve services for the community, reduce resistance to project delivery and reduce the risk of costly changes later in the process.
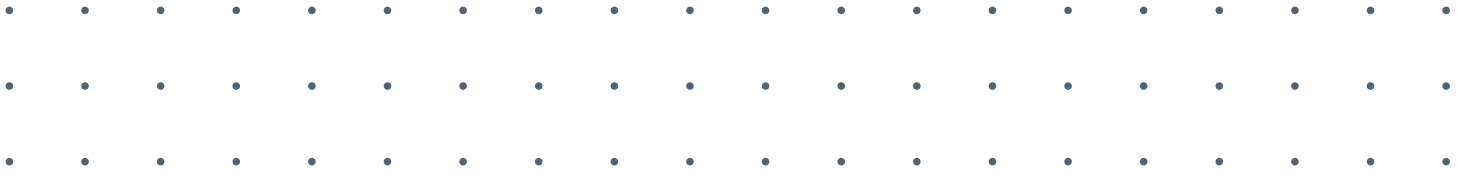
**THE URBAN PLANNING VALUE CHAIN**

To describe the different interests in urban planning we have used the concept of an urban value chain, adapted from the World Economic Forum (2015) and illustrated in **Figure 2**. The value chain concept captures the role of the different industries and government interests involved throughout the lifecycle of a development or renewal of an urban area including policy development, strategic and statutory planning, design, implementation and construction, operations and maintenance and monitoring, as well as the financing of urban development projects.

**FIGURE 2: URBAN PLANNING VALUE CHAIN**
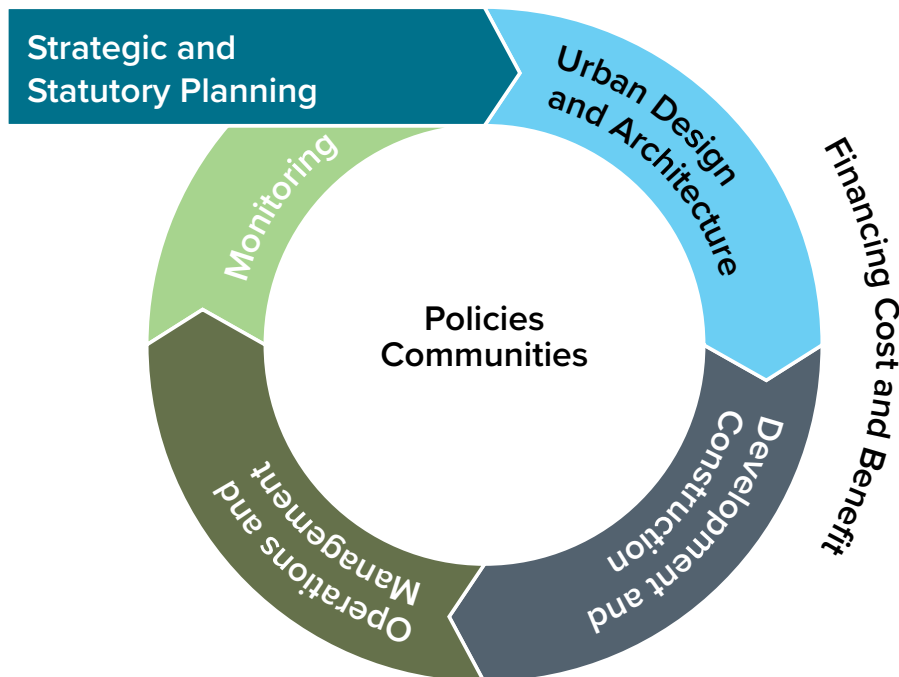


Source: Adapted from World Economic Forum (2016) Shaping the Future of Urban Development and Services initiative (page 38).
Link https://www3.weforum.org/docs/WEF_Urban-Services.pdf

## THE RELATIONSHIP BETWEEN EARTH OBSERVATION AND THE URBAN PLANNING VALUE CHAIN

The interview and consultation process revealed that satellite and aerial imagery are the two main sources of EO data currently used in urban planning. Whilst we acknowledge the broad remit of EO including mapping via drones, balloons and other sensor networks, in this report we consider only satellite and aerial imagery. **Table 1** provides a summary where in the urban value chain the technology has been used, as well as comments relating to the strength and weakness of each EO type.

The planning industry is currently exploring the opportunity that digital tools and environments will have on the planning lifecycle. Digital Twins, both at State and Local Government level are being used right across the planning lifecycle, to bring together the information needs and decision support tools.

EO is a critical source of data that is held in twins, and assists a range of decisions. For example: 3D object models of the existing built form can be created from oblique aerial photography, and these models are used when assessing planned development for their shadowing and overlooking potential

### TABLE 1: EO TYPE, URBAN PLANNING APPLICATION, STRENGTH AND WEAKNESS.

| Sensor/ Value chain | Typical Urban Planning Application | Strength/Weakness |
|---|---|---|
| **Satellite** Strategic Planning, Monitoring | To measure and monitor vegetation coverage, land use change and water quality. To derive new data (such as GeoScape Buildings) or Digital Elevation Models. Macro level change detection. | **Strength:** Frequency, historical data availability and region-wide coverage. **Weakness:** Lower Resolution, skills needed to acquire and manipulate. |
| **Aerial** Architecture and Urban Design, construction | To view fine scale data such as building outlines. To validate and ground truth building development work without needing to be onsite. To provide a map and overlay with existing data such as urban growth boundaries and ecological vegetation and soil types to protect both biodiversity and productive agricultural land on the edge of urban areas. Thermal imaging collected via thermal sensors is also being used to understand and mitigate the Urban Heat Island Effect. Lidar for height detection of vegetation and DEM product development. | **Strength:** High resolution. **Weakness:** Cost, Timeliness (often quarterly or yearly updates are not frequent enough to measure new development activity). |

## MEASURING THE VALUE

Given the large number of sectors and agencies involved valuing urban planning and the ripple effects is complex and so we have provided a summary of the economic value. It is important to also recognise that good urban planning does not necessarily cost more to deliver but offers strong competitive advantages to be spread to those operating across all sectors of the market.

| Local Government | Local government employs 194,000 people which is nearly 10% of the total public sector (as at June 2018). In 2018-19, local government collected $18.9 billion in rates. Local government's total annual expenditure is $38.8 billion (2018-19).[6] |
|---|---|
| Architectural services | Architectural service firms provide architectural design and drafting services, landscape design services and town planning services. Industry operators also provide consultation on land zoning and building code regulations. In Australia the combined market size is estimated at $7 Billion, and the number of businesses is 12,986.[7] |
| Property development and Subdivision | Property development is usually seen as an industry made up of firms that buy land to build on, but it has a wider scope. The industry is responsible for the continual creation and renewal of the built environment. |
| Construction | The construction industry plays a major economic role in Australia, producing around nine percent of the country's GDP. The construction industry generates over $360 billion in revenue, producing around 9% of Australia's Gross Domestic Product, and has a projected annual growth rate of 2.4% in the next five years. In 2020, employment reached just under 1,180,000 and is projected to exceed 1,282,000 by 2024.[8] |
| Property Market | Good urban planning creates places of lasting economic value. In May (2021) CoreLogic announced its estimate of the total value of residential real estate in Australia has reached $8.1 trillion.[9] |
| Smart Cities / Digital Twins – Value | The economic benefits of digital twins, smart cities and emerging digital technologies are considerable. The global digital twin market is projected to be US$29.1 billion (AU$43.3 billion) by 2025. In Australia, emerging digital technologies such as IoT and big data are predicted to increase our annual GDP growth rate by 0.5 to 1.0 percent, and the aggregate direct and indirect value of government data in Australia was AU$25 billion per annum in 2014.[10] |
| Community Benefit | Although it is difficult to quantify in economic benefits heath and economic studies over many years have proven that well-planned urban spaces improve wellbeing and social connectedness. Well-designed transport systems boost productivity, reduce congestion and pollution increasing the liveability of places. |

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6   Australian Local Government Association (ALGA) (2021), Facts and Figures https://alga.asn.au/facts-and-figures/
7   IBIS World (August 2021) Architectural Services in Australia – Market Research Report. Available Online: https://www.ibisworld.com/au/industry/architectural-services/550/
8   Australian Industry and Skills Committee (July 2021) Industries/Construction. Available Online: https://nationalindustryinsights.aisc.net.au/industries/construction
9   CoreLogic (2021) https://www.corelogic.com.au/news/australian-housing-market-surpasses-8-trillion-valuation#:~:text=Australian%20housing%20market%20surpasses%20%248%20trillion%20valuation,-CoreLogic&text=CoreLogic%20today%20announced%20its%20estimate,markets%20now%20at%20their%20peak
10  Lateral Economics (2014) Open for Business: How Open Data Can Help Achieve the G20 Growth Target referenced in ANZLIC (2019) Principles for Spatially Enabled Digital Twins of the Built and Natural Environment in Australia

# PART 3: ACTIVITIES CARRIED OUT ACROSS THE URBAN PLANNING VALUE CHAIN

Earth observation has the potential to add value to multiple organisations operating across the urban planning value chain.

These stages broadly include:

1. **Strategic and Statutory Planning** Strategic planning encompasses policy, legislation and plan making which is typically undertaken by State and local governments. Strategic planners are responsible for setting the vision for an area as well as reviewing the planning policy and legislation to ensure consistency with the vision. In contrast statutory planning involves working with landowners the preparation of development applications and peer review of development applications these applications are assessed against the requirements of statutory planning instruments (e.g. planning scheme, state planning policy, etc).

2. **Urban Design & Architecture:** Urban designers interpret the context of the area and work to create useful, attractive, safe, environmentally sustainable, economically successful and socially equitable places. Good urban design pursues local identity and sense of place, cultural responsiveness, and purposeful environmental innovation. Urban design is complemented by the skills of architects who design the built form and create the blueprints for construction. Architects are also often responsible for the public safety and overseeing the delivery of the building including the construction.

3. **Development and Construction:** This stage involves acquiring and subdividing the land as well as undertaking construction of the new places & communities. The construction process involves the delivering of buildings and infrastructure (ie. Roads, bridges) associated with activities through to the end of life. This state typically starts with planning, financing and design and continued until the asset is built and ready for use. Construction also covers repairs and maintenance work any works to expand, extend and improve the asset, and its eventual demolition, dismantling or decommissioning.

4. **Monitoring, Operating and Maintaining:** Urban places are complex with layers of infrastructure below and above ground, people interacting across space and time managed through infrastructure such as traffic lights, car parking time limits etc. At the same time there is an increasing amount of digital data available that can help to understand decision making in the urban context. How we manage and interpret that data is important and lends itself to the development of tools such a digital twin.

## Strategic and Statutory Planning

**Objectives**

Identify areas for growth & urban renewal.

Develop zoning systems to guide and facilitate growth and development (incl. land for the allocation of services.

Community consultation.

**Activities**

Legislation (Zoning and Overlays).

Economic feasibility analysis.

## Urban Design and Architecture

**Objectives**

Design liveable places for the long-term.

Minimise impact on the environment and keep costs down for residents and community.

Ensure places are designed in keeping with the heritage and culture of an area.

**Activities**

Development Approvals.

Drafting plans.

Economic Feasibility and secure funding.

The planning **policy** sets the direction for planning across each state. Specific policies can include, environmental and landscape values, environmental risks, natural resource management, built environment and heritage, housing, economic development, transport and infrastructure.

## Monitoring, Operations and Management

**Objectives**

Ensure the places are safe, that services are available and maintained.

Operation of the community services.

Identify opportunities for refurbishment/renewal.

Secure operating budget for maintenance.

**Activities**

Monitoring of defects, operation and maintenance of buildings, equipment and infrastructure.

## Development and Construction

**Objectives**

Feasibility and cost benefit analysis.

Ensure that the building regulations are adhered to and obtain the necessary permits.

Construction of the building/development.

Ensure the quality of the construction.

**Activities**

Efficient construction of houses, services and utilities.

## Technology enablement

Technology enablement tools such as digitisation of the planning process, digital twins incorporated with Earth Observation (EO) data have the potential to transform the design, management and performance of the assets across the built environment.

# POLICY

Policy development is a key function of state and local government. The planning policies and procedures provide the framework within which development occurs. For state and local governments, they define what the rules and regulations are and what is permitted. Having clear policies offers clarity and helps both the public and private sector to operate more effectively. It means there will be fewer misunderstandings or debates about what to do. In Australia, metropolitan planning strategies represent the main policy framework guiding urban interventions

by state governments. These strategies provide a long-term outlook for the development of Australia's cities.

In South Australia the 30-Year Plan for Greater Adelaide focuses on the future of Adelaide over the next 30 years.[11] Whereas, the *Greater Sydney Region Plan: A Metropolis of Three Cities* guides Sydney's development to 2056 as a metropolitan region consisting of three main centres. Despite the intention of long-term strategic planning to cover a ten-to-forty-year horizon, metropolitan planning

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11  The Government of South Australia (2017) The 30 year plan for Greater Adelaide https://livingadelaide.sa.gov.au/
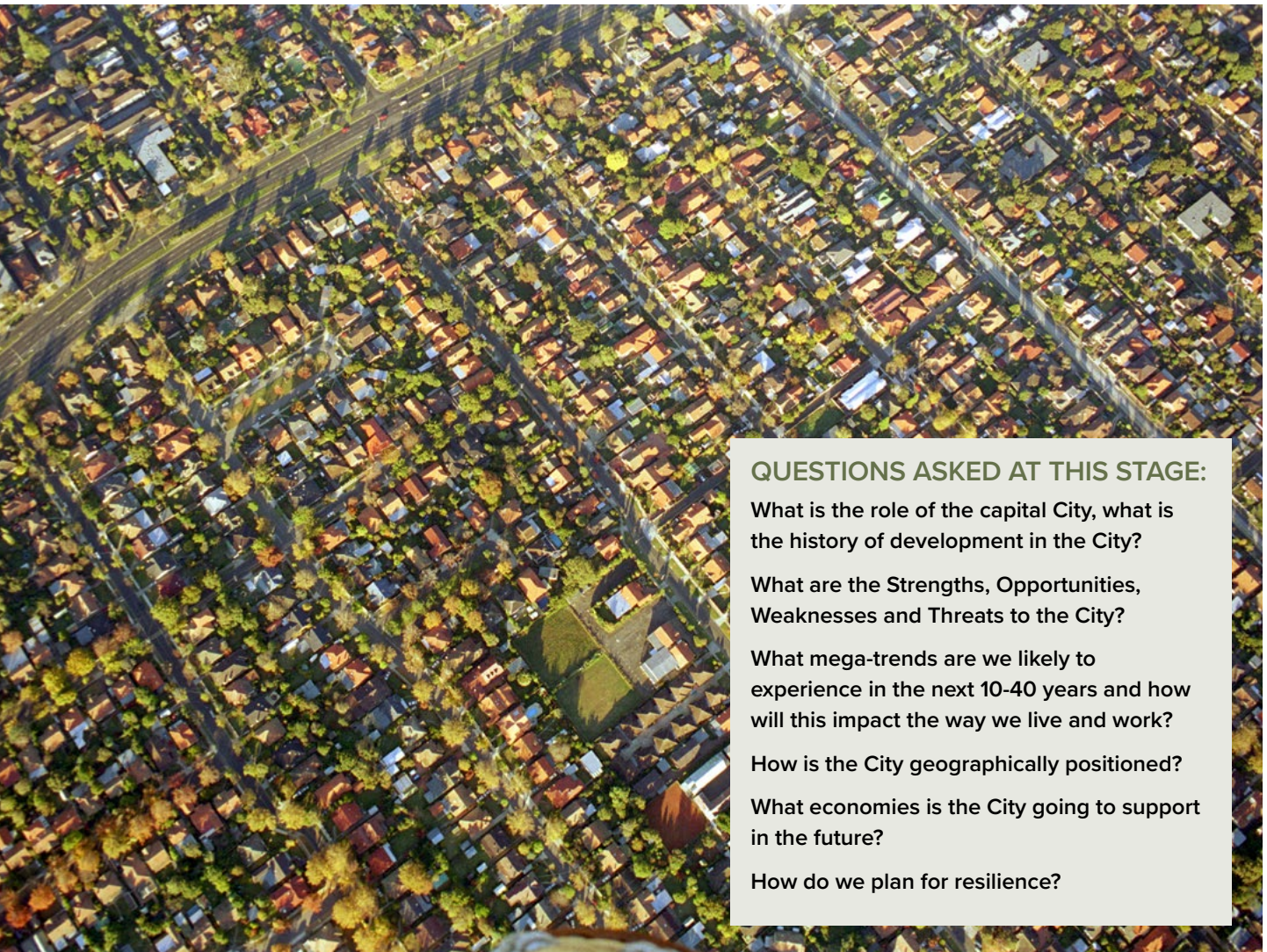


**QUESTIONS ASKED AT THIS STAGE:**

**What is the role of the capital City, what is the history of development in the City?**

**What are the Strengths, Opportunities, Weaknesses and Threats to the City?**

**What mega-trends are we likely to experience in the next 10-40 years and how will this impact the way we live and work?**

**How is the City geographically positioned?**

**What economies is the City going to support in the future?**

**How do we plan for resilience?**

strategies are revised frequently. For instance, Melbourne's metropolitan planning strategy, Plan Melbourne, was released in 2014, then refreshed in 2017 by a new government as Plan Melbourne 2017-2050.

The common requirement for these plans is to identify their basis having regard to economic, social and environmental matters and for monitoring and reporting creating the opportunity to improve the integration of data and analysis that informs transparent decision making and implementation through local government strategic and statutory plans.

**EO CAN HELP MAXIMISE EFFICIENCY AT THIS STAGE BY:**

- Providing a common evidence base for all parties to access
- Identifying natural areas that are sensitive to change (ie vegetation, waterways, contaminated land)
- Provide historical data illustrating the urban context and natural environment
- Model the growth potential of a place and explore scenarios for the long-term future
- Providing a macro picture of land use across an area
- Ongoing monitoring of change to assess how effective the policy has been implemented

## USE CASE: GREATER SYDNEY REGION PLAN: A METROPOLIS OF THREE CITIES
### (OBJECTIVE 30 URBAN TREE CANOPY COVER IS INCREASED)[12]

The Greater Sydney Commission have used satellite data to illustrate the current tree canopy coverage across Sydney. Within the plan they report the benefits to the community of tree canopy coverage as a form of green infrastructure providing shade, which reduces ambient temperatures and mitigates the heat island effect. This plan also outlines the major challenges in many areas with a lack of space to extend urban tree canopies and the need to balance creating space for urban tree canopy with the need to allow sunlight into homes and onto roofs for solar power.

Technical Guidelines for urban green cover in NSW provide practical information for planning and expanding urban tree canopy and green ground cover. The NSW Government has prepared the draft Greenfield Housing Code[13], which will help to provide more space for trees, in both front and backyards, in new residential areas. To complement this, up to 5,000 trees a year will be provided over the next three years, under the Free Tree Initiative[14], to owners of new homes approved under the complying development code in Greater Sydney's greenfield areas.
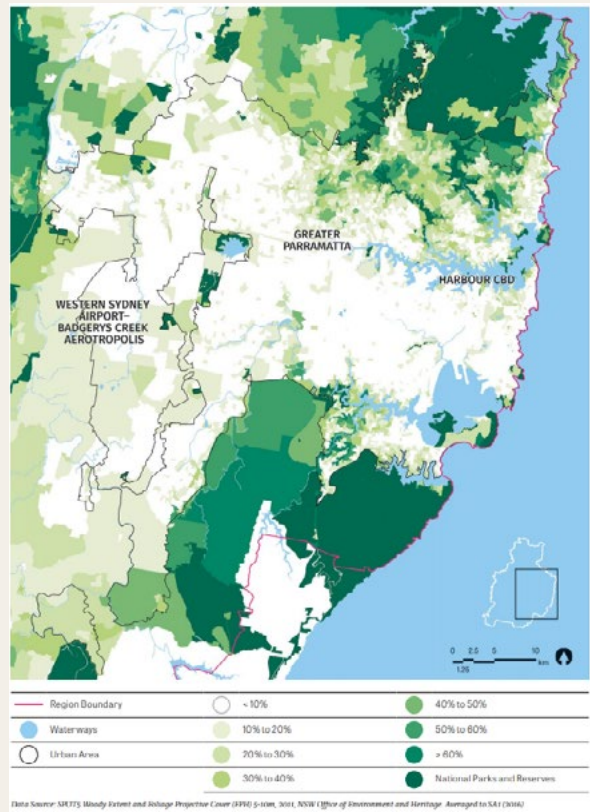


12 *Greater Sydney Commission (2017) Our Greater Sydney 2056 A metropolis of three cities – connecting people https://www.greatercities.au/metropolis-of-three-cities*
13 *Greenfield Housing Code – (nsw.gov.au). Available online: https://www.planning.nsw.gov.au/Policy-and-Legislation/Housing/Greenfield-Housing-Code*
14 *Greenfield Housing Code | Planning Portal – Department of Planning and Environment (nsw.gov.au) https://pp.planningportal.nsw.gov.au/greenfield-housing-code*

# LIFECYCLE STAGE 1: STRATEGIC PLANNING

Urban strategic planning determines the direction of development of a city or urban area, in the context of its current profile and future opportunities. The strategic planner helps the city to respond to fast moving events, to manage change and improve the quality of life. It is a dynamic process that changes to reflect the demographic, economic and changing situation in a city. The process of strategic planning is orientated towards the future and attempts to see how the world could be different in five to ten years from now.

Urban strategic planners help to answer questions like:
• Which areas are growing and how are they growing? Is this growth appropriate for the community, infrastructure and environment?
• What is the future vision for this area set by the council, and how does it differ from other councils?
• How can the existing economic base be preserved and expanded?
• How can quality of life be protected and enhanced?

The strategic planning process guides development in the direction of those strategic priorities identified by all stakeholders through a consultative process with industry and communities.

**EO CAN HELP MAXIMISE EFFICIENCY AT THIS STAGE BY:**
• Identifying land appropriate for urban renewal and/ or development
• Understanding the vegetation cover
• Understanding the future impacts of climate change
• Model the growth potential of a place and explore scenarios for the medium-term (5-10) year future
• Ongoing monitoring of change to assess the implementation of the strategic plans.



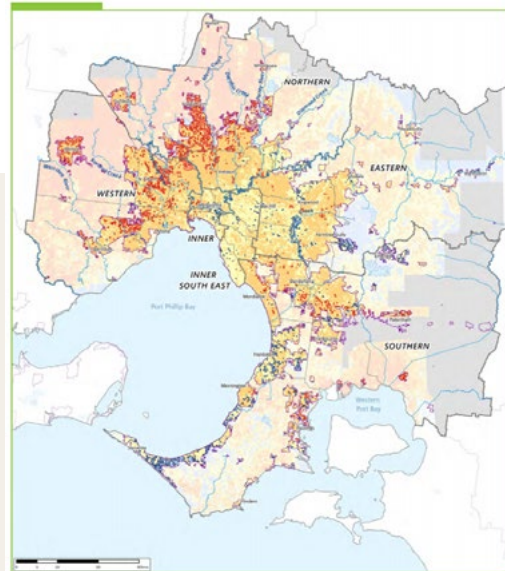## CASE STUDY: LIVING MELBOURNE

Living Melbourne is a strategy for a greener, more liveable Melbourne.[15] The strategy has been developed in collaboration with 32 metropolitan councils, state government agencies, non-government and community organisations, and other partners united around a common vision for an urban forest. The strategy uses EO data to measure the current tree canopy cover over Melbourne and identifies areas with intense urban heat islands.

Using a variety of Australian Bureau of Statistics indices such as the Socio-Economic Indexes for Areas (SEIFA index), which ranks areas in Australia according to relative socio-economic advantage and disadvantage, the analysis found a close correlation between hot spots in the landscape and vulnerable populations. It also identified that, in most cases, there is a greater number of hot spots where the percentage of residential rental properties is highest and where weekly household income was lower. A close correlation was found between vulnerability and ambulance call-outs in Melbourne on hot summer days.

Data Source: Map of urban heat island across metropolitan Melbourne[16]

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15 *The Nature Conservancy and Resilient Melbourne (2019) Living Melbourne: Our Metropolitan Urban Forest Technical Report. The Nature Conservancy and Resilient Melbourne, Melbourne.*
16 *Caccetta, P., Devereux, D., Amati, M., Boruff, B., Kaspar, J., Phelan, K., Saunders, A., 2017. Land surface temperature and urban heat island estimates for Australian urban centres. v2., s.l.: Commonwealth Scientific and Industrial Research Organisation (CSIRO).*

**QUESTIONS ASKED AT THIS STAGE:**

Where are the opportunities for renewal or growth?

What are the stresses and/or how would the City respond to sudden shocks?

Where are the impediments to growth – sea level rise, preservation of sensitive wetlands or species?

What is the likely demand in this area (residential, employment, education)?

What happens to the area if we develop (ie transport systems/road infrastructure, community services, culture and heritage)?

# LIFECYCLE STAGE 2: URBAN DESIGN AND ARCHITECTUAL DESIGN

Urban designers and architects aim to create high quality places that are fit for purpose to support innovation, boost local economies and complement the wider group of neighbourhoods and districts. These places are adaptive to climatic conditions and are attractive to residents, businesses, workers and visitors and enhance the overall liveability of the city or town. Architects are responsible for the design of the building, selection of materials, and water runoff.

**EO CAN HELP**
- Understanding the current and historical local environment and site conditions
- Mapping vegetation community types across the project site
- Developing 3D models
- Understanding water catchments
- Understanding urban form including street patterns, building setbacks, open and green space.
- Understanding air quality
- How does the place change over different time scales such as within a day i.e. shadowing impacts; or during the seasons for building materials and solar direction.
- Urban Heat Mapping

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## USE CASE: URBAN HEAT

The City of Port Phillip has identified the need to reduce the urban heat island (UHI) effect – increased ambient temperature in high-density urban areas compared to surrounding suburban or rural areas – as a key priority in developing a greener, cooler and more liveable city that is resilient and can adapt to climate change. EO data has been used to understand how the South Melbourne precinct fits within the climate profile of Metropolitan Melbourne. Nine local cooling intervention scenarios were made available for the South Melbourne Precinct via the UHI-DS Tool.[17] The UHI-DS Tool allows users to interact with and visualise the cooling effects of the various cooling intervention scenarios reported. An example of such an analysis is shown in Figure 5, where the key interactive functions include:

**Urban Context:** explore sensor data, surface temperature, and air temperature

**Urban Development:** explore development potential compliant with planning controls, along with exploration of the impact of new buildings with increased height going beyond existing height limits

**Cooling Intervention Scenarios:** Current and Future Climate Conditions: explore cooling effects under climate conditions in 2020 and 2050

17 UHI-DS Tool interface (2021) Accessed online: http://uhimitigationindex. be.unsw.edu.au/portphillip/index.html

**Indicators of Results:** Air temperature distribution – allowing users to select a cell of heatmap to view localised air temperature

Figure 5: Land use classification in Greater Melbourne (d04) (NASA, MODIS database). The City of Port Phillip municipal boundary shown in white.
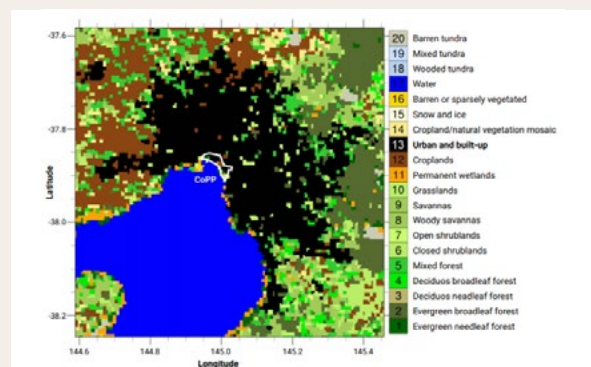
**QUESTIONS ASKED AT THIS STAGE:**

How does this design, site or precinct fit within the local context of built form and regulations such as environmental, cultural and heritage requirements?

How do I optimise the time to gain community and government approval?

How can we design a building/precinct that responds to the externalities of the site (i.e. potential for flooding, urban heat island etc)?

What interventions can be put in place to respond to external stresses and threats?

What is the Cost Benefit Analysis (CBA) and/or the feasibility of undertaking the development?

# LIFECYCLE STAGE 3: DEVELOPMENT AND CONSTRUCTION

Property developers need to be assured that the project is financially feasible and to minimise risks. This process often requires a Cost Benefit Analysis (CBA), this is a process where decisions about the proposal are analysed to ascertain if the benefits outweigh the costs, and by what margin. This process requires collecting as much information as possible about the project. Increasingly environmental impact is being costed into the project.

EO data can be used during the development phase to virtually monitor and report on progress. It can also be used to foresee issues on sight. EO is also used by the regulators to confirm when on-site inspections are needed and where to concentrate resources.

**EO CAN HELP MAXIMISE EFFICIENCIES AT THIS STAGE BY:**

- most development projects require creation of exhaustive environmental impact statements, water and vegetation protection plans, and right-of-way access strategies.
- Secure investment – funding and financing required throughout construction
- Identifying and assessing potential development sites
- Providing highly accurate information on construction progress and saving on valuable inspection time
- Compliance information (regulator)

## USE CASE: NEARMAP HIGH RESOLUTION IMAGERY

Technology that allows for virtual site inspections provides construction and engineering companies with an edge, helping businesses to keep projects and planning moving during site shutdowns and restrictions, and to support construction sites to lower their carbon emissions.

High-resolution aerial imagery, 3D content and Artificial Intelligence data insights – like those provided by Nearmap – have become invaluable for many of Australia's largest construction companies while they can't be on site.

Companies are using technology to get ahead of planning, scope remedial work and undertake remote site preparation.

They're harnessing technology to consult with stakeholders on challenging community projects, and to continue collaborating with teams.

https://www.nearmap.com/au/en
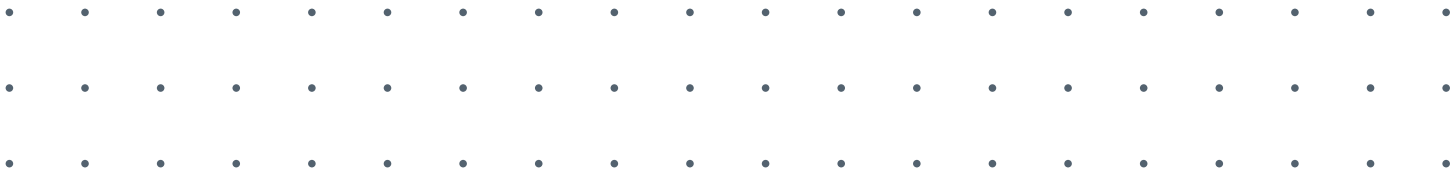
**QUESTIONS ASKED AT THIS STAGE:**

Can I see the progress of construction?

Can I see the building materials used ie. roof type, solar panels, swimming pools; factors that feed into the property valuation process?

Can I see that development has commenced and which floor they are operating on?

Can I see the building extent and height of the construction?

How effectively are the environmental controls on the site being managed (eg entering into fenced off areas, our outside allowable construction footprint)

Check how waste/spoil is being managed

# LIFECYCLE STAGE 4: MONITORING, OPERATIONS & MANAGEMENT

Just as urban places require careful planning they also require careful management to ensure that they remain attractive and liveable, and that services such as the supply of water, removal of waste and cleanliness of the area are maintained. Services that can be enabled include those of park rangers, environmental officers, building inspectors and facility managers.

This stage also includes monitoring the changing patterns of population growth and settlement in the broader area related to transport services.

Individual building and/or infrastructure are monitored along with the surrounding landscape – allowing potential issues, such deformation to be identified before they become a problem.

Issues to be tracked in the urban environment include coastal erosion, build up of fuel for bush fire, urban vegetation, status of utility infrastructure and public health metrics. This could include monitoring if the planning controls are having the desired outcomes - eg is there enough greenspace, canopy cover, carparks, etc.

**EO CAN HELP MAXIMISE EFFICIENCIES AT THIS STAGE BY:**
- Building a common operating picture of the site and surrounding threats (ie bush fire loads, sea level rise air quality).
- Contamination of waterways
- Health of vegetation and tress over time
- Urban Heat Island
- Waste and contaminated land



**QUESTIONS ASKED AT THIS STAGE:**

How quickly is change occurring in the area?

How do I see if there have been changes to the site or the area?

What data is most appropriate to use and how can we use this to predict future scenario models?

How can I integrate this data with population demographics to understand who is at risk?

## USE CASE: MONITORING THE GOLD COAST COASTLINE

An investigation into patterns of post-storm beach recovery in the Gold Coast, Australia between 2015 and 2020, featured the development of an automated methodology for waterline extraction utilising Sentinel-1 Synthetic Aperture Radar (SAR) satellite imagery and tidal state data to investigate net accretion or erosion, subject to whether waterlines move shoreward (erosion) or offshore (accretion).

The image shows erosion and accretion of the coastline at Palm Beach on the Gold Coast before and after Cyclone Marcia in 2016. The green line shows the location of the coastline on 1 June 2016 before Cyclone Marcia, while the blue line shows the location of the coastline on 13 June after the cyclone.

This use of EO will be valuable as sea levels increasingly impact residential developments close to the shore and the coastline needs to be managed more intensively.

**https://www.spaceclimateobservatory.org/monitoring-gold-coast**



## USE CASE: VEGETATION MAPPING

The Office of Planetary Observations (OPO) provides environmental analytics from satellite in near real-time for city planning purposes. Data products are made available as 'Analysis Packs' for the non-spatial user towards underpinning city planning decisions with data driven insights promoting climate resilient cities. Primarily focused on urban greening, OPO's Urban Greening Platform (Beta) makes accessing environmental analytics for policy easy. These metrics available include: vegetation cover/health, land surface temperature and tree canopy, made available at 10m, 30m and sub 1m resolution to the customers specific area of interest.

By streamlining the data processing, pipeline to dashboard journey OPO removes the need to be an expert in satellite data analysis and management, along with dramatically reducing the time it takes to gain insights. Instead, our decision ready data means at the click of a few buttons, the non-spatial user can harness the power of Earth Observations time series analysis into their day-to-day operations. Providing efficiencies through optimising workflows, and essentially promoting the health of our collective green infrastructure, creating sustainable cities of tomorrow.

**https://www.officeofplanetaryobservations.com**

# PART 4: USER PROFILES

## USER EO MATURITY LEVELS

The outcomes of this report's industry consultation have been summarised as a series of generic user profiles, grouped according to characteristics and levels of EO use maturity.

*Earth Observation User Maturity Levels, adapted from the EC/ESA publication "The Ever-Growing Use of Copernicus across Europe's Regions."*

| EO User Maturity Levels | Description of user |
|---|---|
| **UML 0**<br>**Non-user** | Has never had any interest in EO. |
| **UML 1**<br>**EO Explorer** | Has never made use of EO but is aware of it and may have planned occasional tests to assess its potential benefits. |
| **UML 2**<br>**Ad-hoc user** | Has used EO on an ad-hoc basis but without an explicit interest in repeated usage. |
| **UML 3**<br>**Pilot/Experimental tester** | Has already used EO in one or more trials and is considering its integration within standard practices. |
| **UML 4**<br>**Confident user** | Has confidently used EO and is working to incorporate it as part of operational activities. |
| **UML 5**<br>**Operational user** | Has adopted EO operationally and has integrated it within standard operational processes. Related resources such as staff, budget and resources are either allocated or readily deployable. |

## USER PROFILES

The following profiles have been created to represent individuals who are most likely to use or promote EO within their part of the urban planning value chain.

A number of common requirements emerged across all user profiles. These are that EO data and products need to:
- provide a transparent evidence base so that different parties can all see the same information
- deliver the stated outcomes (they work)
- be easy to access
- fit with existing workflows for example valuation models or provide a basis for what if scenario planning
- increase automation and digital transformation
- have clear and consistent instructions and documentation
- save time
- deliver cost savings
- increase production
- decrease the risk of non-compliance

# THE STRATEGIC PLANNER

### Meet Gail

Gail has worked as a strategic planner for many years. She currently works in State Government and runs a number of contracts which provide her with information about the current and future population so she can make decisions about how new towns and cities will look and function. She wants to create liveable cities that provide citizens with quality of life. She wants data sets that describe trends in demographics and environmental change, often over long periods. She doesn't have the technical skills to work with EO but will use descriptive EO-derived products to inform her decisions and as evidence supporting decisions she makes.

### Urban Planning value chain category:
**Strategic Planning**

### Role in Urban Planning:
**Plans future land use classifications.**

### Key driver:
**Allocating land to meet the future population needs (ie. health and community services, education).**
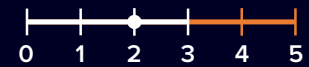
### As a strategic planner:
"I want to know information about the existing urban form and opportunities for strategic development and renewal. I also want to know about the demographics of the future population and their requirements."

# THE RISK AND RESILIENCE PLANNER

## Meet Meg

Meg works to understand the pressure on the urban environment that could impact on the wellbeing of citizens. She seeks to develop, and plan for, future scenarios so that impacts on citizens from threat like climate change are minimised. EO is a useful dataset for Meg to understand where disaster events have occurred in the past and to map their impacts. EO is also important to Meg's work as a key input into the models of future risk she uses, but she works more closely with the results from such models rather than the input data like EO.

**Urban Planning value chain category:**
**Strategic Planning**

**Role in Urban Planning:**
**Builds resilience to disasters into the design of the urban environment.**

**Key driver:**
**Understand the nature of future risks and threats to the wellbeing of the population so as to minimise adverse impacts.**
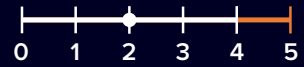
**As a risk and resilience planner:**
"I want to build resilience to disasters into the design of the urban environment. I often need long time series of data to understand probabilities of disaster events occurring and the outputs from models that predict the future."

# THE URBAN DESIGNER

0   1   2   3   4   5

## Meet Evan

Evan is an experienced Geographic Information System (GIS) analyst and produces maps of the urban environment. He is most familiar with using satellite images as backdrops but doesn't usually have the skills to create new derived products. Both the form and the function of the urban environment at the scale at which individual people interact with it are important to Evan, so when he uses satellite imagery, he favours high resolution data. However, lower resolution data like temperature are becoming increasingly relevant to him to describe environmental factors like urban heat islands.

## Urban Planning value chain category:
**Architecture and Design**

## Role in Urban Planning:
**Design the form and function of the urban environment at the neighbourhood scale.**

## Key driver:
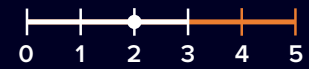**Maxmise the wellbeing of citizens in everyday life.**

## As an urban designer:
"I want to use the data that help me design the urban environment to suit the people that live there. I will use data analytics from many sources but the insights I glean are more important to me than the data themselves."
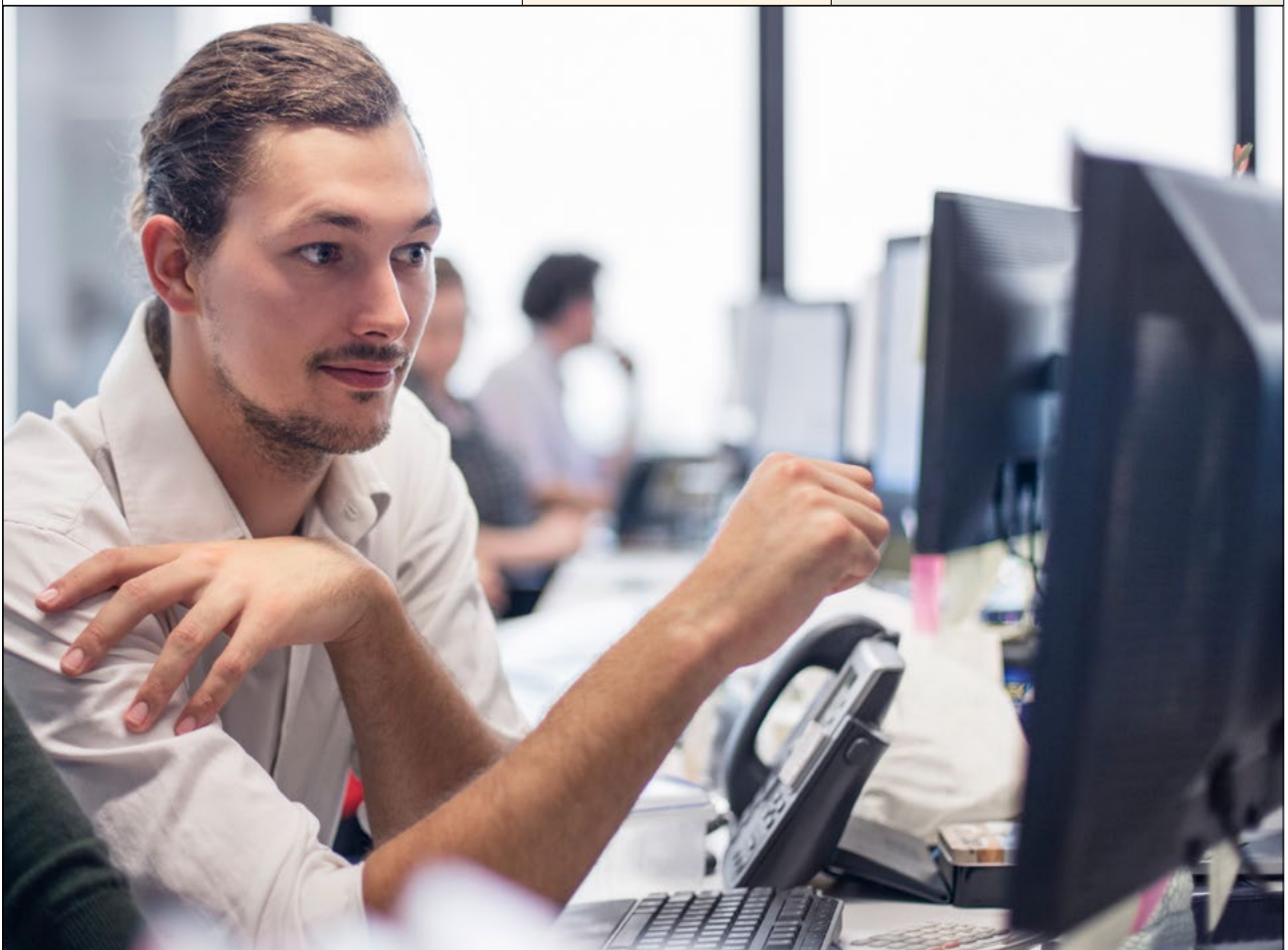
# THE PROPERTY DEVELOPER

0  1  2  3  4  5

## Meet Stan

As a property developer, Stan takes vacant land and older properties within the built environment and constructs new buildings. Historic timeseries of imagery can be useful to see past land use and identify potential issues like land contamination which affect land value. Timelines are crucial for Stan and any delays cost money. Satellite imagery that speeds up the approval and development process is valuable Stan. He is not a technical EO person so wants to buy ready-to-go high resolution imagery products that clearly show him and his business partners what they need to see.

## Urban Planning value chain category:
Development and Construction

## Role in Urban Planning:
Oversees the construction stage of residential developments.

## Key driver:
Delivering the developments on time, within budget, and according to the approved development application.

## As a property developer:
"I want high-resolution imagery that shows the level of detail that I need. I want to know the cadastral boundaries, the elevation, and any impediments to the site such as contamination or utilities. I want to be able to prove to the bank the stage of development to secure our funding source."

# THE BUILDING REGULATOR

0  1  2  3  4  5

## Meet Lauren

Lauren has a busy role facilitating building applications, confirming construction activities match what is reported, and ensuring buildings are compliant with regulations. Lauren's job is made easy by simple access to the data that enable her to approve applications efficiently and provide clear evidence for either compliance or non-compliance with regulations and building codes. She is not an EO expert and needs the most recent high-resolution imagery provided to her in a form where she can easily make decisions.

## Urban Planning value chain category:
**Development and Construction**

## Role in Urban Planning:
**Facilitates the construction process.**

## Key driver:
**Ensure all urban development and building activities comply with regulation including approval of building permits, the carrying out of building inspections and the issue of occupancy permits.**

## As a building regulator:
"I want the most recent information on the status of development applications and construction activities at my fingertips. Evidence is critical to assessing compliance in my role so I need data that can be trusted to accurately describe the situations I am interested in."

# THE DATA MANAGER/ANALYST

| | | | | | |
|---|---|---|---|---|---|
| 0 | 1 | 2 | 3 | 4 | 5 |

### Meet Maxine

Maxine deals with all types of data – from written reports and census data to IoT and satellite imagery. Her challenge is to develop and manage data and data infrastructure so that data can be used seamlessly across many different systems and software packages. Satellite imagery is just one of the types of data she deals with so she is unlikely to be an EO expert, but she knows how to use it and that it is becoming important for his colleagues.

### Urban Planning value chain category: Operations and Management

### Role in Urban Planning:

Acquires, synthesises, and analyses data to provide ready to use information and analytics for colleagues.

### Key driver:

Making sure all data needed by colleagues is available and accessible.

### As a data manager/analyst:

"I want to source all the data my colleagues need to carry out their roles. I want to make it available to them in easily accessible ways to ensure that anyone can easily and efficiently find the data they want."

# THE PHYSICAL ASSET MANAGER

0   1   2   3   4   5

## Meet Adrian

Adrian manages physical assets like buildings, street signs, foot paths and light poles, typically for a local government. Keeping track of the state of all assets across a wide geographic area can be a challenge. High resolution satellite imagery can help Adrian, particularly if it is regularly acquired, relatively inexpensive and easily accessible. The increasing utility of machine learning with satellite imagery can help Adrian extract features of interest and detect change, but he needs ready-to-go imagery as he is not likely to have technical expertise with EO data.

## Urban Planning value chain category:
**Operations and Management**

## Role in Urban Planning:
**Ensuring physical assets are well-maintained and managed.**

## Key driver:
**Ensuring public assets provide benefits to citizens.**

## As a physical asset manager:
"I am responsible for maintaining structures within the built environment and making sure they are fit for purpose and safe for the public. Data on condition and use of physical assets to plan repairs or replacements are what I need as one component of new and more efficient ways of working."

# OPERATIONAL STAFF

0  1  2  3  4  5

## Meet Kat

Kat might be any number of operational staff working for local government. She may be a park ranger, environmental health and safety officer, or a building inspector for example. In any of these roles, Kat increasingly needs to issue data as evidence for making decisions and as a basis for actions, and she will often be a data collector herself. A major challenge for Kat is how to manage data between the different systems and software she needs to use and still be able to carry out tasks efficiently. For outdoor environmental work in particular, Kat finds satellite imagery increasingly useful, but she is unlikely to be an expert and prefers to use ready-to-go imagery products that don't need any input from her.

## Urban Planning value chain category:
**Operations and Management**

## Role in Urban Planning:
**Carry out the tasks that ensure the public are safe and can enjoy the urban environment.**

## Key driver:
**Providing quality services to the public.**

## As operational staff:
**"We work to make sure the urban environment is safe and enjoyable for the public. We need to know where hazards are, where things are broken, and ensure general compliance with regulations that support liveability within the urban environment."**

# THE TRUSTED ADVISOR

### Meet Jason

Jason is a trusted advisor. Jason works to use best practice in urban planning from around the world to influence the policies, decision making and delivery of services of organisations like local government. Jason is an expert in the urban planning field and will use all types of data to produce the information and evidence decision makers need to enact his suggestions. He feels at home using EO data to visualise and describe the urban environment and is increasingly becoming aware that he can get a lot of information out of EO as well as it being a good tool for communicating his vision for form and function.

### Urban Planning value chain category:
**All**

### Role in Urban Planning:
**Inform government organisations on best practice in urban planning from around the world to influence decision making and shape the urban environment.**

### Key driver:
**Create value by connecting international trends to local policy and practice.**
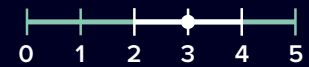
### As trusted advisor:
**"I am responsible for maintaining structures within the built environment and making sure they are fit for purpose and safe for the public. Data on condition and use of physical assets to plan repairs or replacements are what I need as one component of new and more efficient ways of working."**

# THE ENVIRONMENTAL CONSULTANT

0   1   2   3   4   5

### Meet Albert

Albert is an environmental consultant, often trained in environmental science. Satellite imagery is already a key tool for Albert. Albert will most likely be proficient with the use and application of satellite imagery. He will use it in combination with other data sources to monitor and manage things like vegetation canopies, waterway health and air pollution. Albert will use satellite imagery with different spatial scales as appropriate and use time series of data to identify change as well as real time data to respond to and manage incidents as needed.

### Urban Planning value chain category:
**Operations and Management**

### Role in Urban Planning:
**Monitor and manage the impact of the urban environment on the natural world.**

### Key driver:
**Ensuring urban development is sustainable.**

### As an environmental consultant:
"I want metrics that describe the health of the environment. I work to relate these metrics to the policies and practices of stakeholders in the urban environment to inform future planning and development. I also conduct remediation and repair when necessary, so satellite imagery is a valuable tool for me. I like to use it but don't want to spend time processing it myself."

# THE SPATIAL COMPANY
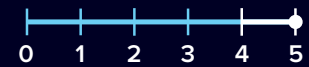
## Meet Amber

Amber is passionate about geospatial data and maps. She knows how her data can be utilised by customers to create value and solve their problems and wants to increase its uptake. She wants to continually provide better products and services to clients to transition products and services from provision of imagery to provision of insights. Amber is highly skilled working with satellite imagery and is increasingly applying machine learning to extract those new insights which can be more easily used by her customers.

## Urban Planning value chain category:
All

## Role in Urban Planning:
Provide EO and other spatial products that help stakeholders across the urban planning value chain understand the urban environment and make decisions.

## Key driver:
Develop spatial products and services that increase business in the urban planning sector.

## As a spatial company:
"I want APIs to automate access to quality-controlled data via an open framework. I want analysis-ready time series EO data based on standard methodologies, in standard formats, with high quality metadata at the right spatial resolution for the application. I want to work with partners to deliver products and services that customers will pay for, and to see an increase in customer maturity and engagement with EO technology towards the higher value products I can provide."

# THE DATA ANALYTICS SME

0  1  2  3  4  5
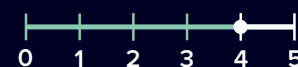
### Meet Jessica

Jessica works to provide clients with data they are unable to source themselves that helps them solve their problems. Her clients might be anywhere in an organisation but are most commonly in roles where multiple datasets are aggregated and synthesised into information products to help others make decisions. She has usually relied on IoT, census, social media and crowd-sourced data to glean insights on the activities of the population that are valuable to her customers across the urban planning value chain. She is becoming increasingly comfortable working with EO data and sees it as an increasingly valuable data source for the future as it becomes more accessible, and a diversity of product offerings suited to the urban environment are available."
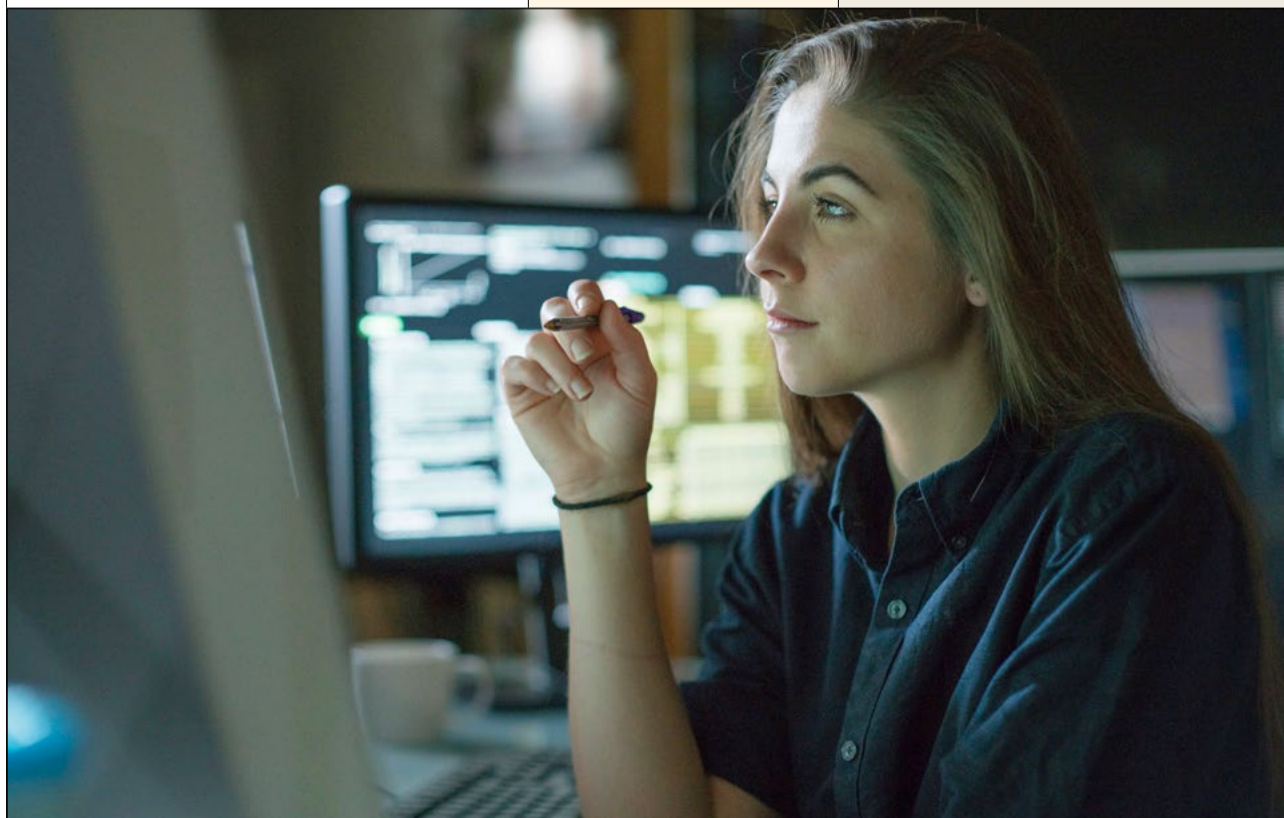
### Urban Planning value chain category:
All

### Role in Urban Planning:
Provide analytics and information products combining multiple data sources that help customers make better decisions.

### Key driver:
Develop data analytics products and services that increase business in the Urban Planning sector.

### As a Data Analytics SME
"I integrate multiple data sources to derive insights and metrics that help others make decisions. I'll use traditional datasets like census data as well as crowdsourced data, IoT data and other technology. I manipulate data and present it to clients in easily understandable and actionable formats. It acts as the evidence they need to justify decisions."

# PART 5: OPPORTUNITIES

EO has an increasingly large role to play across the urban planning value chain. Developments in the range of data products, ability to capture finer grained details (resolution), their frequency of capture and easier accessibility all support greater utilisation of EO data.

Of most value to the sector is the roles that EO can play as evidence for decision making and as a common language between the numerous roles which comprise the urban planning industry to converse with each other and provide information to the public. More specific opportunities for EO to add value across the value chain are described below.

## EO USE CAN BE EXPANDED ACROSS THE URBAN PLANNING VALUE CHAIN

As noted above, as EO data availability and accessibility improves, supported by greater computing power and cloud-based services it is becoming easier for urban planning-focused users and the public to use and interact with it.
- In the strategic planning phase it provides time series of data to understand how the urban environment has changed and be used as an inputs to develop future scenarios for models.
- In the urban design and architectural design phase potential EO can be increasingly used to understand how environmental parameters interact with the urban form to result in population health outcomes.
- In the construction and implementation phase development sites can be identified and construction progress can be tracked.
- In the operations and maintenance phase health of the urban environment and infrastructure can be monitored to help ensure public safety and quality of life.

## EO CAN INFORM THE DESIGN OF FUTURE CITIES

Cities as they are today were not built for the climate scenarios that they will likely experience over coming decades. Urban environmental artifacts like heat islands can be identified using EO, and integrating higher resolution EO into modelling of the built environment enables the evaluation of the contribution of urban form to urban environmental conditions and liveability. 3D data captures from LiDAR and Synthetic Aperture Radar (SAR) will become increasingly important in this space to describe urban form and as inputs to models for designing future cities, and redesigning existing ones, to adapt to future climate scenarios.

## EO CAN ENABLE CAPITAL TO FLOW

A key financial benefit of EO to the urban planning value chain is enabling workflow efficiencies to the development application process. While this process is in train, the capital earmarked for the development is idle, and is only released into the economy once the development application is approved. Access to the most current EO products, at appropriate spatial resolution, within the approval process workflow can eliminate the need for site visits, enabling higher throughput of approvals. The decreased time to approval then frees up capital more quickly to flow throughout the economy and contribute to productivity across the entire urban planning value chain.

## INCREASING USE OF AI AND ML WITH EO UNLOCKS NEW POSSIBILITIES FOR AUTOMATION OF PROCESSES

Traditionally, building regulators collect compliance information through site visits. Increasingly, EO imagery can be used to capture the detail sought for compliance purposes, for example building footprints. These can be mapped manually, however new machine learning-based tools can be trained to automatically extract the building footprint with sufficient accuracy to enable an automated process to carry out checks and freeing up resources for more value added tasks. More complex processing can also allow other building features to be extracted for compliance purposes and automatically assessing the status of assets like street signs. As these algorithms perform better more parameters can be extracted which enable the automation of processes like valuation, energy efficiency rating and development of liveability indexes at the property level.
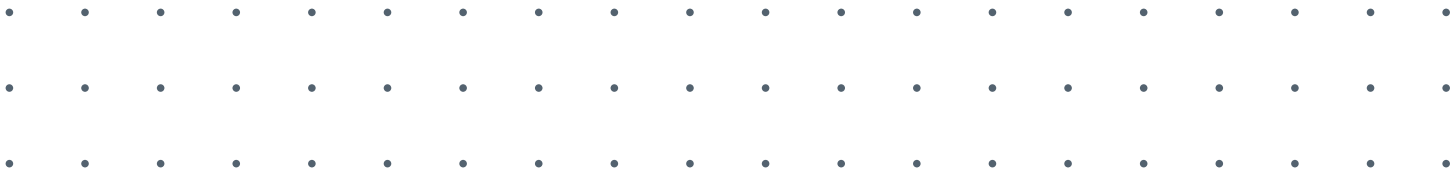
## URBAN ANALYTICS PROVIDERS ARE BEGINING TO UTLISE EO

Urban planning and design is becoming increasingly data-driven. This has created new opportunities for providers of data analytics derived from sources including mobile phones, social media, and point-of-sale to create new information products from the blending of these data sets to provide new insights into how people move, where they spend time, and where they spend money, all of which are high value to urban planners. To complement these data, analytics providers are investing in EO capabilities to be able to access, process, and integrate them into the new data products enabling insight into environmental drivers of population trends and dynamics and as inputs into models for the design of future cities and urban environments.

## EO CAN BE A CORE PART OF DIGITAL TRANSFORMATION AND AUTOMATION

If all the opportunities for EO are bought together in one system designed to link the many data-driven processes and workflows that make the urban environment work, then a fully digital replica of the urban environment can be constructed. With such a digital replica (a digital twin) at its heart the urban planning value chain can fully transform into the digital age. A critical enabler for the digital twin ecosystem is the adoption of a shared language to describe and understand what EO is for both users and the public.

# PART 6: CHALLENGES

## VALUE PROPOSITION

The cost-benefit analysis of EO application within the urban environment remains a challenge to increasing the wider adoption of EO-based products and services across the urban planning value chain.

There are two key value propositions that need to be met to increase uptake of EO. One is the augmentation of human labour with automated, data-driven processes. If people are still required within a workflow that can be automated using EO, there are often not enough cost savings to make any change viable. The second is around the value of new insights. To drive uptake of new data it must be possible to clearly demonstrate the value to decision making and operations of the insights extracted from EO data.

The benefits must be articulated very clearly to secure investment as there are always other areas where funding could he spent to produce known outputs from entrenched workflows which represent less risk than something new and untried, which may ultimately be more beneficial.

## PIXEL SIZE AND VIEWING ANGLES

The natural environment can be readily measured, monitored and managed with well-known satellite imagery like Landsat and Sentinel. However, at between 10 and 30m resolution the utility of this data in urban centres for data-driven decision making is currently limited. Their value, however, can be found in is the long time series of such data, and they commonly find application in longer timescale land use and land cover change detection and mapping and planning for future scenarios involving changes in the natural environment.

In urban centres, monitoring assets is the key application of EO. The size of these assets typically means high resolution data has the most value to the urban planning value chain as it describes the highest value assets and any automated workflows used to monitor and maintain them. Most of these data are captured close to nadir, however, which means their utility for determining building characteristics can be limited as oblique views often contain more structural information about the built environment.

As noted previously, new data analytics providers are combining many new datasets into valuable information products and are blending datasets at different spatial scales.

The challenge to greater adoption here is that the cost-benefit analysis mentioned previously limits what data can be applied in the urban context, meaning that the most cost-effective data may not be those which are fit for purpose. As new satellite providers emerge this will change, however, and we may see an EO data-driven revolution in the planning of our cities.

## BUILDING USER MATURITY AND CONFIDENCE

The majority of users of EO across the urban planning value chain are low maturity users. As a result, building their maturity and confidence using EO data to solve problems, and as the evidence to the decisions they make, is central to increasing the use of EO across the sector. There are two key parts to building user maturity and confidence:

- Awareness of what data exists – throughout the industry consultation undertaken for this report interviewees were excited to learn what was already available that they weren't aware of and were eager to use it. Building awareness of what data are available and how to access it will see an immediate increase in use.
- Which data are fit for purpose – once users know data exist and where to get them the next challenge is to educate and train them so they are equipped to select the best data for their work. This involves building users' knowledge of the limitations of the data and the expected accuracy for a given data set and, accordingly, any uncertainty this may cause in regards decision making based on the application of EO data.

## OVERCOMING NUMEROUS DISCONNECTED SYSTEMS

It was clear from the consultation that almost every individual, organisation, or small to medium enterprise, had their own software systems to process and analyse data and often had different workflows to get to the same point.

This makes trying to use of EO more complicated and time consuming than it needs to be for users and dissuades them from engaging with EO. The time needed to get up to speed with using EO data with existing systems is a barrier to uptake. The numerous systems employed by users is challenging for EO data providers as it means they must cater for many means of accessing the data and it is hard to cater for them all.

A further challenge is that, at the user end, data often needs to be passed between systems to be put into a usable form for the different applications of each user. If it is too hard to do this usage no one will use the data.

# PART 7: RECOMMENDATIONS

The following actions are recommended to increase the use of EO within the Urban Planning sector.

## PROVIDE A SINGLE SOURCE OF STANDARDISED PRODUCTS THAT LOCAL AND STATE GOVERNMENTS NEED

We have found from this consultation that plenty of eager potential users of EO exist, they just need a single source of standardised imagery products that are fit for their purpose and are easily accessible to get started. Investing in such infrastructure and data products will increase the use of EO across the urban planning value chain. As well, all data should be accompanied by well-described metadata.

## SUPPORT A COMMON PLATFORM FOR VISUALISATION AND ANALYSIS OF EO

A common platform for visualising and analysing EO which interfaces easily with the systems that users already use will complement the standardised products referred to above and drive greater use of EO. Ideally, to promote EO uptake such a system would enable users to access and apply EO data in their work in the same way, and as easily, as they can access and apply any other data.

## INVEST IN INCREASING EO AWARENESS

- Partnerships with industry bodies such as Planning Institute of Australia (PIA), Australian Local Government Association (ALGA), Smart Cities Council, Australian Urban Research Infrastructure Network (AURIN), and National Growth Areas Alliance (NGAA) will build the user base for EO across the sector.
- Promote use cases of existing products (ie Land Cover and Coastlines) that teach others how to use them and embed them in planning processes and digital twins.
- Showcase and share the code (ie. One person uses and many can benefit). Users in this sector will be unlikely to create their own processing code and systems themselves. If data, code and systems are

ready to go more users of EO will be gained as a result.

## INVEST IN INCREASED EDUCATION & TRAINING

Increasing user confidence is key to building the use of EO data across the urban planning value chain.

- This should be achieved through education and training in the use of EO which is targeted to user groups within the sector and include increasing awareness of what data are available, how to access EO data, and what data are fit for purpose for a given application.
- Work with Universities to develop short courses and microcredentialled offerings through existing and new courses for undergraduate and post graduate urban planners[18]. This could be extended to include Australian Geographers Australian Curriculum.

[18] Example Geographical Information Systems and Urban Informatics course offered at UNSW as part of the Master of City Planning, through the City Analytics specialisation.

# PART 8: CONCLUSION

The urban environment is under more pressure than ever before. As the population increases so too does the size of cities, which necessitates greater use of resources, and results in greater environmental impacts. When combined with the challenges future climate scenarios represent, and the high standard of liveability demanded by the public, the urban environment becomes complicated to plan and manage.

But at the same time, technology is providing new data sources, analytics, insights and tools to meet this challenge. EO is one of these tools and this report shows it can become a fundamental tool of high value to all stages of the urban planning value chain. If integrated properly, EO technology can play a vital role in urban planning's digital transformation.

This report outlines recommendations to help integrate EO into the workflows and processes which underpin the form, function and liveability of our cities. While the user maturity of most EO users engaged in urban planning is low today there are real opportunities for increasing the use of EO across the value chain as urban planning becomes even more essential to maintain quality of life for the public.

If you or your organisation would like to benefit from new technologies like EO, you are encouraged to:
- Start talking about problems, not solutions.
- Get involved in the adoption of Earth Observation products and services.
- Share this report within your organisation and discuss how you could adopt the recommendations.
- Consult supporting documentation for further information and visit the DEA Industry Strategy website: frontiersi.com.au/dea
- Tell us your thoughts: dea@ga.gov.au

## FURTHER READING

Australian Space Agency (2021), Earth Observation from Space Roadmap 2021-2030, November, available at space.gov.au

Hurwitz, M., Braneon, C., Kirschbaum, D., Mandarino, F., and R. Mansour (2020) Earth Observations Inform Cities' Operations and Planning, available at https://eos.org/science-updates/earth-observations-informing-cities-operations-and-planning

Jackson, D (2019) Digital Earth: the paradigm now shaping our world's data cities, The conversation, available at https://theconversation.com/digital-earth-the-paradigm-now-shaping-our-worlds-data-cities-104938

Wellmann, T., Lausch, A., Andersson, E., Knapp, S., Cortinovis, C., Jache, J., Scheuer, S., Kremer, P., Mascarenhas, A., Kraemer, R., Haase, A., Schug, F., and D, Haase (2020) Remote sensing in urban planning: Contributions towards ecologically sound policies?, Landscape and Urban Planning, Volume 204, 103921, ISSN 0169-2046, https://doi.org/10.1016/j.landurbplan.2020.103921.

Caribou Space, Understanding the impact of Earth Observation for sustainable urban development, Farnham, Surrey, United Kingdom. Caribou Space, 2020. https://www.thegpsc.org/sites/gpsc/files/caribou-space_gaf_esa-eo-for-urban_v1.pdf

The following key bodies offer valuable sources of learning about the urban planning sector:
- PIA: https://www.planning.org.au/
- AURIN: https://aurin.org.au
- NGAA: https://ngaa.org.au
- SMART CITIES COUNCIL: https://eee.smartcitiescouncil.com

## ACKNOWLEDGEMENTS