Sensing the Future: How will smart city principles and technology enable citizen co-creation in public policy-making, consent processing and service provision?

Laurence Sherriff
Align Limited - lsherriff@align.net.nz

Wednesday 15th April – 1.30-3.15pm

Keywords: Smart Cities, Civic Engagement, E-participation, Sensors, Crowdsourcing

Abstract

The purpose of this paper is to determine how smart city principles and technologies could enable citizen co-creation in public policy-making, consent processing and service provision.

Several cities around the world, including Christchurch, have embarked on smart city programmes. The smart city movement can be viewed as a set of principles, which sum up social, technological and environmental capital as key production factors in modern urban frameworks. These translate into city architectures that are built from goals, people and community ecosystems, soft infrastructures, city systems and hard infrastructures.

Smart city governments focus heavily on the participation of citizens in the co-creation of civic affairs. The evolutionary aim of the smart city model is to integrate all of the dimensions of human intelligence, collective intelligence, and artificial intelligence using digital telecommunication networks (nerves), ubiquitously embedded intelligence (brains), sensors and tags (sensory organs) and software (knowledge and cognitive competence).

Co-creation (or co-design) describes the process of bringing stakeholders into the service design process. It is not customer or provider-focused, but is instead user-centric where collaboration is based on the notion of a citizen participating in the process. Co-creation

aims to move mindsets from what technology developments can do - towards what stakeholders' need - when reshaping public services.

Smart city technologies provide a platform for new engagement mechanisms (e.g. mobile apps, open data, crowdsourcing, virtual design, augmented reality, crowdsourcing, etc.). These offer efficient and practical ways for local government to engage in citizen co-creation to identify problems and develop solutions. Importantly, this covers policy-making, consenting and service provision.

This paper gives those working in public policy, consents and service provision a glimpse of how smart cities, co-creation and new technologies might affect their functions in the years to come.

What is a Smart City?

The main driver of smart cities is urban population which accounts for 54% of the total global population, up from 34% in 1960. The number is expected to grow approximately 1.84% per year between 2015 and 2020, 1.63% per year between 2020 and 2025, and 1.44% per year between 2025 and 2030 (WHO, 2014). This has caused urban problems such as congestion, pollution, rural migration, resource scarcity, energy inefficiency, and health and safety hazards to become widespread.

Interest in smart cities has also been motivated by major challenges such as climate change, economic restructuring, online retail and entertainment growth, ageing populations and pressures on public finances.

Currently, there are no finished smart cities on Earth. There are of course local governments aspiring to make their cities smart, but in reality these bodies are just beginning to explore the benefits of emerging technologies for the betterment of urban citizens.

The smart city movement can be viewed as a set of principles. These principles encapsulate social, technological and environmental capital as key production factors in modern urban frameworks. Smart cities are distinguished from their more technology-laden counterparts (digital or intelligent cities) by their investment in human and social capital, in addition to high-tech physical capital. Part of this investment includes a strong focus on the participation of citizens in the co-creation and open innovation of civic affairs.

Typically smart cities are characterised by economic, social and technical systems that:

- Make efficient use of infrastructure (roads, built environment and other physical assets) and energy;
- Engage with citizens on local governance and decision-making through open innovation processes, e-participation and co-design; and
- Learn, adapt and innovate, and respond effectively and promptly to changing circumstances.

Further to this smart cities embody:

- Strong and visionary leadership;
- Citizens creating their own goals and taking an ongoing role to deliver these;
- Embracing new information and communication technologies, and modern infrastructure;
- Effectively managing natural resources;
- Delivering sustainable economic development; and
- Delivering a higher quality of life for citizens.

The evolutionary aim of the smart city model is to integrate all of the dimensions of human intelligence, collective intelligence, and artificial intelligence within the city. This is achieved across a combination of digital telecommunication networks (nerves), ubiquitously embedded intelligence (brains), sensors and tags (sensory organs) and software (knowledge and cognitive competence) (Mitchell, 2007).

The commercial opportunities for smart cities are expected to create a US$1.5 trillion market opportunity over the next 10 years (NZTE, 2014). The prospective growth of smart cities is attracting vendors throughout the value chain to invest in the sector. Interestingly, some critics claim that the technology companies are cultivating the smart city trend for their own ends (Mullagh, Blair, Dunn, 2014).

Smart city *operations* provide citizens and external organisations with e-services delivered by an organisation's automated business processes, which are supported by information and communication technologies (ICT). The delivering organisation must manage these services using architectures: business architectures, information systems architectures, technology architectures and the processes used to produce them.

Importantly these infrastructures must be designed in the context of the human, social, cultural, business, political and physical environments in which they will exist and interact (The Urban Technologist, 2012). According to Robinson (2012), smart city architecture should consist of the following elements: goals; people and ecosystems[1]; soft infrastructures; city systems; and hard infrastructures.

[1] An ecosystem is a community of interacting entities—organizations and individuals (including customers or users)—that co-evolve their capabilities and roles and depend on one another for their overall effectiveness and survival (Iansiti & Levien, 2004).

Figure 1 – Elements of Smart City Architecture

Goals are needed for a smart city initiative (e.g. sustainability, inclusivity, and social & economic growth) to provide direction. These are implemented through a smart city strategy, which brings about concrete and behavioural changes to a city. People and ecosystems are integral to the co-creation of the goals and strategies.

Soft infrastructures play a vital role in smart cities. Examples include: governance processes; measuring progress and performance of city systems against objectives; frameworks for procurement criteria; and standards and principles for integration and interoperability across city systems. Soft infrastructure can also be informal and cover: stakeholder forums that create and implement strategies; hackathons using open data; neighbourhood meetings; and social and business organisations.

City systems provide the life support for cities. These systems feed, transport, educate and deliver healthcare for citizens, communities and businesses. Existing city systems can be a significant constraint for smart city design, because they are old, expensive or impossible to extend; or because operations are contracted to service providers subject to strict performance criteria.

The hard infrastructure (i.e. technology platforms) offers to transform city systems. These platforms include networks such as 4G and broadband; communication tools such as VoIP, social media and video conferencing; computational resources such as cloud computing; information repositories to support open data; and analytic and modelling tools that can provide deep insight into the behaviour of city systems.

Smart cities are not science fiction. They are here today, with local governments already using technologies that include wireless networks, big data analytics, mobile applications, Web portals, social media, sensors and trackers.

The Nature of Co-creation

Broad imperatives are pushing governments to redefine their relationships and the nature of engagement with citizens in problem-solving (Nambisan & Nambisan, 2013). These are:

- The affordability of resource-intensive business models and problem-solving modes in government.
- The complexity of social problems demanding collaborative approaches amongst other agencies and the citizens who possess first-hand knowledge of the problems.
- New technology lowering the cost of collaboration for government agencies and citizens.
- Pressure from voters living with the consequences of failed urban projects (Mullagh, Blair, Dunn, 2014).

Public services need to adapt to the needs of citizens, yet many new e-services are often technology-driven when they should be user-driven. Co-creation (or co-design) describes the process of bringing stakeholders into the service design process. It is not customer or provider-focused, but is instead user-centric where collaboration is based on the notion of a citizen participating in the process.

Co-creation emphasises engagement by those responsible for delivery of a service or product with stakeholders in general, and with the end user/customer/citizen in particular. It starts with a simple ideal where the users of the proposed system actively collaborate in:

- defining what the system should do (problem definition);
- the development process; and
- acceptance of the results.

It should also be seen in the wider context of the co-production of services, where citizens have ongoing roles in delivering a service once the design stage is complete.

There are four main themes underlying co-creation:

- Participation: co-creation is collaborative.
- Development: co-creation is a developmental process that builds on exchanges of information and expertise.
- Ownership and power: co-creation shifts power to the process, creating a framework that defines and maintains the necessary balance of rights and freedoms between participants; and serves to create a sense of collective ownership of the issue.
- Outcomes and intent: co-creation activities are creative, practical and outcome-based.

There is no one clear definition for co-creation, particularly for government service delivery. However, when it is considered in the context of smart cities, co-creation can be seen as:

- Moving mindsets from what technology developments can do towards stakeholder needs;
- Fundamentally reshaping services; and
- Working with stakeholders, partners and other agencies in a concrete way.

Furthermore, co-creation can be viewed as having three dimensions:

- Horizontal movement – learning and working with colleagues in parallel organisations, who can be in the same region or in other regions (e.g. joint work with neighbouring councils).
- Vertical movement – working with stakeholders up and down the service delivery chain.
- Intensity – fact-finding engagement through to shaping an outcome with citizens.

Smart city technology places local government and ICT departments in a strong position to progress towards co-creation. However, the adoption of co-creation can be hampered by organisational capability to define the process, carry out the process and actually implement the process.

Community Ecosystems & Innovation Platforms

IBM's Centre for the Business of Government identifies four distinct roles for citizens in public service co-creation: as explorers, ideators, designers, and diffusers (Nambisan & Nambisan, 2013). These roles relate to the main stages of innovation:

- Identifying, discovering, or defining an emerging or existing problem (Explorer);
- Conceptualising a solution to a well-defined problem (Ideator);
- Designing and developing implementable solutions to a well-defined problem (Designer); and
- Directly supporting the diffusion and adoption of public service solutions among citizens (Diffuser).

These four roles create different types of contributions in civic problem-solving and different types of interactions between local authorities and citizens; and hence the need for different engagement mechanisms and support infrastructures.

A wide range of engagement mechanisms can be employed for citizen co-creation, which can include mobile apps, e-petitions, data analysis communities, contests and competitions, hackathons, open databases and online citizen communities. These mechanisms provide practical ways for government agencies to engage with citizens in different aspects of problem-solving. However, they are dependent on two essential ingredients: community ecosystems and innovation platforms.

Community ecosystems provide an organising structure for a collective of actors (i.e. citizens, government employees, non-for-profits, etc.) to come together and co-create service offerings. Innovation platforms provide a physical or virtual 'venue' for the community ecosystem to gather and co-create service offerings. When the two are combined they serve to:

- Build and sustain participating ecosystems;
- Promote shared views between citizens and local government employees;
- Define the architecture of participation to coordinate collaboration activities;
- Partition the problem-solving process (platform); and
- Provide communication infrastructure and the rules of engagement (platform).

Engagement Mechanisms for Policy-making, Consenting and Service Provision

While community ecosystems and innovation platforms offer a conceptual map for co-creation, engagement mechanisms (e.g., mobile apps, e-petitions, etc.) provide a practical means for connecting. Some of these mechanisms are discussed below.

Mobile Apps

Local governments sometimes have limited visibility of a problem, and can remain unaware of it until it becomes very costly to fix. Typical problems include potholes, damaged signs, street lighting, graffiti, non-compliance, road hazards, pollution and water issues. Citizens are likely to be aware of these problems, but if the citizen and authority are disconnected, then the problem may not be identified in a timely manner.

Fortunately, there are new technologies that can reduce these disconnections and enable citizens to report problems. These are mobile apps and e-petitions.

Mobile apps are particularly useful for reporting *local* problems. There are now several examples of these apps both in New Zealand and abroad (e.g. Palmerston North City Council FIXiT App). Typically they are used by: citizens to submit work requests to fix problems; agencies to post progress updates; and citizens to report public transport problems.

E-petitions

Local governments can also use technology to enable citizens to identify *broader* problems in the civic arena. Citizens can submit e-petitions to request public policy changes, regulatory changes, or to address inefficiencies. E-petitions are normally submitted by a citizen on an authority's website, and allocated a timeframe to attract a pre-defined level of support before further consideration. The process can of course be adapted to meet the requirements of various jurisdictions.

Online Open-source Databases

The two mechanisms above employ technology to report on problems that are very apparent. However, in certain situations problems may be broader in scope, diffuse in

nature and less or partly visible to individual citizens. One example is air pollution. In these circumstances, citizens can *contribute* data on parts of the problem that when put together - as an open-source database - can discover broader patterns in air pollution using geographical information systems.

Fixed sensor arrays (like those proposed in Christchurch) and native sensors on citizen's mobile phones can also be used to supply data to open-source databases. Furthermore, data can be extracted from social media sites (e.g. twitter) using automated keyword searches and data acquisition algorithms, to reveal widespread problems and patterns.

Online open-source databases can help authorities to identify specific problems in some situations. For example, they can be used to identify polluters contravening resource consent conditions.

Open Data and Hackathons

Several governments have embarked on initiatives to make more data available to the public. Programmes such as the Open Government Partnership[2] (to which New Zealand has signed up to) and OpenGov[3] have helped to spur this movement on. The resulting outputs have been online databases containing geographical, health, education, transportation and other data - referred to as "open data"[4].

Open data provides *significant* opportunities for exposing simple and complex problems, and areas for improvement. Nevertheless, open data analysis requires strong IT-based skills and resources that many local government agencies lack.

This challenge has opened the door for citizens to contribute their skills and capabilities in 'mining' (i.e. analysing) public data and discovering problems[5]. It is now common to see advertisements for weekend events called hackathons. These usually involve bringing government or not-for-profit organisations (with well-defined data problems) together with hundreds of volunteer data scientists to tackle the challenges offered by the data.

Crowdsourcing

When a problem is fairly well-defined and narrow in scope, it is possible for a local government organisation seeking a solution to communicate it to a large crowd of interested parties and to invite solutions. This practice is known as crowdsourcing. Crowdsourcing is the process of requesting services, ideas, or content by soliciting contributions, usually online, from a large group of self-identified volunteers, where each contributor adds a small portion to the greater result (Wikipedia, 2015).

[2] http://www.opengovpartnership.org/

[3] https://www.opengov.com/

[4] And in some cases 'big data', due to the enormous volumes of data involved.

[5] This approach (data analysis) can be combined with citizen-based data collection and open source database approach (data collection) discussed above to complete the circle.

A proven method of crowdsourcing is online contests and competitions. Online contests and competitions are hardly new. However, today's technology makes it significantly easier for organisations to open up idea competitions to a global pool of citizens and to find a more diverse set of innovative ideas and solutions.

Online contests have been used in the public sector to enable citizens to conceptualise solutions. In 2009, the Community Foundation of Greater Birmingham asked the community to come up with ideas that would, "physically transform Birmingham into a cooler, more vibrant city" using an online contest. More than 1000 ideas were received from many locations and the winning concept was implemented (Hansen, 2011).

Open Innovation Platforms

In some situations a problem can be so broad in scope that solutions require combining many different ideas. Therefore, large forums are needed to facilitate the sharing of multiple perspectives on a problem, contributing ideas and building upon each other's ideas.

Open innovation platforms are massive online discussions that enable a diverse set of volunteers to put forward ideas (related to a broad topic) and then to build upon each other's ideas. Subject-matter experts, moderators and text analysis tools are employed to channel idea generation and bring coherency to the discussions. Theme analysis and qualitative research are conducted afterwards to identify major themes and insights, as well as the most promising ideas and concepts.

This mechanism has been used to engage citizens in solving broader and more complex civic or social problems, such as climate change, human rights and urban sustainability (e.g. UN-HABITAT Jam which engaged over 39,000 participants from 158 countries in 72 hours) (Global Dialogue Center, 2006).

Virtual Design and Prototyping Tools

Citizen contributions can now extend well beyond creating new ideas, or solving problems, to turning conceptual solutions into concrete designs ready for implementation. Citizen design has been largely energised by the advance of new IT-based tools that support knowledge sharing, visualisation, virtual prototyping and collaborative idea building.

IT-based virtual design and prototyping tools can be used to build an idea, and to design and develop a prototype of the solution. Using this mechanism citizens can be asked to develop innovative concepts and to detail these ideas on design boards. Importantly, citizens are given the ability to clearly articulate and visualise the specific features of their solution.

This mechanism can be useful when solutions involve the redevelopment of public places, prominent buildings, public spaces, user interfaces (e.g. council webpages) and documents that citizens use (e.g. application forms).

Data Mashups

It is sometime necessary to provide citizens with the data and tools needed to *design* and *develop* technology to address *specific* problems. A mechanism that meets this need is a data mashup. Data mashups use volunteer developers to mix and match different datasets and application functions from multiple sources to develop either a web page, site or application (Mix & Mash, 2014).

The Christchurch Quake Map is an example of a mashup, which shows the latest quakes (data from NZ GeoNet) on a Google Map (data from Google).[6]

Data mashups have been successfully used to fuel innovation in the public sector. When government agencies are able to provide open data on land use, environmental quality, budgets, health statistics, traffic, employment, etc. citizen developers can make use of this data to develop new apps. These apps can be developed to compare statistics between areas (i.e. zones, districts and regions), provide property information, identify planning rules and to inform commuters about travel conditions.

Online Communities

Citizens can act as change agents to help catalyse the adoption of new local government policies or services. This idea rests on the claim that innovation adoption is a social process and that adopters are influenced by opinion leaders in the same community (Rogers, 2003).

An online community is a virtual community consisting of members who interact with each other mainly over the Internet. An online community can act as an information system where members can post, comment on discussions, give advice, or collaborate. These are a very popular way for people to interact and they normally make use of chat rooms, forums, e-mail lists and discussion boards (Wikipedia, 2015).

Online communities are highly applicable to civic activities, especially for the diffusion of new or proposed policies and services (e.g. new recycling practices). To achieve rapid adoption of policies and services, citizens must understand how they should act and why they should adopt a policy or service. With an online community these new initiatives can be shared with and communicated by citizen leaders to other online citizens.

Virtual and Augmented Reality

Another approach that is becoming more accessible is the use of computer-generated virtual reality. Virtual reality immersion is a perception of being physically present in a non-physical world. The perception is created by surrounding the user with images, sound or other stimuli to provide an engaging environment (Wikipedia, 2015). Citizens can experience or trial a proposal, form impressions, and decide to agree or disagree with aspects of the computer induced presentation.

[6] See http://www.christchurchquakemap.co.nz/

Leaner, but equally effective approaches, such as augmented reality are already used in New Zealand. Augmented reality is a live view of a physical, real-world environment whose elements are supplemented by computer-generated sensory inputs (Wikipedia, 2015). For example, Augview (an Auckland-based software product) is used to assist local government staff visualise underground services, such as water pipes, using a computer tablet[7]. Planners have been using similar approaches (e.g. photomontages) for many years to assess the visual and landscape effects of proposals.

Virtual and augmented reality technologies will become more accessible for local government and citizens over the next few years. Augmented reality apps are already available on iOS and Android phone platforms.

Augmented reality apps will also operate on Google Glasses. These will superimpose montages, using the lenses, over the actual urban landscape of the site as it is viewed in real-time. The combined images will give viewers a dynamic view of proposed developments.

Glasses are located next to the head, eyes, skin, ears and mouth making these an ideal mechanism for interacting with citizens. While a citizen is experiencing stimuli from the glasses, it will be possible to collect feedback using the glasses microphone and camera. This is only the beginning. Eventually glasses will include eye tracking to pinpoint eye focus and iris dilation; voice and facial expression to distinguish emotion; and biometric sensors to detect galvanic response and heart rate.

Once these types of technologies hit the ground, authorities will be able to crowdsource and aggregate any number of responses, visualise real-time data on maps and show how citizens feel about a proposal – in a highly automated manner.

Summary - Christchurch the Smart City

The earthquakes have given Christchurch a rare opportunity to do things differently, and to redesign a modern city and the surrounding economy on a clean sheet of paper. Given this opportunity and the contents of this paper, it is useful to briefly consider whether Christchurch is taking steps towards becoming a smart city.

Leadership of the rebuild has sat squarely with the Government. Many have argued that the rights of Cantabrians have been severely eroded and that CERA (Canterbury Earthquake Recovery Authority) has been given extraordinary powers (Walls, 2014). Despite this, CERA has managed to articulate a vision, recovery strategy and a multitude of programmes.

There are examples of citizens participating in vertical co-design processes, such as the "Share an Idea" campaign. This was a social media campaign run by Christchurch City Council in May 2011, which gathered over 100,000 ideas from citizens on how to rebuild the city's life, space, transportation and business (IBM, 2013). Furthermore, the development of the Economic Recovery Programme by CERA has been a cooperative effort from a range of

[7] See http://www.augview.net/

organisations and agencies. These organisations have included representatives from central government, local government, industry sectors and leading local business organisations from within the greater Christchurch region.[8]

Other signs of citizen engagement include the:

- CERA Community Forum - consisting of 24 members from a cross-section of the Canterbury community;[9]
- CERA website information, written submissions, public meetings, stakeholder workshops and community forums;[10]
- Collaborate Canterbury site - a virtual meeting space connecting people to businesses;[11]
- Rebuild Christchurch - a community run website and twitter feed aggregating news and views;[12]
- SCIRT twitter feed and e-newsletters.[13]

A high level of horizontal co-creation has also occurred. Several national, regional, local and commercial organisations are working in parallel as part of the rebuild. One example is SCIRT which is an alliance of Christchurch City Council, CERA, New Zealand Transport Agency, City Care, Downer, Fletcher Construction, Fulton Hogan and MacDow New Zealand.

Commercial infrastructure providers such as Orion, Telecom and Vodafone are rebuilding telecommunication infrastructure systems. Civic apps appear to be increasing in popularity. Christchurch City Council has developed mobile phone apps for wheelie bins, library services and city information. The University of Canterbury has also developed a mobile app that allows people to see photos, text and 3D models of buildings as they used to be before the earthquake (University of Canterbury, 2011).

Christchurch has also embarked on programme called *Sensing City* as part of the earthquake recovery. The project will incorporate a carpet of sensors in the rebuilt infrastructure to monitor and measure everything in real time from traffic flows, noise levels, environmental quality, lighting, parking, rubbish bins, rainfall, UV levels to water use. The aggregated data will be available in an open data store where it can be analysed by city officials and citizens alike (Dennis, 2013).

In brief, it would appear that Christchurch is taking steps towards becoming a smart city, which is a promising sign given what it has suffered. Whether it actually becomes a smart city - only time will tell.

[8] See http://cera.govt.nz/recovery-strategy/economic/economic-recovery-programme
[9] See http://cera.govt.nz/community-forum
[10] See http://cera.govt.nz/
[11] See http://collaboratecanterbury.org.nz/
[12] See http://rebuildchristchurch.co.nz
[13] See http://strongerchristchurch.govt.nz/about/stay-informed

Technology is an important enabler, but it should not be the reason for instituting citizen co-creation initiatives or creating smart cities. Instead, the motivating objective should be to help governing bodies understand citizens' problems and issues. And, in the process we may see a shift in citizen roles in public services - from that of a passive service beneficiary - to that of an active informed partner.

References

Canterbury Earthquake Recovery Authority. (2015) *Economic Recovery Programme*. New Zealand Government. [Online] Available from: http://cera.govt.nz/ [Accessed: 04 March 2015].

Dennis, R. (2013) *Sensing Cities, Smart Citizens?* [Online] Available from: http://www.sensingcity.org/stay-informed/sensing-cities,-smart-citizens [Accessed: 02 March 2015].

Global Dialogue Center. (2006) *We came to the Habitat Jam*. [Online] Available from: http://www.globaldialoguecenter.com/exhibits/backbone/index.shtml [Accessed: 05 March 2015].

Hansen, J. (2011) *One Birmingham Place, a proposed eight-part facility, wins Prize2theFuture contest*. The Birmingham News [Online] May 05 Available from: http://blog.al.com/spotnews/2011/05/wins_prize2thefuture_contest.html. [Accessed: 03 March 2015].

IBM (2013) *Smarter Cities Challenge Report: Christchurch.* [Online] Available from: http://www.cdc.org.nz/wp-content/uploads/2014/12/ibm-smarter-cities-report-christchurch.pdf [Accessed: 04 March 2015].

Iansiti, M., Levien. R, (2004) *Strategy as Ecology*. Harvard Business Review. [Online] Available from: http://www.cs.cmu.edu/~jhm/Readings/HBR-Strategy_as_Ecology.pdf. [Accessed: 01 March 2015]

Mitchell, W. (2007). *Intelligent cities*. e-Journal on the Knowledge Society. [Online] Available from: http://www.uoc.edu/uocpapers/5/dt/eng/mitchell.html. [Accessed: 04 March 2015].

Mix & Mash, (2014) *New Zealand's great remix and mashup competition*. [Online] Available from: http://www.mixandmash.org.nz/index. [Accessed: 04 March 2015].

Mullagh, L., Blair, L., Dunn, N., (2014) *Beyond the 'Smart' City: Reflecting Human Values in the Urban Environment*. Lancaster University. SMART 2014: The Third International Conference on Smart Systems, Devices and Technologies.

Walls, J. (2014) *Labour targets earthquake recovery bodies as 'undemocratic'*. NBR. [Online] Available from: http://www.nbr.co.nz/article/labour-targets-earthquake-recovery-bodies-undemocratic-jw-159053. [Accessed: 05 March 2015].

Nambisan, S. & Nambisan, P. (2013) *Engaging Citizens in Co-Creation in Public Services*. [Online] Available from: http://businessofgovernment.org/sites/default/files/Engaging%20Citizens%20in%20Co-Creation%20in%20Public%20Service.pdf. IBM Centre for the Business of Government. [Accessed: 01 March 2015].

New Zealand Trade & Enterprise. (2014) *Video: Smart Cities - The $US1.5 Trillion Opportunity*. News and Media. [Online] Available from: https://www.nzte.govt.nz/en/news-and-media/features/video-smart-cities-the-us15-trillion-opportunity/. [Accessed: 06 March 2015].

Rogers, E., (2003) *Diffusion of Innovations*, 5th Edition. Simon and Schuster. ISBN 978-0-7432-5823-4.

The Urban Technologist. (2012) *The new architecture of Smart Cities*. [Online] Available from: http://theurbantechnologist.com/2012/09/26/the-new-architecture-of-smart-cities/. [Accessed: 06 March 2015].

University of Canterbury. (2011) *UC mobile phone app helps people see the CBD as it used to be*. [Online] Available from: http://www.comsdev.canterbury.ac.nz/rss/news/?feed=news&articleId=280. [Accessed: 02 March 2015].

WHO. (2014). [Online] Global *Health Observatory (GHO) data - Urban population growth*. Available from: http://www.who.int/gho/urban_health/situation_trends/urban_population_growth_text/e. [Accessed: 04 March 2015].

Wikipedia. (2015) *Augmented reality*. [Online] Available from: http://en.wikipedia.org/wiki/Augmented_reality. [Accessed: 02 March 2015].

Wikipedia, (2015). *Crowdsourcing*. [Online] Available from: http://en.wikipedia.org/wiki/Crowdsourcing. [Accessed: 04 March 2015].

Wikipedia. (2015) *Online community*. [Online] Available from: http://en.wikipedia.org/wiki/Online_community. [Accessed: 01 March 2015].

Wikipedia. (2015) *Virtual reality*. [Online] Available from: http://en.wikipedia.org/wiki/Virtual_reality. [Accessed: 01 March 2015].

Bio

Laurence is the founder of Align Limited, a planning firm based in Auckland, Wellington and Christchurch. He is also the founder of a software company that has developed engagement software called LineUp. LineUp is used for infrastructure projects across New Zealand for stakeholder engagement and project management. LineUp is now undergoing a further round of development. Part of this development will be to connect LineUp into the CBD sensor grid planned by Sensing City in Christchurch. Laurence is interested in crowdsourcing, e-participation, civic-tech, opengov, sensor grids and open data, and how these relate to public services.