Strategy Refresh – trends in the spatial information industry and how these relate to WRC

"Advances in technology and rapid digitization are fundamentally transforming societies, economies and ways of doing business. Often referred to as the Fourth Industrial Revolution, this development presents great opportunities for all actors involved and a previously unimagined solution space for some of the world's most pressing problems"

Klaus Schwab, Founder and Executive Chairman, World Economic Forum from The Global Risks Report 2016.

This document was written for Waikato Regional Council in 2016 with the assistance of e-Spatial.

In 2012 the first Spatial Information Strategy was written. A refresh of that document in now being developed.

The purpose of this document is to outline trends in geospatial information since the first Strategy in order to provide background information and to be aware of changes that need to be considered for the Refresh. The content ranges from considering WRC business drivers, local and national initiatives and trends that may have some impact on the WRC geospatial work as well as global trends. Content has come from a range of documents, and from suggestions from e-Spatial during a peer review process.

1. Global trends in spatial information – what to consider

1.1 A customer centric approach – a good strategy starts with the voice of the customer

It is important to see that spatial information (or GIS or geospatial) exists to support an organisation to reach its goals and therefore it is a business support system; an enabler. An organisation must consider all its uses, needs and benefits for its internal and key external stakeholders when developing its strategy. The benefits of future investment or the consequences of not investing need to be clear, driving all the way from outcomes and KPIs through to specific spatial information initiatives.

There is a need to provide business-centric solutions not map-centric solutions (Szukalski, 2016). Spatial solutions are collaborative solutions that are delivered in consultation with the requestors, frequently an iterative process. E-Spatial have stated that spatial solutions offer the opportunity for the organisation to discover innovative solutions that could assist with efficiency savings and in creating shared collaborative opportunities (including business to business, business to stakeholder and business to client collaboration).

1.2 Spatial data, systems and people

Spatial information needs to provide good quality, appropriate data and information through intuitive interfaces.

Spatial information often used to stand alone and have a cartographic and technical emphasis. Now spatial information is not just a software application but a platform (Szukalski, Winter. p31) in which linkages with other systems enables collaboration and integration across business systems –

internally and externally. Spatial information can offer a vital role in enabling the presentation of information, analysis, and discussion and inform decision-making in a wide range of ways from long term planning to emergency response (UN-GGIM, 2013, p9).

Because there is the ability to be able to share the data and information from a GIS system there is a change in the spatial information user community with four roles emerging:

1. Authors – who create the information
2. Analysts – who examine, refine and synthesise the data
3. Administrators and publishers – who make the data and information available
4. Consumers – who view and use the information (ArcNews Summer 2015, p32)

Not only are there the traditional geospatial analysts but also others who analyse data, sometimes at an advanced analytics level such as the work undertaken by computer scientists. There is a need to ensure that these people have the tools to be able to undertake analysis - across software for desktop, web as well as enterprise server for data storage and its management. (Wallace, p16). As well as advanced analytics occurring within organisations there is also an emergence of 'neo-cartographers' and 'neo-geographers': those who have little if any expertise in cartography or geography who want to visualise data and information and to undertake analysis for themselves. This is a shift from map consumers to a combination of map producer and consumer, creating a new category of 'prosumers'. (Faby and Koch, p.1).

Another emerging consumer is the crowd sourcing community. Major change (often referred to as 'disruptive') has occurred with crowdsourcing using satellite imagery on Tomnod. The result of this is the speed in which results can be delivered with many more eyes accessing the data than the core team (2 million users are currently registered with Tomnod), plus keeping the rescue team out of the danger zone such as a cyclone, earthquake or other natural disasters (Chester, 2015, Position. p. 17). Recent examples has been the capture of change data for a Nepal relief effort and the February 2016 Fiji floods. Tomnod has also been used for citizen science such as improving public spaces in developing nations (Gregory, 2016, p16).

1.3 Spatial data exists in everything we do

Crowdsourcing is not without its challenges. Crowdsourced cartography can result in online maps growing at different rates from area to area and at different levels of accuracy and detail (Regnauld, 2015). The intelligent aggregation, omission or other value judgements or rules that a professional would apply, may not occur, or may be inconsistent. There is a need to consider how crowdsourced data will sit alongside more traditional data and how it might be visually presented. In time data traditional cartographic skills for crowdsourced data might be simulated through automatic generalisation tools so increasing quality and reliability.

e-Spatial has suggested that enabling citizens to update or add new information could be done by the use of clear governance processes and done in a structured way by applying spatial topologies. This way crowd sourcing brings about an extension to data capturing and enrichment. E-Spatial goes to suggest that what needs to be considered though is how crowd sourced data is to be used and what will the benefit of that be, especially if there are legal implications from the data. What WRC stands to benefit if crowd sourcing can be done well is improved WRC to stakeholder relationships as well as more frequent update of data in a faster timeframe. Examples where crowdsourcing has been applied well currently are the NZ Police for real-time context to assist with management and

deployment of resources and NZTA for open Street Maps validation and maintaining of the spatial representation of the state highway network.

Coupled with the change in the consumers / prosumers, is the transformation from traditional 2D maps to 3D, 4D, interactive applications and virtual reality where a user can explore an area or trial out actions. The move from 2D is not a linear process that discards the previous forms, but is an expansion of actions that show the increase in portability of information and repacking to suit requirements in the most convenient way. (Sensor, March, 2016). WRC needs to consider the use and benefit of 3D which e-Spatial considers to be a key growth opportunity and trend within the spatial industry. Care needs to be taken to ensure that the infrastructure design is well planned. There could also be opportunities with augmented reality and virtual reality. Videos with 3D models, animations and fly-throughs are becoming more familiar to users and assist in the engagement with citizens through interactive, predictive and visual appealing methods.

The pertinent point is that the challenges for the organisation are not only developing ways to make data available such as through data portals, but also ensuring that people understand the data that they are using, its currency, scale and accuracy for what it is being used for. Also to understand what is occurring when the data is generalised to understand it at smaller scales such as on a mobile device without sacrificing quality. (Position, August/September 2015, p28).

1.4 Making spatial easy

Geospatial data can also be repackaged for different insights and conveniences. Interactive maps allows the user to be able to click and explore the underlying data, giving the user their own personalised tour of the data. It allows the user to explore further the aspects that have particular interest for them (Ball, 2016.).

E-Spatial has several suggestions to consider: it is important to be able to re-use data for multiple purposes and within different systems e.g. Business Intelligence reports using spatial data and models though an API; new applications for use of spatial data not traditionally associated with a particular field; and the ability to be able to quickly create and use application based on the use of interoperability OGC and IT standards to enable machine to machine integration of data (LAWA web services are a current example).

The ability to access more and more data and information via mobile solutions is going to advance in a big way in the coming years in two ways and the strategy needs to address the value and opportunities of these:

1. The need to provide for mobile workers - users being able to access our technology and data wherever they are. This is not necessarily using a dedicated map, it is seamless mobile access and transactions.
2. With the 'internet of things' there are more sensors everywhere and more collection of location based data. Because of this mushrooming in growth in sensor data, there is the need to be able analyse big data (Wallace, 2015, p16-17; Jackson, 2015 p.35). What WRC needs to consider if what data might emerge that could be of value to the organisation and how to show the value of this to stakeholders.

With the expansion of analysis of big data organisations need to consider how best to support this processing. Traditional desktop and server based GIS may need to be supplemented or surpassed by alternative methods in cloud based processing. Hadoop-based database systems provide for high-

throughput platforms included real-time data feeds. At this stage the developments are mainly in the open source domain but commercial enterprises such as Esri expect to move towards cloud geospatial data storage and processing. Consideration needs to be given to security (Blog archive, 2016).

Braue (2016) believes that companies need to develop a comprehensive approach to storage, analysis and cloud computing in order to get the full benefit. There will be a need for growing internal skills in analytics but also in software development, IT support and cyber security (Tech Decisions, Analytics, hungry Feb 2016). Organisations need to consider how to address analytics from a technology perspective, but not forgetting the capability that will be required, developing the right skills while also considering the opportunity for both shared capabilities with other agencies.

1.5 The opportunities of open data

Howard has stated that "by 2018, a third of digital government projects will treat any data as open data." (2016). He goes on to pose the question of how do we get from where we are currently to this point. The value of public open data is that it enables transparency, which results in new internal and external ways of delivering data that is more efficient or gives new insights. Ultimately for NZ's central government the desire is to contribute to economic growth.

It is important to see open data not only as public data, but also as data that is machine readable and accessible through an API. E-Spatial considers that machine readable data is likely to have greater benefit for users in that the data is up-to-date but it does bring with it the need to be maintained as others will have a dependency on the data. E-Spatial goes on to recommend that WRC considers the development of a community of users as has been done in Brisbane City Council and Plymouth City Council (UK) to better understand stakeholders uses and potentially the development of a shared roadmap of required data in order to lead towards working with others to create useful apps and enrichment of datasets.

In NZ linked data is being explored with LINZ and ALGIM undertaking pilot projects. Linked data is new not only in NZ but globally. However if progress can be made the opportunity is for easier sharing and integration of data across organisational boundaries. Not only will entrepreneurs benefit but government and local government agencies themselves as new service delivery channels enable easily collected, published and re-used data no matter where it originates from (Howard, 2016). It will break down internal information silos as well as bring together the wider community that can contribute and participate (Szukalski, 2016). It does have challenges such as security and privacy implications, data 'ownership' and the skills for the development of linked data.

It is important not only to consider technology, skills and data but also to consider the back end, data management. An organisation needs to focus its data management strategy on the business initiatives at the centre of the considerations so that data is collected and gathered for the right purpose. Key points to consider with data management:

1	Develop an analytic roadmap linked to business initiatives	Don't build separate solutions; make sure the databases and applications link as needed so that analysis across domains can occur; and data is quality checked; Look for where different 'extract, transform and load (ETL) processes have been built to

		collect the same data for different targets; look at planned initiatives
2	Ask "what are your planned and funded business initiatives and what data and analytics will be needed for their success?"	Not: 'what data do you need and what is their value?'
3	Once you have a road map, consider what data management capabilities are needed and for what purpose	

From: Lewis, 2015.

2. Central and local government perspectives and trends:

Having set the scene with general considerations of the industry this document now considers trends that are emerging in NZ.

Central and local government will continue to have key roles in providing geospatial information although it will change over time. While the role may change there are core responsibilities that are forecast:

1) Data – continue to have a role in the provision of fundamental data
2) Collaboration – continue to put in place projects that building bridges between organisations enabling collaboration e.g. historic scanning project partners developing a publically accessible national viewer
3) Provision of geospatial frameworks - provision of frameworks that have trusted, authoritative and maintained geospatial information. This role is evidenced in NZ with the Land Information NZ Strategic Plan 2015 which states that "we will make geographic information accessible and useable. We're connecting geographic information into a national spatial data infrastructure for New Zealand.[1]

The LINZ Strategic 2015 Plan states its three strategic objectives as

1. Increase in the use of geographic information
2. Unlock the value of property
3. Improve resilience to natural events.

These three show the focus for central government on the provision of data increasing with a specific emphasis on property and natural hazards. As one would expect in a Strategic Plan, this is a more focussed approach than was seen through the National Strategic direction (ref). LINZ wants to deliver more information, at an acceptable standard of quality and timeliness and one that provides better decision-making across NZ, but with a focus on assisting Maori and iwi and their decision-making needs. (LINZ. P5). LINZ sees that data and information management is at the centre of what they do. They want to establish national consistent standards for collection, recording, holding and sharing interoperable data and to model stewardship and custodianship framework.

In February 2016 the LGGA met with Local Government Geospatial Alliance (LGGA) to discuss projects that LINZ were undertaking that the LGGA and local government might be able to collaborate on. The presentations showed the strategic direction implementation projects and the

[1] The document goes on to define a spatial data infrastructure as 'a network of components that allows people to find, share and user spatial data", including topographic maps and nautical charts, property information and aerial imagery. P4.

areas that LINZ saw that local government could most assist with. The three main LINZ initiatives are:

i. Property Data Management Framework (PDMF)
ii. Address Information Management System (AIMS)
iii. National Spatial Data Framework (SDI)

Other initiatives are National Imagery, base maps, topographic data, roads integration, national elevation and building outlines and rivers. WRC is involved already with a number of these directly and indirectly.

Earlier in 2016 the Spatial Information Business Association (SIBA) produced a diagram that showed their stakeholders and relationships within the industry, placing central and local government as early adopters. The opportunity that SIBA provides to local government and WRC is opportunities where central or local government are unable to assist, that the SIBA members with their fleeter of foot, entrepreneurial nature may be able to assist. For instance the LGGA has recently been in discussion with one of the members on cloud storage for large datasets where central government were not willing to partner at this stage.

3. What are WRC's business drivers that need to be considered?

Discussions have occurred across the organisation to understand the organisation's business drivers in order that the Refresh supports the organisation.

On the whole, these discussions have not been solution oriented although some recurring themes and some requirements have emerged

Collaboration to enable discussion and decision making

- Interactive e-planning so that others can interact with the data that WRC has provided (e.g. policy based information;
- Discussion enablers such as SeaSketch, the Water Allocation Calculator, MarineMate and the Coastal Inundation tool

Integration of data and information:

- Eg to support LAWA and MfE monitoring. This will be an ongoing requirement and will in time develop to other requirements for collaboration. WRC needs to consider how to deliver most efficient processes such as web services. Not only should WRC consider central government needs but also what it can provide for Waikato councils and what web services can assist WRC in consuming data.
  There is also a need for central government agencies (such as MfE, MpI, etc) to ensure upfront data centric planning to approach these projects.
- Better integration with current business systems
- Iwi and co-management data – so that WRC and its iwi partners can use the data in new ways to get greater understanding and new insights
- Citizen science data and how to merge this

Visualisation

- Publishing of data – enabling information to be geographically represented as a new way of accessing the data

- To enable science development e.g. the use of data intersecting in new ways (e.g. Changes in vegetation, peat depth; use of remote sensing for wetland discovery)
- Use of mobile applications to enable the use of data on the fly. E.g. MarineMate.

Data collection and provision

- Ongoing provision of the metadata catalogue so that staff and external parties know what data is held and in what ways they can use it
- Use of the metadata catalogue to provide web services and self-serve functions
- Use of national data standards for data capture e.g. LINZ's standards for imagery; will need to be extended to cover other national data sets and schemas. Central government agencies together with LGGA, ALGIM, SIBA, etc must set this vision.
- Addressing accuracy of data collection for staff in the field and for consent data entry
- Greater understanding across the organisation of data ownership and the needs for standards

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