TULIP

Pilot Planning Document

V.1.0

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- Display in public space (outdoors)
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TULIP overview

Technology

Emerging Internet of Things (IoT) technologies such as LoRaWAN (Low Range Wide Area Network)[1] are enabling low-cost deployment of environmental sensor networks that can capture real-time data about the health of the urban environment. LoRaWAN uses radio waves to send small quantities of data over distances of a few kilometres. Transmission 'nodes' send data back to centrally located 'gateways' that can support inputs from many hundreds of nodes simultaneously. The technology is inherently simple, modular, accessible and collaborative.

Data

TULIP makes use of existing sensor technologies to measure air temperature, noise pollution, noxious gases (NOx, SOx, CO, O3) and airborne particulates (PM2.5, PM10) and then transmit this data back to a central server. Through the simultaneous measurement and transmission of multiple variables from multiple locations at regular short time intervals (e.g. every five minutes) we will, for the first time, begin to understand how these factors interact in real urban settings, with potentially profound implications for urban design, public policy, and a range of business sectors.

Applications

TULIP is the first major initiative focused on using IoT and distributed sensor networks to gather high-definition temporal-spatial environmental data in Australian cities. Data streams from sensors may be directly comparable (e.g. explore relationships between heat and noxious gases) and may also be compared to other existing temporal-spatial data sources relating to variables such as traffic flow, energy use, meteorology, hospital admissions, insurance claims or crime reports. During TULIPs Pilot phase we are exploring a number of specific hardware configurations to determine the most appropriate options for wider deployment in the Australian context. The Pilot will also explore use case scenarios for data, applied across numerous sectors, with the aim of fine tuning system design and methodology to better suit these uses.

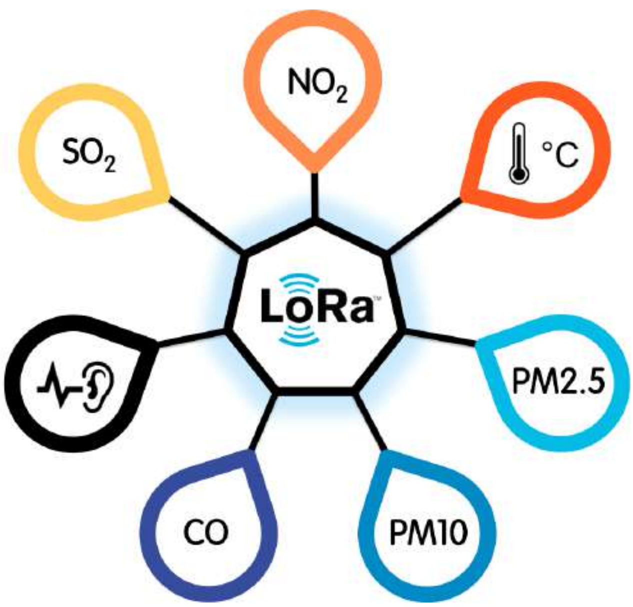


Fig.1. What TULIP will measure

[1] LoRaWAN is a major focus of TULIP, particularly during the Pilot, however the project may go on to explore other IoT technologies that support core aims, as we develop our capacity.

Project architecture

TULIP will use sensors to gather raw data about the urban environment on a micro-resolution scale, both spatially and temporally. This data will be shared, analysed and presented to a variety of end users or passed directly to automated 'smart' systems. The aim is to influence policy and design decisions and to scale the entire exercise through a citizen deployment initiative. TULIP is expected to create value for a wide variety of end user groups.

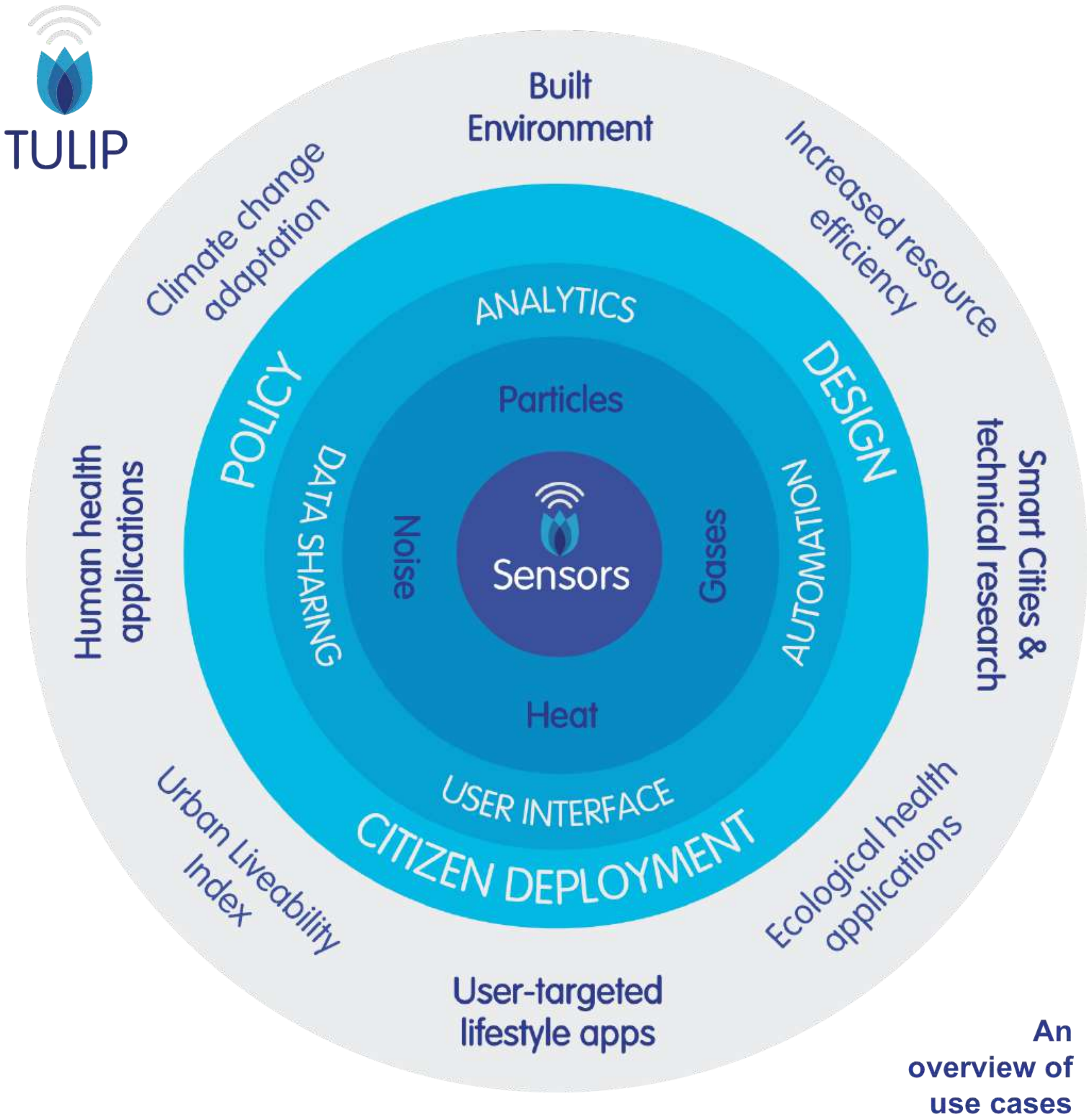


Fig. 2. An overview of TULIP use cases

TULIP: Broad aims of the project

To define the aims of the TULIP Pilot it is necessary to define the aims of TULIP more generally. The Pilot must answer the right questions and develop the understandings, assets and strategic relationships that propel the project towards its medium and long-term goals.

What are the broader aims of TULIP?

1. Develop TULIP as the **leading Australian initiative** employing LoRaWAN sensor technology in the Smart Cities and urban liveability context.

2. **Produce consistent, high-quality, rigorous data** that is recognised as such by multiple scientific organisations

3. Use this data to

    a. **Conduct specific research projects** in areas including but not limited to engineering, IT, life sciences, humanities, human health, architecture, planning, public policy.

    (Short term goal - ongoing)

    b. **Develop user interfaces/tools/interactions** that engage the general public with the growing challenges of urban heat, air quality and noise.

    (short/medium term goal - ongoing)

    c. **Leverage progressive urban design and policy** that promotes cool, clean, quiet cities.

    (medium term goal - ongoing)

    d. **Develop commercial data services** with a robust business model that supports ongoing operation and growth of the project, making TULIP financially self sufficient

    (Longest term potential)

4. **Scale** through a broader community of engagement by developing a **crowd deployment** design/strategy for sensor nodes, accessible by individuals and organisations, building towards a large and significant environmental data commons.

Rationale

TULIP is primarily concerned with measuring urban air quality and heat. By providing unprecedented high resolution temporal and spatial data, TULIP will provide fuel for research and subsequent advocacy geared towards cooler cities with cleaner air. The project will also build grassroots community engagement around heat and air quality, as well as feed into responsive smart city systems designed to maximise liveability.

Figure 3 shows how a cool city with clean air can produce a cascade of positive effects, resulting in social, economic and environmental prosperity. This is the rationale for TULIP - the positive outcomes that the project ultimately aims to leverage. It is likely that these outcomes will be achieved via a wide variety of routes, working with many different disciplines, fields and partners.

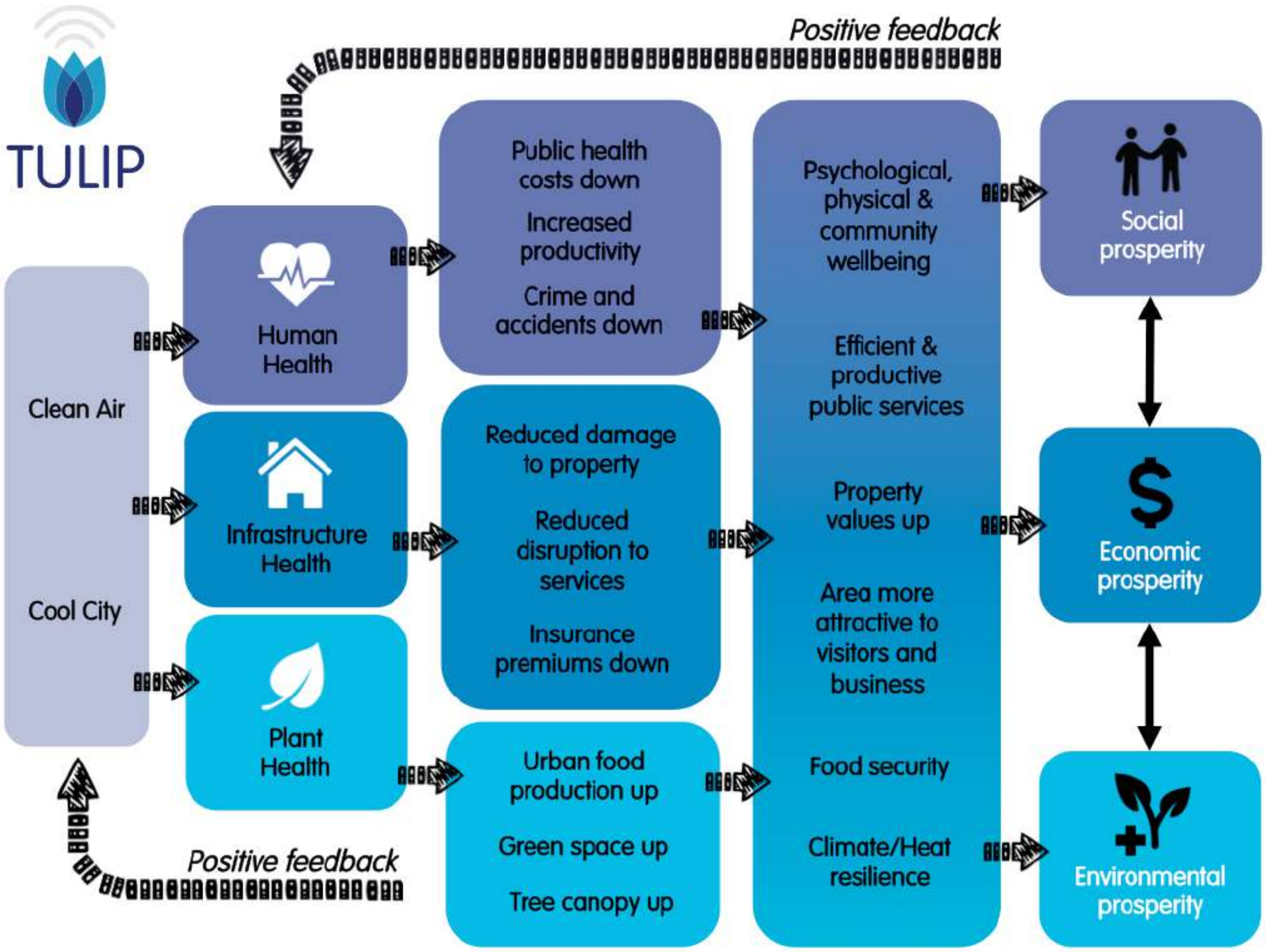


Fig. 3. Cascading positive effects of clean air and cool cities

Creating Impact

DATA: Interpret ⇒ Present ⇒ Engage ⇒ Impact

A core aim of TULIP is to create positive change in the urban environment, to help create more liveable, sustainable and thriving cities. The following graphic explains how this might be achieved[2]

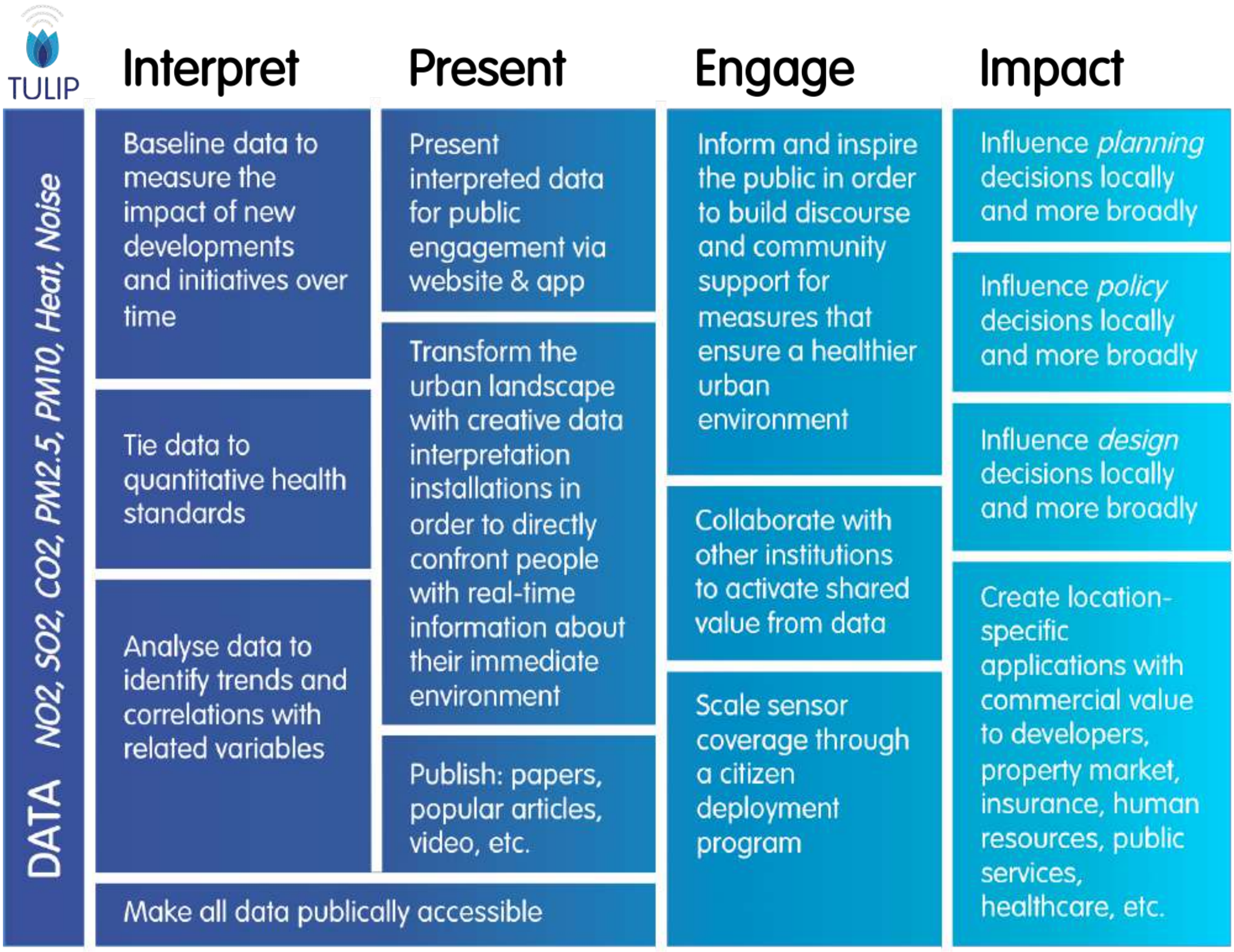


Fig. 4. How TULIP will create impact through analytics, interpretation and engagement activities

[2] Fig. 4. focuses on data analytics, interpretation and subsequent leverage of policy, planning and design. It does not cover potential use of data in automated systems. Such 'automation' may hold major potential for TULIP and is touched upon below in 'The evolving complexity of data utilisation'.

Pilot Overview

TULIP will be running a Pilot deployment of LoRaWAN-connected environmental sensors in the first half of 2017 with a focus on the Central to Everleigh (C2E) precinct in central Sydney.

Preliminary activities (pre-Pilot)

The following actions have been undertaken, prior to commencing with the Pilot project (October 2016 - February 2017).

- A group of collaborating parties has formed and a Memorandum of Understanding (MOU) has been established to formalise the collaboration, for a period covering a Pilot project (roughly understood as being the first half of 2017).
- Baseline infrastructure is in place (UTS/Meshed LoRaWAN gateway; basic test sensors) allowing initial proof of concept for the technology application in our immediate context.
- A regular meeting schedule has been established.
- An administrative framework has been established, with access available to all collaborators.
- TULIP has been established as a temporary project of the Institute for Sustainable Futures, for the purpose of financial management.
- Roles and areas of specialisation within the group have been discussed and are roughly followed but are not formalised.
- Brand IP and basic communications collateral (website, two-page overview,, etc.) have been established.
- Initial contact has been made with third parties that may be interested in collaborating on specific use cases (including but not limited to various UTS faculties).
- Initial contact has been made with potential funding partners.

Key activities of the Pilot:

- **Explore collaboration potential** across UTS and with other organisations not part of the initial core group with the aim of defining and developing various use case scenarios for TULIP data.
- **Deploy sensor nodes** in the C2E precinct and use them to
  - Explore key **technical enquiries** (outlined below) relating to design, positioning and calibration of sensors.
  - Explore potential methodologies relating to a range of possible **use case scenarios**.
- Build a broader **community of engagement** around TULIP with a view to future scalability
- Generate **media and industry coverage** of Pilot project activities with a focus on use case scenarios and broader narratives on urban liveability, heat and air quality. Promote these scenarios and narratives via a clear communications strategy.
- **Report** on results of the pilot with a published document.

Other parallel activities:

- Raise additional funds to cover the costs of the Pilot project and ongoing activities (including the building of strategic relationships with industry and government).

Pilot Location: Why focus on Central to Everleigh?

Fig. 4. Map of the Central to Eveleigh precinct

The Central to Everleigh (C2E) precinct will be one of the largest urban development projects in Sydney's history. It comprises around 100ha situated adjacent to UTS and the Total Environment Centre, at the southern end of the CBD. Conducting TULIP's pilot deployment in our immediate locality will greatly assist with early operations. However we are fortunate that the C2E precinct is also a highly relevant location for studying urban liveability data that we believe will provide the TULIP pilot with a compelling narrative of great value to the project's ongoing success.

We are interested in using TULIP to deliver baseline data across a range of environmental variables in urban locations that are due to undergo major redevelopment. As an area is subsequently transformed, ongoing data may be compared to the baseline to provide a clear picture of how the redevelopment ultimately impacts urban liveability. In this way we hope to provide a powerful new tool for evaluating new developments. By piloting TULIP in the C2E precinct we will begin this baselining work. One of our goals with the pilot is to develop stories that attract media and industry attention, which can then be harnessed to build momentum and grow the project.

Defining Roles

During the Pilot Project, TULIP consists of a collaborative group of parties, as defined by the group's founding Memorandum of Understanding. In addition, an inner circle of associated interests, particularly individual researchers from with the University of Technology Sydney (UTS), is playing an important role in developing the ideas and trajectory of the project. Roles are necessarily fluid and informal. However, it is helpful to break up the overall task of developing TULIP into five distinct (but interconnected) areas.

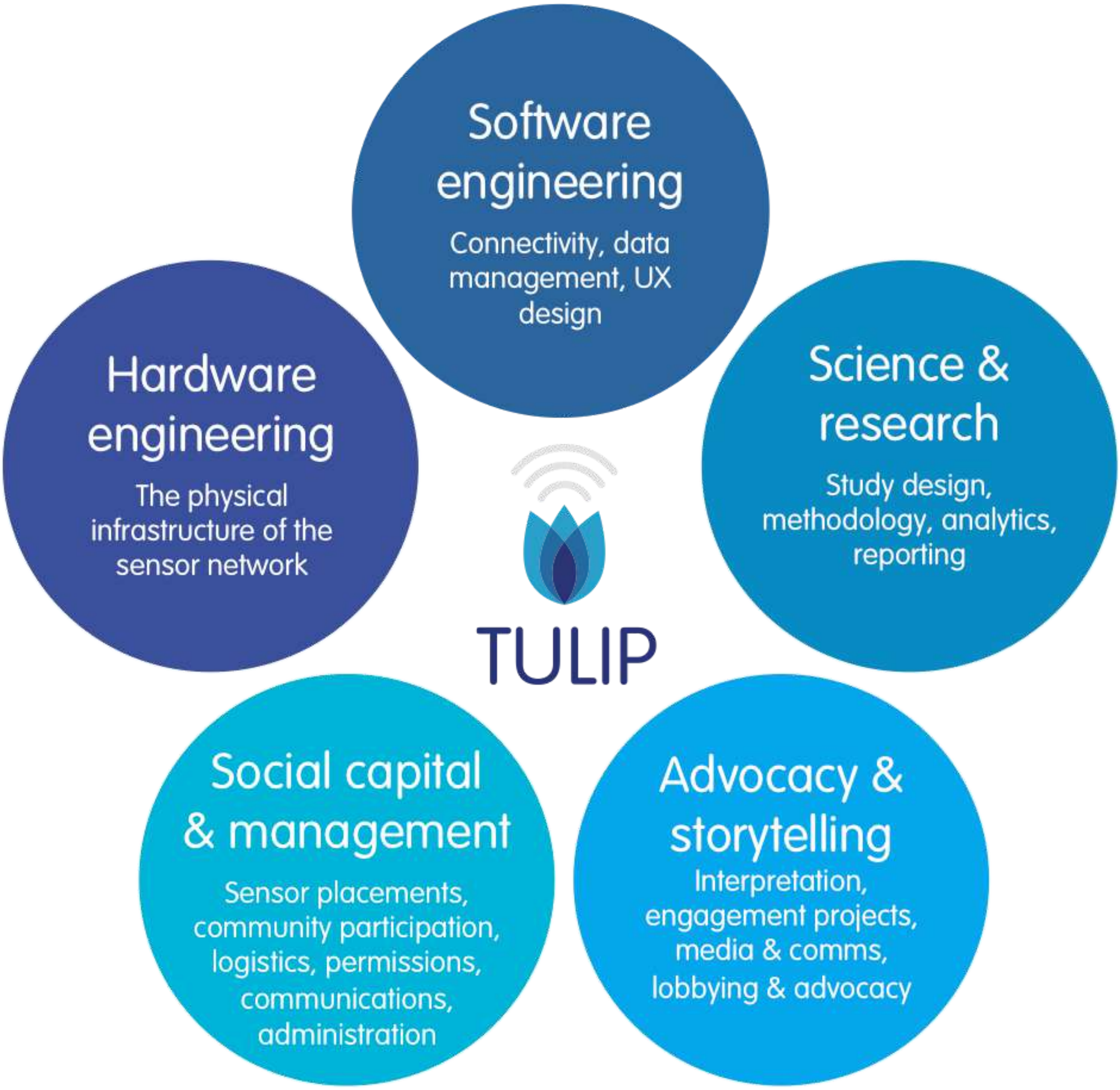


Fig. 5. Five areas of core activity for developing TULIP

Data as a product or service

If end users are considered to be data consumers then we may identify a hierarchy of data utilisation that informs data as a product or service.

TULIP seeks to support a growing data commons and thus all data would be made freely available. This would serve a variety of community interests. However, there are a number of increasingly complex data services and data-derived products that would support business models in parallel to such open access.

As TULIP develops, our capacity to deliver more complex products and services will increase. During early operations we are likely to achieve delivery of custom filtered data, for use by specific end users. Longer term, interpreted data and fully incorporated products and services may allow TULIP to grow a stronger scalable commercial foundation.

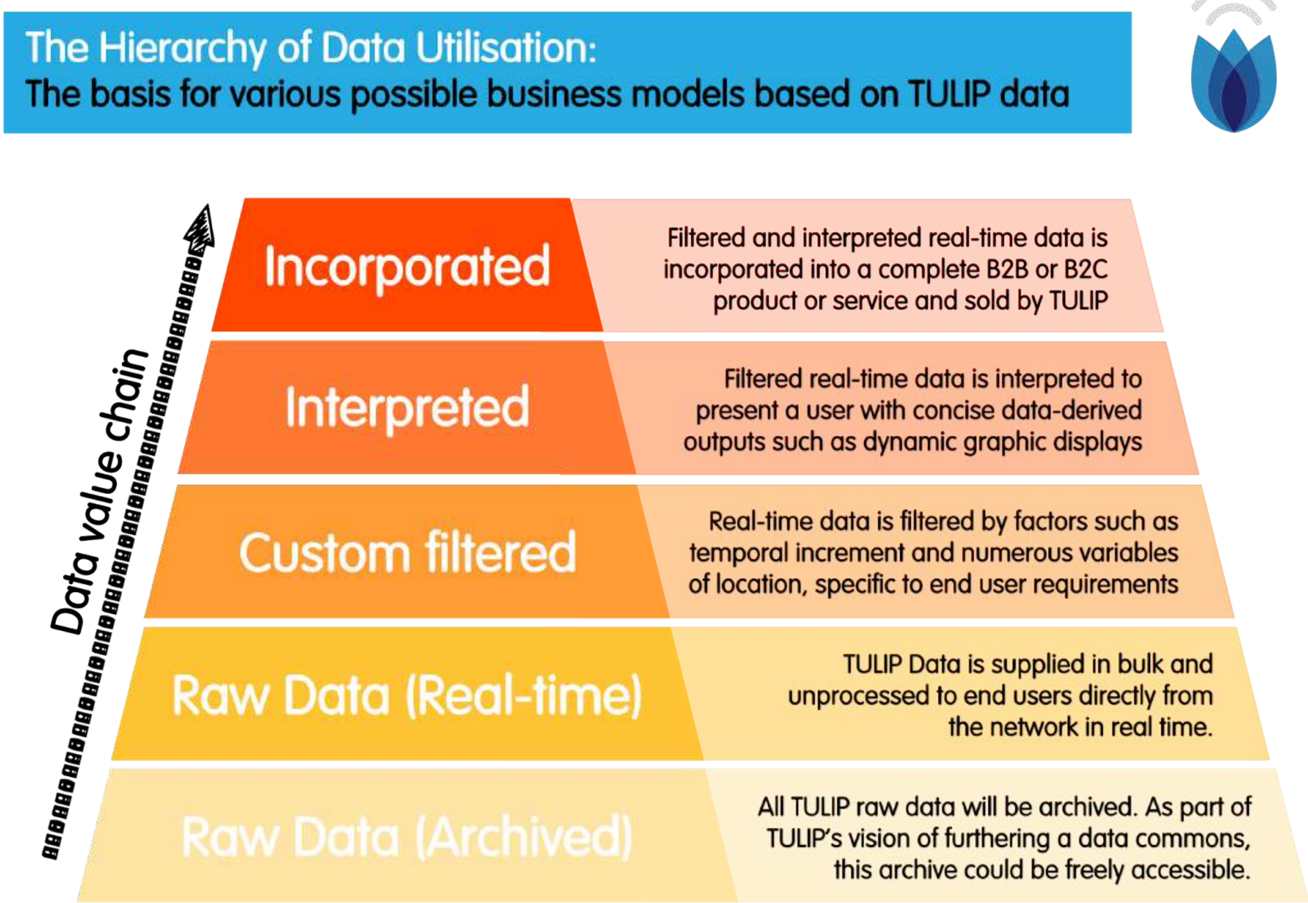


Fig. 6. A Hierarchy of Data Utilisation showing increasing complexity and commercial value

Pilot Aims: 7 stages

The aims of the Pilot may be laid out as consecutive stages.

Core development work

Pt. 1: Develop a range of use case scenarios for TULIP data

Pt. 2: Build a support network

Develop the science and methodology: sensor design and deployment

Pt. 3: Research and deploy various hardware and software solutions

Pt. 4: Explore sensor placement and accuracy to create baseline data for calibration

Apply methodology to end users

Pt. 5: Trial sensor deployment relating to one or more specific use case scenarios

Interpretation and communication

Pt. 6: Develop an advocacy and communications strategy and promote the project

Pt. 7: Report on all findings and early data analysis

Pt. 1: Develop a range of use case scenarios for TULIP data

TULIP is being developed to gather data on the urban environment and use that data to improve urban liveability through a wide variety of channels. The Pilot will identify specific use case scenarios for TULIP data, which will themselves inform the design of sensor nodes, sensor placement and data models. The identification of specific end users of TULIP data and subsequent delivery of data that is relevant to those end users is perhaps the primary focus of the TULIP Pilot.

1.A A growing need for data

Against a backdrop of increasing social, environmental and technological complexity, access to the kind of high-quality data that TULIP will provide is of increasing concern.

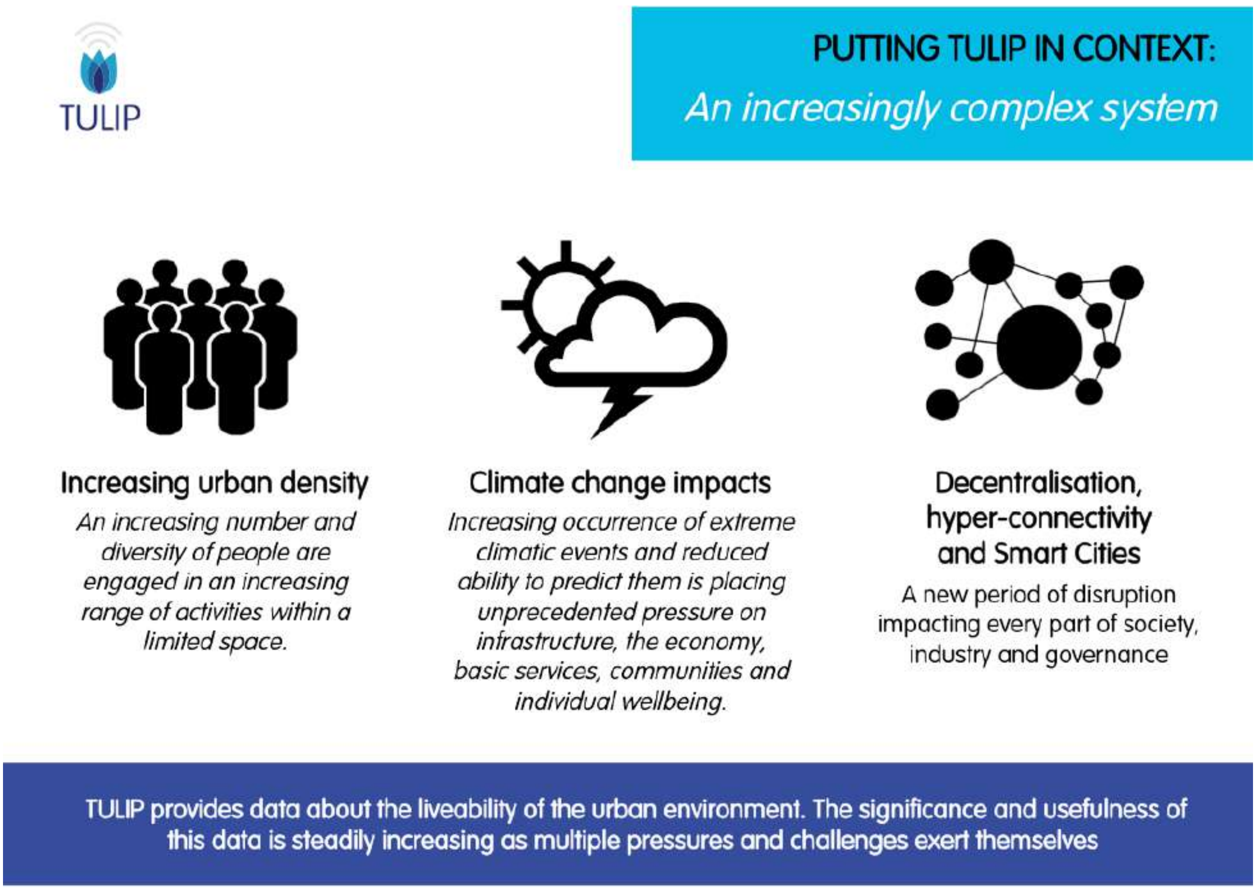


Fig. 7. As complexity increases, so does the need for data

1.B Identifying end users: disciplines and fields

Liveability may be improved in a large number of ways, making TULIP data potentially relevant to a great number of disciplines, fields and end users.

From the perspective of the TULIP Pilot, it is helpful to identify faculties and departments within the University of Technology Sydney that may be keen to collaborate from an early stage, with a clear understanding of how disciplines and fields might inform system design with respect to end users.

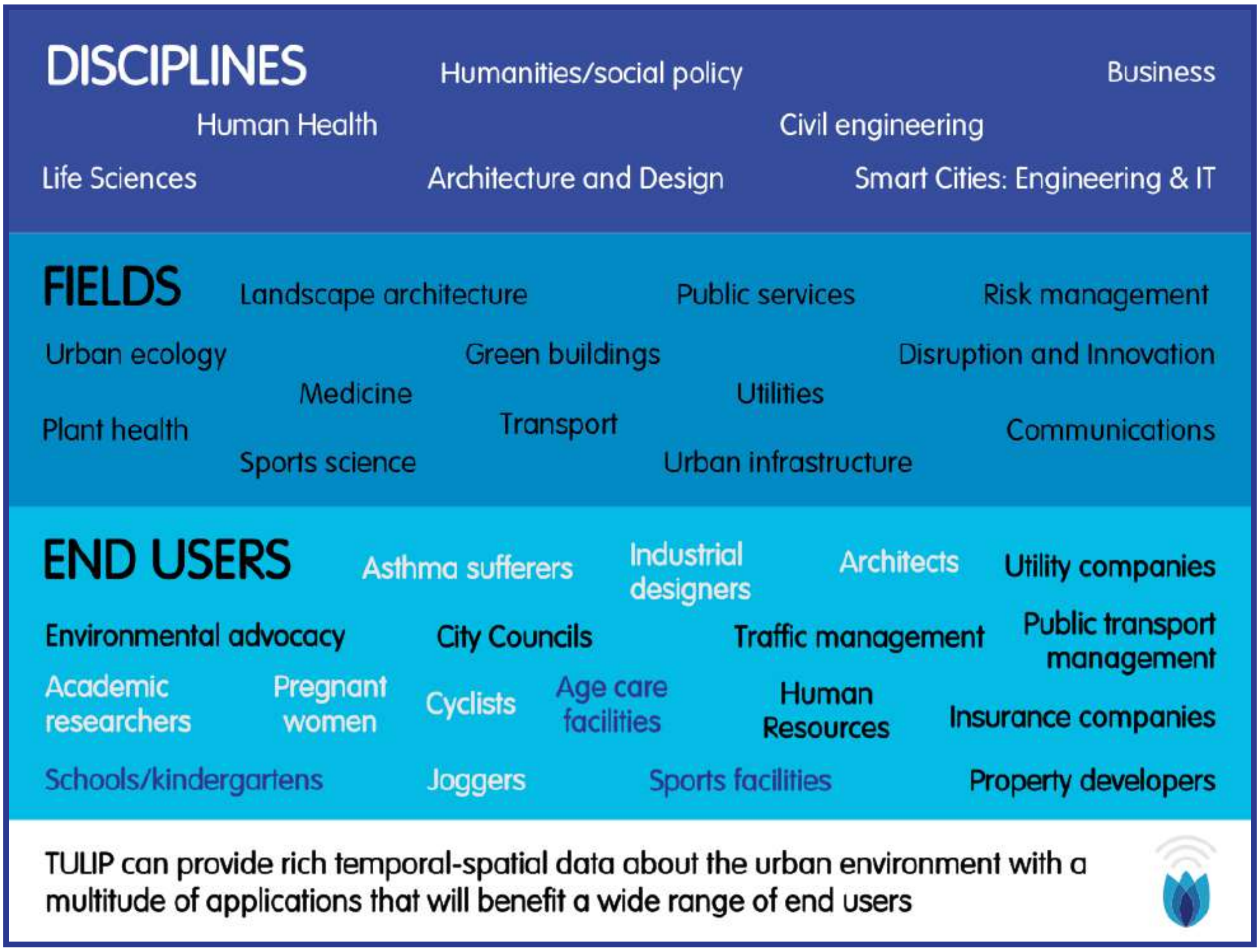


Fig. 8. Examples of the multiple disciplines and fields that might collaborate with TULIP

1.C Identifying end users: sectors

Potential end users of TULIP data may be grouped into four key sectors: individual consumers, businesses, government and civil society. Universities and research institutions form a fifth overarching sector that may engage in research that intersects with any of the other four sectors.

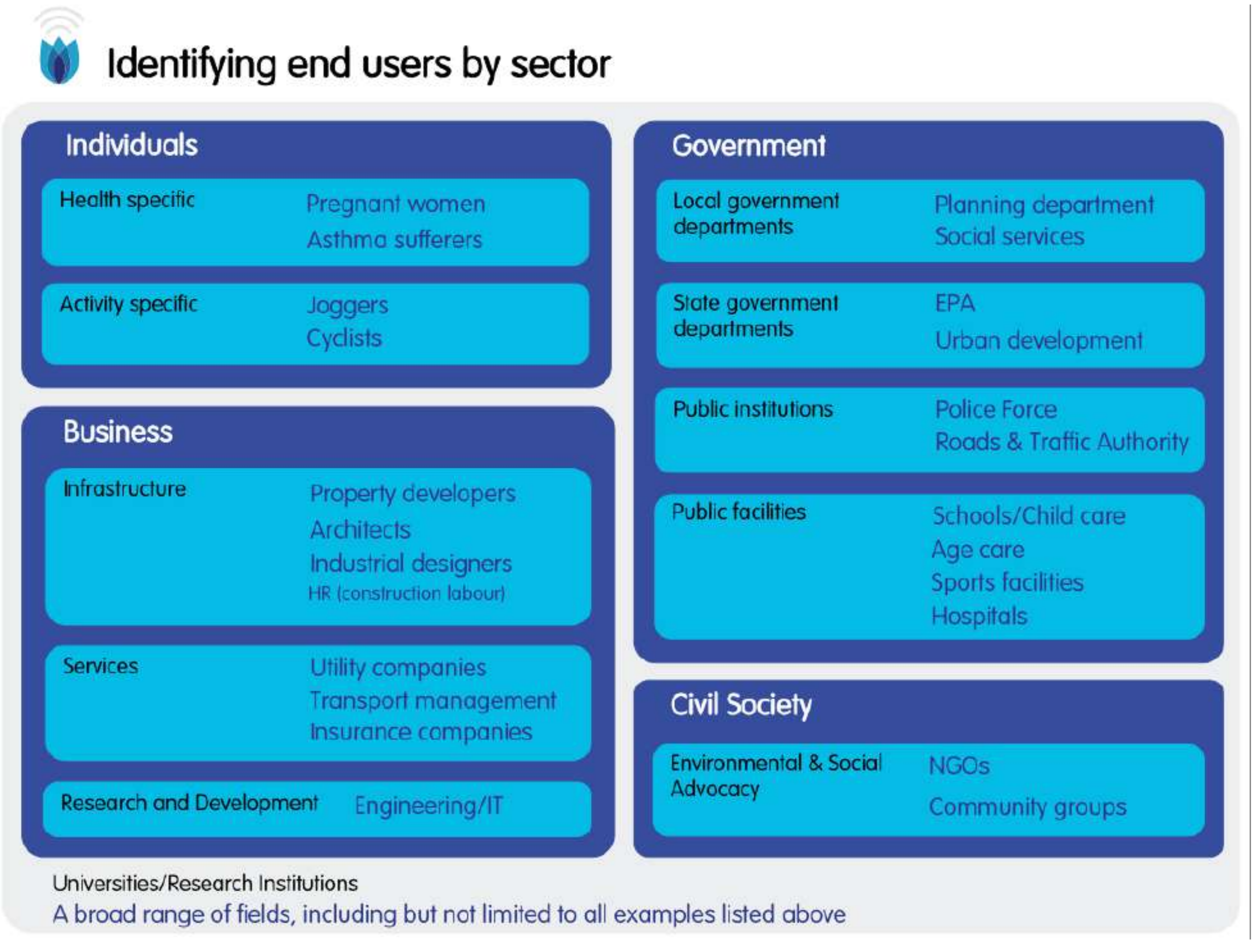


Fig. 9. A summary of possible end users, by sector

1.E The evolving complexity of data utilisation

Data may be utilised at three levels that relate to the growing spheres of social media and smart cities. This distinction sits alongside the hierarchy shown in figure 7 above, insofar as interpreted or incorporated products or services may be based upon any of the three levels of complexity shown below in figure 8.

Traditionally, data is compiled and analysed and conclusions are drawn that may then inform a variety of actions, such as design, business management or government policy. This is the first level of complexity in data utilisation. It is very much the realm of traditional academic research and also covers a wider variety of possible offerings to business, government and civil society.

User directed data is where data is provided to a community of users via a user interface application, most likely with a personal login and possible social media integration. The purpose of such an application would be to provide targeted information of direct relevance to a target group of consumers, for example joggers. This level of utilisation is only possible with the kind of high definition real-time data that TULIP will offer. As a user base builds we may expect to see adaptive responses by the community to the urban environment, tied to an increased awareness of the core liveability factors concerned. By tying data to lived experience and personal lifestyle choices we may build critical community support for evidence based policy and design based on level 1 data analysis.

The third level of complexity is where data is fed directly to responsive automated systems. This is the core of IoT and smart cities and may ultimately be the the most important sphere of engagement for TULIP over the longer term. TULIP data may conceivably inform systems that manage every aspect of the urban environment, particularly flows of energy, water, waste, goods, traffic and people. With smart cities infrastructure still very much in its infancy it may be a while before the full potential of this space may be realised and engaged with.

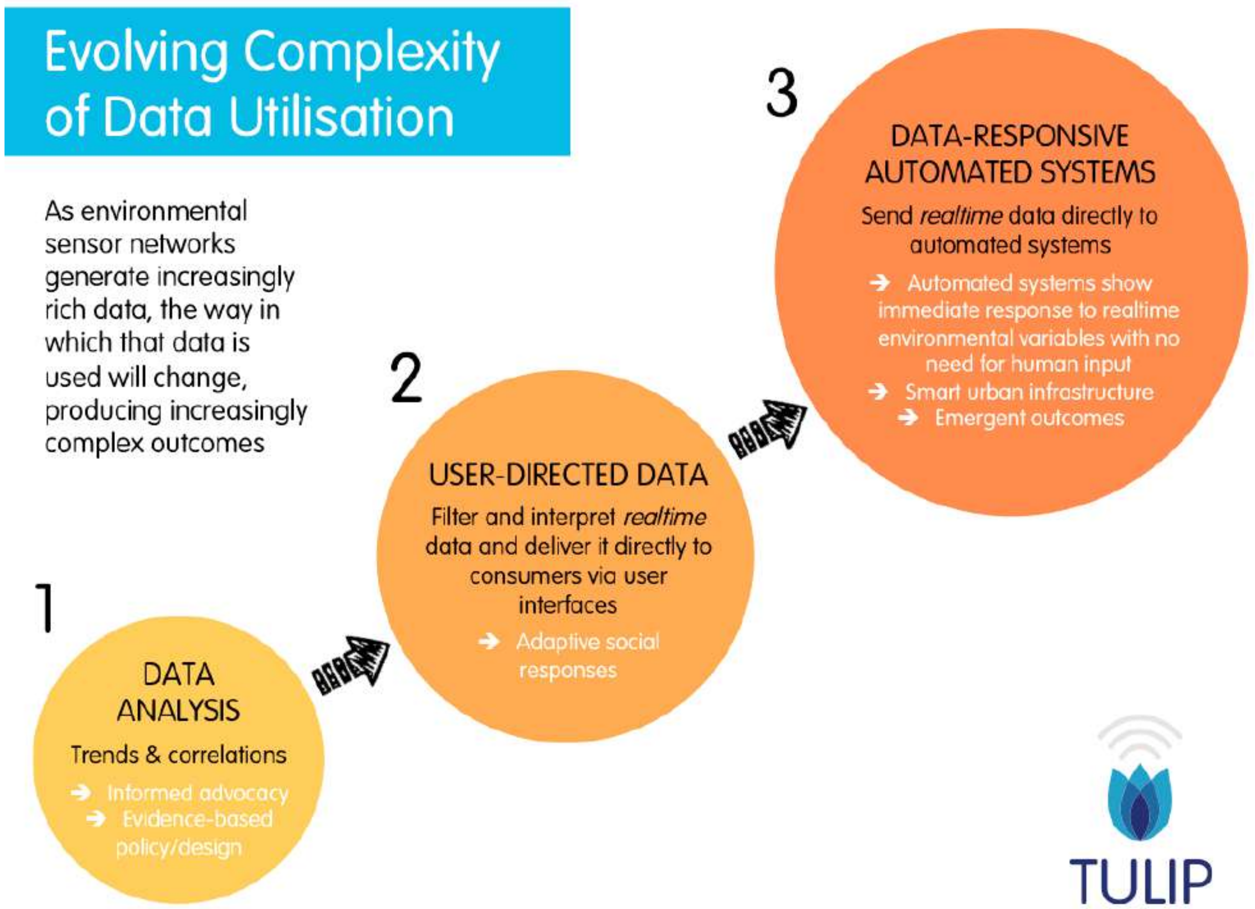


Fig. 10 A Hierarchy of Data Utilisation showing increasing complexity and commercial value

1.F Bringing it together: some examples of possible use cases

Below are just some possible use case scenarios. The list is by no means exhaustive and is intended as an illustration of the breadth of possible use cases open to exploration.

Smart Phone App
Personalised map that compares health risk factors with real time data and forecasts (with AI learning based on individual activity) to suggest optimal times and routes for commuting and exercise. This could be of particular use for joggers, cyclists and for people with health conditions such as asthma or pregnancy.

Precinct evaluation
Monitor the performance of a newly built precinct to provide detailed evaluation over the first years of operation. This would involve working with a developer or contractor to install sensors prior to or at the time of a build.

Architectural performance
Explore how architectural design and spatial factors (aspect, tree cover, relative positions of buildings, etc.) alter liveability data at very high definition (i.e. a large number of sensors in a small area). Provide filtered data to architects to help predict the performance of similar proposed designs. TULIP data may be used to calibrate computer models.

Workers WHS/HR
Produce site-specific data and forecasts of relevance to the wellbeing of outdoor manual workers and provide it to HR departments, insurance companies or trade unions.

Building-specific utility use
Predict energy use in specific buildings by correlating outdoor conditions to HVAC use. Sell real-time data and forecasts to building managers and energy companies.

Smart city automation
Feed location-specifc data into systems that control urban traffic flow (e.g. traffic lights), to clear traffic and people from high risk zones of heat and poor air quality (e.g. near schools/hospitals at peak periods)

Athlete performance
Monitor conditions at outdoor sporting facilities such as tennis courts, soccer pitches, cricket ovals and athletics grounds. Relate that data to individual athlete performance in order to inform individual regimes. Work with sports health researchers to develop early warning systems for heat stress.

Incident prediction
Work with emergency services to correlate crime and accident statistics with high definition temporal-spatial environmental data. Predict periods of high incident risk for specific areas.

Oversight of urban development
Provide community/NGOs access to data archives relating to major urban development sites. Changes through construction and after completion may then be compared to baseline data, providing objective proof of local impact to strengthen advocacy cases on social and environmental grounds.

Pt. 2: Build a support network

2.A Form strategic <u>funding</u> partnerships with industry and government

Approach a targeted list of potential supporters and secure formal relationships.

Key aims:

- Ensure a mix of different organisations to ensure that risk to the project is minimised and no single organisation carries too much weight.
- Prioritise partnerships with organisations that have a direct interest in the core focus of TULIP (smart cities, urban design, social policy, liveability, climate risk, community health, etc.), and who may become active contributors to the development of the project.
- Aim for a mix of private and public organisations.

2.B Begin to develop a localised community network

This process will occur before, during and after technology trials, as the trials will necessarily involve developing new relationships with community stakeholders (e.g. landlords/tenants of buildings that host sensor nodes). TULIP is being positioned as a community-facing initiative and will rely a great deal upon broad community support and engagement. Therefore, despite this being a necessary step towards other more technical aims of the Pilot, it is worth highlighting the importance of the networking process as a distinct aim in and of itself.

One key area of great promise for TULIP is to design a system that allows a strong element of citizen science participation, whereby members of the public host sensors (see point 4 of general project aims, above). Designing for rigour will be critical, however assuming that this is possible, community network building will be a fundamental part of growing the project. Early localised community networking is needed to kickstart this process.

2.C Build a wider community of contacts

This will include all individuals relevant to 2.A and 2.B above, but extend to include:

- Academics
- Journalists
- NGOs and think tanks
- Other professionals working in smart cities, urban design, social policy, liveability, climate risk, community health, etc.

Deliverables:

- Working/internal documents that catalogue contacts and relationships, with notes of aligned activities and projects.
- A mailing list

Develop the science and methodology: sensor design and deployment

In order for TULIP to be taken seriously and to have the impact intended, it is necessary to put significant thought into project design, including technical design and an appropriate data model.

There exist, at the outset, a large number questions that the Pilot Project needs to answer in order for data to be understood as reliable and the product of high rigour.

Strategy

Engage existing experts

- ➔ Engage with scientists at UTS who already work with sensors that measure heat, air quality and noise and establish the parameters that will govern the technical design and placement of sensors.
- ➔ Engage with scientists at other regional universities and institutions (e.g. CRCs) who already work with sensors that measure heat, air quality and noise or who work more broadly in the area of urban heat and air quality.

Experiment with sensor placement

- ➔ Establish technology design and parameters required for accurate and reliable sensor readings (pt. 3)
- ➔ Establish the effects of spatial and temporal variables on sensor placement (pt. 4)

Pt. 3: Research and trial hardware solutions

A range of hardware and software solutions exist, with variations in price, accuracy, robustness and overall performance. For the Pilot we will identify a shortlist of components to deploy and compare their performance in a controlled context. This will then allow us to settle on one or two technical system designs for use in parts 4 and 5 (below) and post-Pilot.

A full list of variables to explore is as follows:

- Sensor manufacturer
- Self-build vs. industrial build
  - *And in the case of self-build: branded vs. (cheaper) unbranded components*
- Housing design
- Specific grouping of sensor types on nodes
- Power requirements (e.g. Solar PV required? Rate of battery replacement?)

Pilot study design

A single site with sufficient space, easy access and clear connectivity to the gateway should be selected (e.g. Total Environment Centre rooftop)

3.A Compare commercial and self-build hardware

- Choose a simple sensor configuration to replicate (e.g. temperature and humidity + LoRaWAN transmitter)
  - Build two versions using commercial hardware (likely lower build requirements by us, but higher cost)
  - Build one version using cheap/unbranded hardware (most likely involving more manual construction by us)
- install all three sensors side by side in same location
- Compare data from all three hardware configurations, noting discrepancies in data points and range
- Also check for calibration drift
- **Use results to**
  - **Decide upon a particular supplier and build approach going forward**
  - **Inform calibration**
  - **Build a clearer understanding of margins of error**

Repeat above steps for other sensor node configurations. Note that different suppliers and build approaches may be appropriate for different types of sensor cluster (e.g. unbranded self-build may be appropriate for temperature and humidity nodes but not for particulates, due to the added complexity of the latter sensors)

3.B Trial weatherproof housings

This step must be completed for each type of sensor cluster *after* step 3.A. Note that 3.A *will* require the use of housings, however we do not currently understand how different housing designs will affect data output, thus this step is about comparing multiple housing designs and checking the impact of this upon the data.

- For each sensor cluster configuration chosen after step 3.A, test data using a 'naked' node (no housing) for a short period on a clear/dry day. This is to establish baseline impact of housings. What difference, if any, does a housing make to data?
- Research and acquire alternative commercial housings for sensors, if they exist.
- Explore options for 3D printing of bespoke housings.
- **Establish optimal housing designs for each of the chosen cluster configurations**

Pt. 4: Research and understand sensor placement and accuracy and create baseline data for calibration

Sensor nodes will be placed in a variety of places. Although we may be reasonably discerning in our choice of sensor locations, we will still need to work with what is practically available and account for variations in immediate context, height above street level, attitude, etc. A major goal with the Pilot project is to determine what factors are significant and what factors are not and then to establish baseline data sets against which future calibration can take place.

There are three key areas of inquiry that will provide insight into sensor placement and which will form the basis of the Pilot sensor deployment enquiry: horizontal, vertical and temporal.

4.A: Variations on the X/Y axis (horizontal)

Use the same hardware configuration in multiple locations across a map. This activity must follow initial testing of possible hardware configurations so that a single suitable configuration can be chosen and replicated.

What range of data variance is recorded on the X/Y axis at a set time? What X/Y spatial resolution (i.e. distance between sensors) is required?

Pilot study design:

- One sensor should be immediately adjacent to a major road (e.g. Broadway)
- One sensor should be a street back from that major road
- One sensor should be two streets back

- One sensor should be in an area with mostly sealed surfaces (concrete/asphalt) and low green space
- One sensor should be in an area with high green space and unsealed surfaces

- Find a location (e.g. along the Goods Line) where various spacings of sensors can be explored (e.g. 10m apart, 20m apart, 50m, 100m, 200m)

A key related challenge is working out a way to quantify or otherwise standardise recording of locational variables that are likely to affect environmental data being measured. Examples of such variables would be:

> Distance from a building

> Attitude of nearest building

> Sun/shade on sensor at time of data measurement

> Wind speed at time of data measurement

> Type of surface (porous/non-porous) in immediate vicinity

> Tree canopy cover in immediate vicinity

Some of these variables may be harder to measure than others. Some of these variables may be more significant to the data than others. The Pilot should aim to clarify some of these unknowns and establish a reporting protocol that strikes a balance between cost, practicality and rigour.

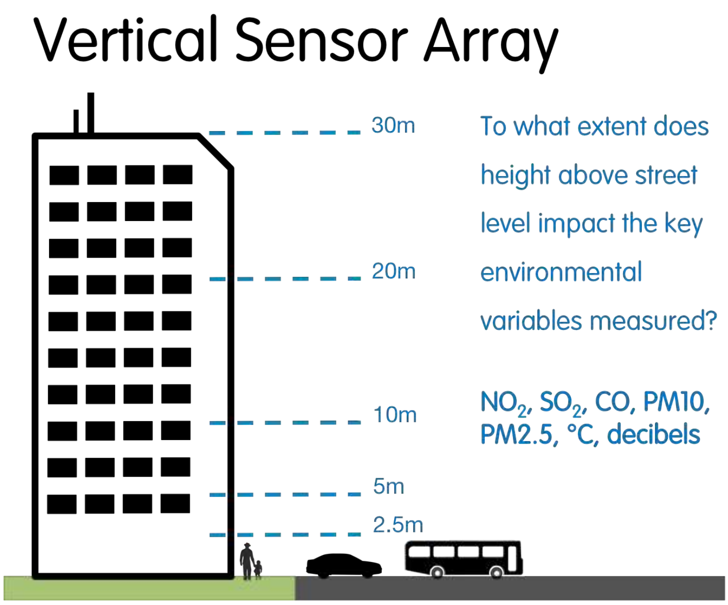
4.B: Variations on the Z axis (vertical)

Different sensor host sites are likely to present variance in height above street level. In an ideal scenario, we would place all sensors at a set height and this may indeed be possible if we were to use lamp posts or similar standardised street infrastructure. However, it is more likely that a variety of rooftops and ledges, at different elevations, become host sites. We do not know how height above street level affects each of the major environmental variables that we will be measuring. Thus a major aim of the Pilot is to gain clearer insight on this and establish parameters for sensor location and calibration.

Pilot study design

Use the same hardware configuration at multiple set heights above street level, in a single fixed location on the map. This activity must follow initial testing of possible hardware configurations so that a single suitable configuration can be chosen and replicated at all height intervals.

Find locations where a tall building (30+ metres) allows access to multiple points up one side. Set up a 'vertical sensor array' with sensors at incremental heights. Ideally set up two or three arrays in different locations to allow comparison between site and assessment of how site-specific variables impact results (e.g. wind speed, insolation, distance from a road).



Towards a vertical correction factor?

It may be possible to use vertical sensor arrays to produce a vertical correction factor that may be applied to data from sensors at various heights. Thus if we want to estimate what data values are at 5 metres above street level, we can apply the correction factor to actual data gathered by sensors at 11 metres. By correcting data to a standard height (within a margin of error) we are then able to directly compare data from various different sites taken at different heights.

Fig. 11 Vertical sensor array

4.C: Variations over time

TULIP will deliver data with high temporal definition. There are not currently existing sources of such high-definition data and so we lack detailed knowledge of temporal variation.

Expected temporal variance cycles:

i) Hourly variation throughout the day/night

ii) Weekly variation (particularly week days versus weekends)

ii) Seasonal variation

TULIP measures environmental variables and applies that data to urban liveability. People live and work according to routines, hence information (and predictions) about environmental factors that directly impact personal comfort and health and which are tied to specific times of day, week or year, are possibly the most significant and practical outputs of the project.

During the Pilot we will measure short term temporal variation (daily and weekly) and establish the range and relationship with with X/Y and Z axis variation. For example, height above street level may not be a significant factor between 5 metres and 20 metres *except* during rush hour traffic. We currently have no understanding of such relationships. By studying them in the Pilot we will aim to develop clear parameters for future sensor placement.

We will also aim to establish temporal definition requirements for each environmental variable (i.e. how regularly do we need to take readings for each thing?). The answer to this question will impact power requirements and various other physical design considerations for the network.

Longer term studies of seasonal and annual variation will not be possible within the proposed timescale of the Pilot but will build over a longer period as TULIP progresses.

A more technical consideration of temporal variation in the Pilot is checking for calibration drift - the possibility that the hardware itself gives shows a drift in readings over time due to limitations or flaws in the design. Such drift will not be apparent in the short term but may be checked for across the entire Pilot deployment period and regularly thereafter. Findings will impact the choice of hardware (see Pt. 3 above).

Proposed Pilot study design

Analyse data from the various X/Y locations and from the vertical sensor array(s). Collect data for at least 3 months.

Apply methodology to end users

Parts 3 and 4 (*Develop the science and methodology: sensor design and deployment*) will answer most of the major methodology questions that need exploring. This should enable subsequent trial deployment of sensors for specific use case scenarios.

Pt. 5: Trial sensor deployment relating to one or more specific use case scenarios

Part 1 of the Pilot (*Develop a range of use case scenarios for TULIP data*) involves establishing clear use case scenarios for TULIP. These scenarios will inform specific trial sensor deployments. Sensor design and deployment strategy will vary depending upon the nature of the use case. Specifically:

- Sensor types deployed - (e.g. NOx, SOx, CO)
- Spatial context (horizontal and vertical) - (e.g. distance from road/building, height above street level)
- Spatial density (horizontal or vertical) - (i.e. how close together are sensors placed?)
- Rate of data updates - (i.e. how often does a sensor node need to transmit a new data point?)

Strategy

➔ **Identify one or more case use scenarios:**

- That may be trialed in the Central to Everleigh precinct or immediate vicinity.
- That require the use of sensors and and other hardware that have already been investigated within the Pilot.
- That may produce significant and reliable results based on existing knowledge (gained from the initial methodology inquiries).
- That have a source of funding.

➔ **Develop each suitable use case scenario into a clearly defined trial initiative**

Each initiative is itself a distinct pilot mini-project. The aim of a trial initiative should be to develop the basic concept and answer core questions that allow a more significant funding proposal to be formulated following commencement of the overall TULIP Pilot Project.

Example:

Work with a property developer. Deploy heat and humidity sensors around a recently completed urban precinct to explore how the design of the development has created microclimates. Pay particular attention to green walls, parkland, tree cover, aspect, shading and wind. Use modest funding from the developer to cover the cost of around ten sensor nodes and administration of the trial project. Gather data for a few months to build up a reliable picture of baselines and temporal fluctuations. The aim would be to build up a picture how the precinct performs relative to original aims of the architects and existing claims of the developer. Following completion of the trial, propose a larger longitudinal study on another development and seek full funding from the developer.

Pt. 6: Develop an advocacy and communications strategy and promote the project

This section intersects with part 2 above (build a support network), insofar as effective advocacy and communications relies heavily on well-developed networks.

6.A Develop a shared communications guide

- Guide should be a working document that evolves as needed
- To consist of copy for communications
- Intended to assist with any media engagements by group members

6.B Develop stories and narratives

- Keep abreast of stories relating to air quality, urban heat, climate change adaptation and smart cities in Sydney, NSW and Australia.
- Develop specific stories and narratives about TULIP activities and how they relate to existing narratives.
- Focus on the human element: health, personal experience and community wellbeing

6.C Develop a mainstream media strategy

i) Build a media list

- Work with internal UTS media and marketing teams
- Engage with individuals in media or communications roles within organisations that form the TULIP group.
- Engage each organisation within the TULIP group to draw up a list of appropriate contacts

ii) Establish a protocol for mainstream media releases

- Designate a press officer role within the group (an individual from one of the core group organisations)
- Develop a media release template

iii) Use the media list and established protocol together with the communications guide and selected stories and narratives

6.D Develop a self-published media strategy

i) Social Media

- **Twitter**: primarily for engaging the professional community - smart cities, IoT, climate adaptation, health, built environment, etc.

- **LinkedIn**: similar business community engagement but with emphasis on tapping into the professional network of individuals directly engaged with TULIP
- **Community engagement** - we may consider a Facebook page or Instagram account for more populist engagements with the general public once we have some more concrete activities to promote. This will be important if we wish to increase community involvement for citizen sensor deployment.

ii) TULIP Newsletter

- Establish a mass-mail account (e.g. Mailchimp) and capture email addresses
  - From support network (see Pt. 2)
  - From website
  - From events

Blog posts (TULIP, TEC, ISF, Things Network)

6.E Participate in events

i) CeBit

6.F Creative use of data for public display

i) Display at website (further development)
ii) Display at node (e.g. LED light display that responds to node)
ii) Display at visualisation hub (e.g. digital wall in Central Park; data arena at UTS)