Building Survey and Geospatial Capacity in Asia and the Pacific Region

Rob SARIB, Australia

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SUMMARY

Numerous survey mapping and geospatial agencies in Asia and the Pacific are modernising their geospatial reference framework, infrastructure and information management systems. Although the drivers for such change vary, some governments in this region have recognised geospatial information and its vital role in land governance, administration and management; policy development; and sustainable growth. It is without doubt these perspectives have gained prominence through the formation of the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM), the UN resolution on Global Geodetic Reference Frames, and various UN related geospatial information or analytics initiatives to support and measure the success of Sustainable Development Goals. Also, with encouragement from the International Federation of Surveyors (FIG) Asia Pacific Capacity Development Network (AP CDN), surveying professions and agencies in emerging economies in the Asia and the Pacific regions have leveraged these UN initiatives to establish, maintain or improve their geospatial reference systems and infrastructure, and to develop the capabilities of surveying and related professionals.

This paper will deliver an overview of the workings of FIG AP CDN with respect to modernising geospatial reference systems, and also provide perspectives on building the capability of our profession to manage the relevant geospatial challenges, trends and expectations.

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1. INTRODUCTION

Today, many national geospatial information or survey mapping agencies from the Asia and Pacific region are undertaking initiatives to modernise their "geospatial reference system" (GRS). The term GRS is a broad concept as it covers components such as the geodetic network, the data, the technical standards and practices, the legal and policy frameworks, the information technology and communications, institutional or organisational arrangements, and most importantly the people. From a lay persons perspective the GRS can be defined and viewed as either the "positioning infrastructure" or "co-ordinate reference system" of spatial data that represents the "reference layer" which underpins land, marine and space based information. In other words it is a system of infrastructures to provide location intelligence to information and data.

As a consequence of this increasing trend to modernise GRSs, and the enhancement of the overall management geospatial information, politicians and decision makers have a greater awareness and understanding of the value and relevance of such positioning infrastructure to achieve national objectives. To support nations and their agencies to re-engineer their GRS, there are several United Nations (UN) initiatives that provide the high level foundations or civil obligations to advance their GRS. Initiatives, such as - the establishment of Global Geospatial Information Management (GGIM) of experts and the Subcommittee on Geodesy; the resolution on Global Geodetic Reference Frames; the endorsement of using geospatial data to measure the success of Sustainable Development Goals (SDGs); and the creation of the Integrated Geospatial Information Framework (IGIF).

To support the survey mapping and geospatial profession during this period of rapid technological and social change, FIG established the Asia Pacific Capcity Development Network (AP CDN). This "network" has encouraged nations, especially those emerging or developing economies from the region, to leverage the abovementioned UN initiatives so as to establish, maintain or improve their GRSs, and to build the capacity of surveying and geospatial professionals to meet the challenges and trends associated with GRS modernisation.

2. FIG AP CDN OVERVIEW

FIG AP CDN describes capacity building or development as a process of identifying the challenges or obstacles that impede an individual / organisation / community from accomplishing their objectives; and then developing the necessary knowledge / skills / competencies / frameworks to achieve them. The "network" also considers capacity

development involves learning to adapt to change (or shifting paradigms); understanding how decisions are made; and that change management is supported by resources and the political commitment to achieve results.

The operations of FIG AP CDN were made official at the FIG Working Week in Christchurch, May 2016. A "network" of professional experts was formed primarily from FIG Commission 5, the UN GGIM Asia Pacific Working Group 1 – Reference Frames, the International Association of Geodesy (IAG), and other leading survey mapping and geospatial agencies in the region. Although this "network" comprised of individuals from organisations that were either based in different countries or represented a diverse group of members, the "network" collaboratively develop a common mission. As a result, a collective "network" outcome and outputs, that are strategically linked with each participating agencies business was formed, and the following statements were subsequently embraced by the FIG AP CDN –

> *"Responsible governance frameworks and integrated administrative systems of tenure (rights and interests) for land and marine, are underpinned by sustainable fit for purpose geodetic / geospatial infrastructure and information management"*
>
> *To obtain this, surveying and geospatial professionals will need to -*
>
> - *Develop and enhance relevant capabilities to address the regional and national social, economic, environmental and technological challenges*
> - *Resolve challenges through a regional, unified, coordinated and collaborative approach*
> - *Ensure activities and initiatives have progressed through alliances and relationships with relevant likeminded bodies and / or development partners.*
> - *Create a culture of self-reliance, and an environment of learning, innovation, comprising of a blend of mature and young professionals, and a gender equity base.*

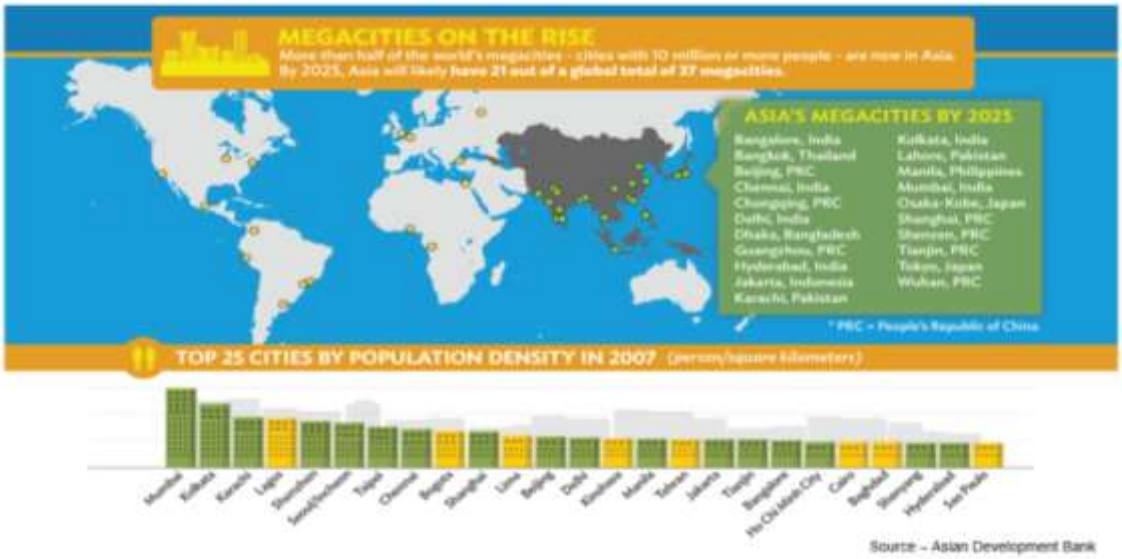
To implement and action the above the "network" shared finite resources to provide independent advice on professional development, and technical or administrative surveying and geospatial matters. This advice was delivered at meetings, forums, workshops, seminars and technical sessions at FIG, UN GGIM Asia Pacific (AP), or national survey mapping hosted events. To review FIG AP CDN and related proceedings navigate to the website – http://www.fig.net/organisation/networks/capacity_development/asia_pacific/index.asp

3. TRENDS and CHALLENGES AFFECTING SURVEYING and GEOSPATIAL PROFESSIONALS

From the analysis of various reports, presentations, papers and questionnaires submitted by participants at FIG AP CDN events, it is evident that the present day surveying and geospatial

challenges being experienced by one country are fundamentally no different from another. The apparent level, degree or extent of the issue however does vary, and is dependant on the nation's state of surveying and geospatial technical and professional capability, along with the cultural, social, economic and political environment. Considering this complexity, a summary of the main geospatial trends and subsequent challenges at the regional level and agency respectively has been prepared to indicate type and range of issues being experienced. The main "global" geospatial trends and activities impacting the Asia and Pacific region are –

- Impact of rapid urbanisation, and smart cities - By 2050 the trend of rapid urbanisation will cause 2/3 thirds of the world's population (approximately 6 billion people) to live in "mega" cities serviced by smart technology. Predictions indicate this will occur primarily in Asia and the Pacific region, along with an expanding middle class, and increased economic activity in numerous sectors (refer to Picture 1).



Picture1

Consequently to better understand this trend and related activity, access to reliable geo-referenced spatial information, datasets or analytics will be a necessity, so as to enable the assessment of the potential impacts, and to influence government departments or private sector groups decision making with respect to –

- Evaluating and implementing urban and land use planning
- Managing sustainable development of finite resources and the environment
- Administering utilities, services, public infrastructure and assets such as power generation and distribution, water reticulation, waste treatment, transportation networks
- Providing and building affordable and efficient housing
- Generating, supplying and delivering sufficient food for the population

- Influence of disruptive technologies and digitisation – This modern day occurrence extends to those technologies which will transform the way surveyors and geospatial professionals do their normal business, as well as present day lifestyle patterns. The disruptive technologies that may have the greatest impression on the world economy by 2025 are –

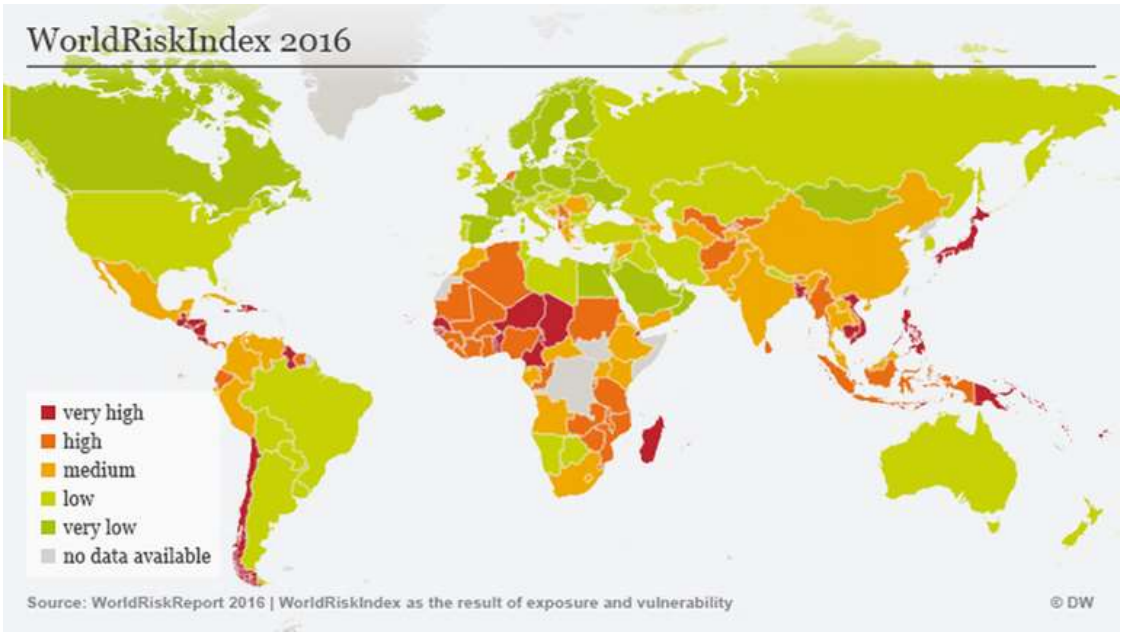
    - Mobile Internet enabled low-cost computing devices
    - Automation of work, knowledge and tasks via software and systems with artificial intelligence
    - Internet of things – networks of Internet based sensors that collect data to assist with processing, analysis, monitoring and decision making.
    - Cloud technology for provision of services or applications through the Internet or networks
    - Advanced robots or robotics that has ability to perform delicate procedures or assist with everyday life
    - Autonomous vehicles
    - Availability and access to "big data" sources such as high resolution imagery and LiDAR in near real time

    It is expected these disruptive technologies will change the work of the geospatial industry by facilitating greater connectivity and access to geospatial data in real time thus enabling real time monitoring and analysis. These technologies will facilitate collaboration by different industry sectors to create business opportunities; to nuture innovation for improved productivity and revenue; and foster more location based applications or services and or embedded intelligent systems. They will also change the "geospatial information cycle" (refer to Picture 6), that is the way digital information is collected, processed, analysed, visualised and interacts with multi land / marine / geographic systems and the user. This will particularly impact, sectors relating to building information modelling; product / resources / asset management, inventory and tracking; emergency management where authorities merge the physical and virtual worlds; and computational and visualisation software accessible via online or the Cloud.

- Disaster / emergency management and building resilience "before, during and after" – It is important to recognise the significant impacts of environmental phenomena such as climate change, sea level rise, earthquakes, tsunamis, and cyclones. In 2017, 335 disasters affected 95.6 million people (killing 9697), with an estimated economic damage of $335 billion US. Notably, Asia was the continent most exposed to natural disasters, with 44% of all disaster events (primarily floods and storms), 58% of the total deaths, and 70% of the total people affected.

    Furthermore, Asia and the Pacific are rated high on the world risk and vulnerability index (refer Picture 2)., translating to an increased incidence of natural disasters and therefore greater impact on inhabitants in the future. Reports also state that the quality

of critical infrastructure such as communication, transportation and utility systems will determine the effectiveness of disaster response and management. Subsequently, the engagement of the geospatial industry to supply, deliver and integrate information for such systems will be vital to the management and outcomes of disaster relief, re-construction and the building of resilience. Noting that, these concepts particularly apply to those locations affected by climate change, in particular Pacific countries and territories under threat from sea level rise. Overall, *"Access to information is critical to successful disaster risk management. You cannot manage what you cannot measure."* - Margareta Wahlström, United Nations Special Representative of the Secretary-General for Disaster Risk Reduction.



Picture 2

- The growing market for and permeation of ubiquitous positioning or "the where is concept" in the non-traditional geospatial community – There is indication survey mapping or geospatial agencies are more cognisant or implementing organisational change to maximise the benefits from quality aerial imagery / satellite data; exploit new mapping technologies / products; utilise multiple global navigation satellite systems; and to support innovation in the location or positioing based disciplines. Agencies are undertaking this activity so as to enhance the quality of life, create a safe environment, and to realise greater productivity and economic efficiencies across a variety of sectors that rely on accurate location. Because of this increased reliance, "fundamental or foundation" datasets (refer Picture3), which support sectors such as mining, transport, agriculture and construction, will require more accurate positioning (note for some applications positioining in real time) and also better interoperability and unification of geospatial data and information systems. Consequently as the GRS

underpins location or positioning frameworks, as well as geospatial data, modernisation, improvement and densification of a GRS will augment positioning reliability (including spatial accuracy), availability to users and stakeholders, and generally lead to greater geospatial information activity.

Picture 3

- Increased UN GGIM lead activity – Since the adoption of the UN General Assembly resolution "A Global Geodetic Reference Frame (GGRF) for Sustainable Development" in February 2015, several key initiatives have been advocated by the UN GGIM for emerging countries to support their mandate for GRS development, and they are –
  - The formation of a Subcommittee on Geodesy and the articulation and implementation of a road map for the GGRF based on five operational principles -
    - ✓ Data sharing – with emphasis on the importance of geodetic standards, and open geodetic data sharing policies or licensing.
    - ✓ Education and capacity building – identifying fit for purpose and appropriate geodetic skills and educational programs.
    - ✓ Geodetic infrastructure – a more homogeneous distribution of geodetic infrastructure.
    - ✓ Communication and outreach – better programs to provide visibility, understanding and advocacy of the value proposition to the community.
    - ✓ Governance - The development and sustainability of the GGRF is reliant on an improved governance structure.

- The use of geospatial information (or analytics) to measure and monitor the SGDs. In conjunction with the Group on Earth Observations (GEO), the UN GGIM have built frameworks and processes to support the use and integration of geospatial information, statistical / demographic data, and earth observations to measure and monitor the targets and indicators of the seventeen (17) SDGs (refer Picture 4).

Picture 4

Through these activities, advocacy and implementation of the "where is it" concept has enabled evidence based decision making; and supported data analysis, modelling, map creation and visualization. It has also enabled government agencies to evaluate impacts across sectors and regions, and to monitor change over time in a consistent and standardized manner. These outcomes can lead to more accountability within governments on economic, social and environmental matters, and increased collaboration; thus adding to the overall value proposition of geospatial information and location intelligence. Examples of geospatial information linkage to SDGs are -

- ✓ **Goal 2. Zero Hunger** – monitoring crop conditions, food production management
- ✓ **Goal 3. Good Health and Well-Being –** provision of social / community information for the management of disasters, reducing risk and building resilience
- ✓ **Goal 6. Clean Water and Sanitation** – mapping extents and annual changes of mangrove cover, catchments, usage, infrastructure development
- ✓ **Goal 11. Sustainable Cites and Communities** – measuring and visualising social patterns, urban and rural development, air quality, pollution and contamination; monitoring waste management practices; general asset, infrastructure and resource management
- ✓ **Goal 12. Responsible Consumption and Production** – provision of geospatial analytics in relation to resource and energy efficiency,

sustainable infrastructure, and access to basic services, and employment opportunities.

- ✓ **Goal 13. Climate Action, Goal 14. Life Below Water, 15. Life on Land** – monitoring atmospheric conditions and sea level rise; management or earth's assets and resources; tracking tree coverage extents; loss and gain over time, flora and fauna management; impacts of development.

- The development of the Integrated Geospatial Information Framework (IGIF) – The IGIF is a implementation guide for countries who are endeavouring to enhance, and manage their nation's geospatial information infrastructure and resources. It recommends countries to consider 9 strategic pathways to achieve this, and provides guidance on the preparation of geospatial information operational, and action plans through a layered framework and series of mechanisms. More specifically, it articulates the various components of "a plan" from geospatial information perspective including vison, mission, goals, drivers, principles, pathways, and reporting. Interestingly, the IGIF also recognises the motivation or purpose for geospatial information modernisation will vary from country to country. Consequently the IGIF suggests countries to look beyond the normal "drivers" or purpose for change, and to also consider potential benefits or opportunities from non-traditional geospatial sectors and applications. For examples of countries implementing the IGIF refer to - http://ggim.un.org/unwgic/nov20-ss-operationalizing-the-integrated-geospatial-information-framework/

In summary, the above mentioned "trends and activities" have provided a high level mandate for survey mapping and geospatial agencies to examine how these will impact their role and function in the future. As a consequence agencies have identified numerous legal, technical, organisational, data, and people challenges and expectations that must be dealt with and managed (refer to Picture 5). The main challenges and expectations which resonant in the Asia Pacific region are –

- Continually justifying and advocating the role, existence, value and importance of geospatial information and the GRS to decision makers at the executive management, financial or political levels. In addition to this, finding the right person(s) and government agency with the "political will" and to "champion" the cause.
- The development and modernisation of survey and geospatial information related legislation (acts and regulations), policies and guidelines, which are agile and flexible to accommodate a rapidly changing environment.
- Competing for finite resources, securing resources, and balancing resourcing priorities.

- Making the necessary changes to governance culture and administrative frameworks to ensure responsible, evidence based, and informed decision making; and transparent accountability to the community
- Ensuring a sustainable workforce by creating and maintaining a diverse environment of gender, age and professional or scientific disciplines.
- Establishing frameworks and mechnaisms to faciliate collaboration between agencies or countries regarding capacity building, training, education and recogition of qualifications.
- Developing and implementing geospatial information and GRS agency strategies and business plans that are linked to national objectives, to action change and support modernisation.
- Making sure there is a national survey or geospatial industry standards and practices framework to ensure standards and practices are maintained, up to date and are complied with.
- Establishing and maintaining the infrastructure, and systems to modernise the GRS to model and monitor of the dynamics of the earth and environment (includes sea level rise, plate tectonics); and to unify height systems
- Contributing geospatial data to early warning systems and the measurement of the effects of natural phenomena such as tsunamis, earthquakes, storm and flooding events, and volcanic activity.
- Ensuring the nation's foundation or fundamental datasets has integrity. That is, data is accurate, current, facilitates integration and interoperability and is operating in a "fit for purpose" information system.
- Guaranteeing land and marine administration, management and governance systems provide indefeasibility of registration of rights, restrictions and responsibilities.
- Geospatial information and datasets are shared openly or with limited restrictions; available and accessible; cater for data security, privacy and sensitivity; and consider financing and commercialisation of data and infrastructure options.
- Integrated geographical information systems are administering and visualising data in 3 dimensions, accommodate a temporal component, and are leveraging the power of the internet, mobile phones, web-based data portals, crowd sourcing, the cloud, and distributed web services.
- Geospatial and GRS infrastructure and systems have access to reliable and affordable digital, high speed / broad bandwidth, internet, and spaced based communications.

Picture 5

4. CAPABILITIES for the FUTURE

The professional surveyor or geospatial scientist, and also spatial leaders of organisations, will need to change to accommodate the challenges, trends and expectations that are occurring now and in the future. Adaption to change can have its implementation issues especially if the management of change does not alleviate the fear of the unknown or fails to explain the "why to change". This can lead to a lack of understanding, resistance and no ownership of the change. When this occurs change is destined to be "unsuccessful" before it is has begun.

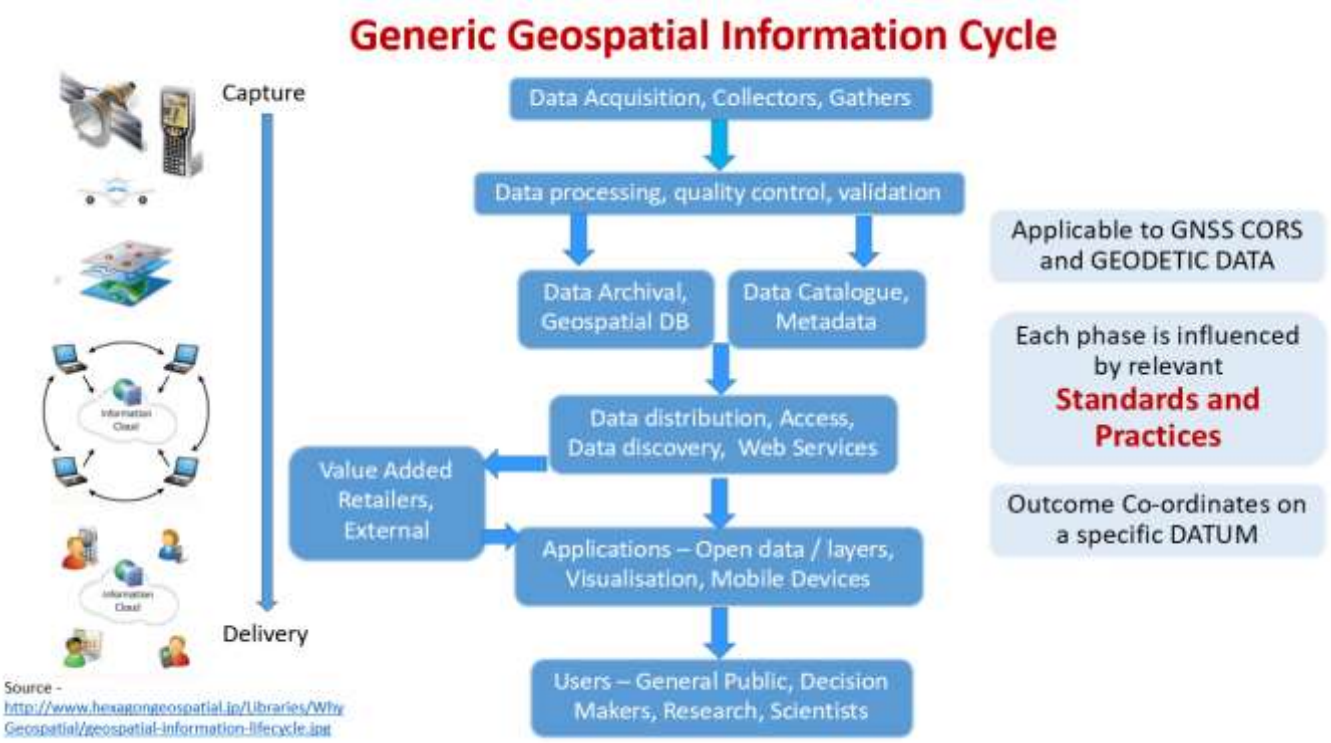
For some countries transitioning an organisation to a different way of operating has been successful. In these circumstances change has been supported and well managed by the leaders who have changed the culture, mindsets and paradigms of the people within the organisation. To do this our surveying and geospatial leaders and professionals will need to transform their attitude towards change, be progressive in their thinking, consider diversifying or refining their knowledge and skillsets to take advantage of the change, be less risk adverse, and be more energetic people managers. These skillset sets are often classified as "soft skills" as they are not technical in nature but more personal attributes to enable better interaction amongst people. There are other similar capabilities that our profession should consider so as to tackle the future challenges, such as -

- Being agile and flexible for continuous change.

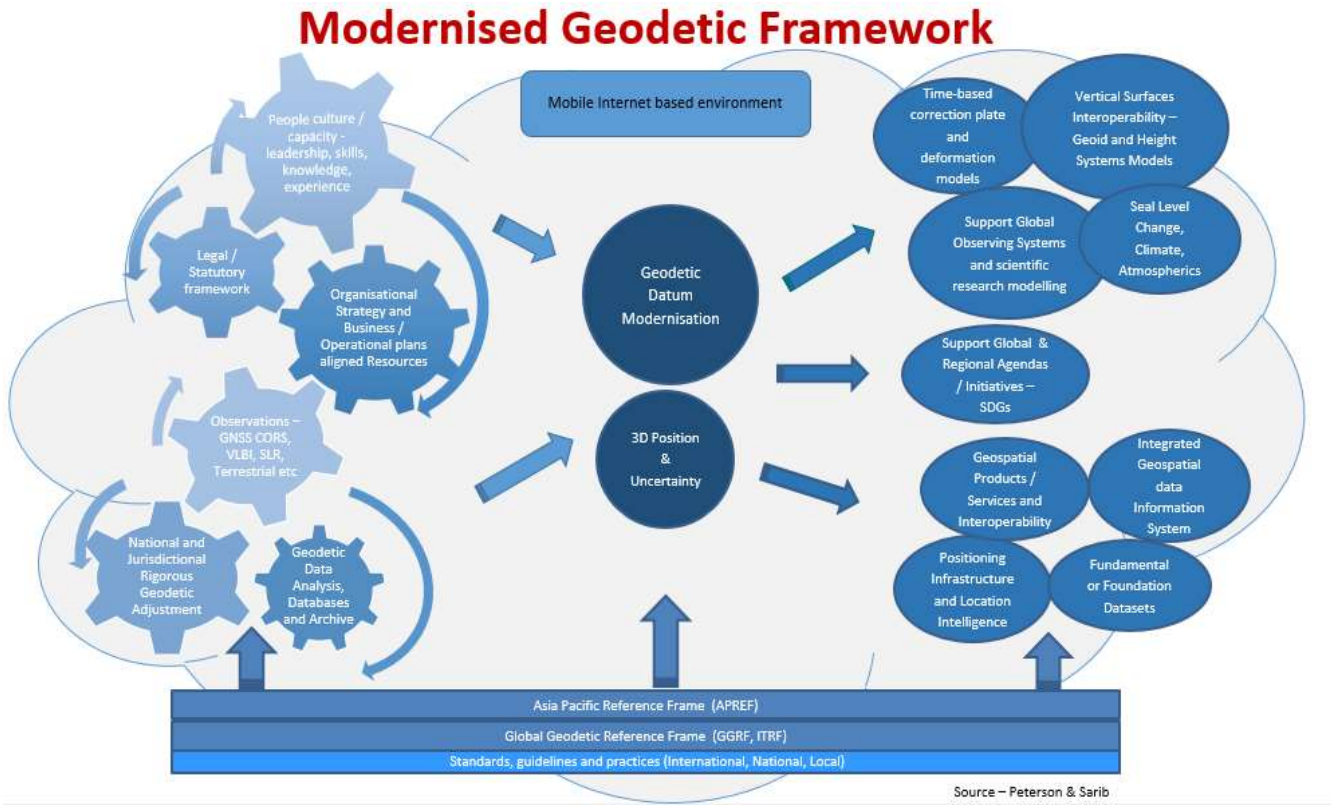
- Having the knowledge and experience to convey professional advice and services to facilitate design, risk assessment, investment analysis, asset management and resource deployment.
- The capability to innovate in multi-disciplinary teams to effectively manage diminishing resources, increased data volumes; and to resolve legal or policy data matters such as privacy, custodianship, sharing, licensing, liability etc.
- Actively leading, negotiating, influencing, and permeating collaboration and change amongst a diverse team of survey and land professionals
- The ability to understand and balance commercial influences, standards and practices, and the integrity of the profession
- Advocating and communicating relevance and value of geospatial information to influence leaders, decision makers, politicians; and to attract a diverse group of new professionals
- Skills to form and administer strategic and operational plans with an outcome / output focus; and qualitative and quantitative monitoring / evaluation frameworks.
- Aptitude to develop sustainable policies to balance consumption of resources with environmental needs; and to ensure a self-reliant, self-determinate community that has gender equity

For an example of implementing a change management strategy please refer to the paper by Blick and Sarib (2018) on "The social, technical, environmental and economic benefits and opportunities of accessing and sharing geodetic data" delivered at the FIG Congress in Istanbul.

From a technical perspective the GRS capabilities and competencies required to accommodate the geospatial trends, challenges and expectations have primarily been concerned with infrastructure and systems to modernise the GRS or more generally the geospatial information cycle (refer to Picture 6). With regards to the later countries in the Asia Pacific are examining how their organisation can re-engineer and improve the collection, processing, evaluation, analysis and visualisation of geospatial information to decision makers and users. They are also exploring what combination of new "disruptive" technologies, crowd sourcing techniques and web / cloud based services they can employ so as deliver, reliable, accurate, and interoperable information in real time.



Picture 6



Picture 7

When it comes to a modernised GRS (refer to Picture 7) survey and geospatial professionals need to embrace and / or enhance their abilities to essentially better measure earth dynamics in real time. That is, they should have the capacity to derive, analyse, maintain / monitor and report on the components of modernised GRS infrastructure. These include a network of Global Navigation Satellite System (GNSS) Continuously Operating References Stations (CORS) that contribute and are mathematically aligned to the International Terrestrial Reference Frame (ITRF) or the subset Asia Pacific Reference Frame APREF; a geodetic datum connected to ITRF / APREF; "fit for purpose" survey control networks that are a hierarchy of rigorously propagated co-ordinates and uncertainties; a unified height datum; a geoid model; a model to facilitate the integration of vertical surfaces for land, water, and intertidal zones; local deformation models; mechanisms to access geodetic information; and provision of geodetic data supporting global observing systems for scientific research modelling such as tectonic plate deformation, sea level monitoring, climate change, and atmospherics.

Level	Competency Requirements	Training provided by	
1	Basic understanding of: • GNSS • Reference frames, including geoid models, vertical and horizontal datums	• Educational institutions – universities and polytechnic institutes • Government mapping agency • Private companies	Countries that might have one CORs and maintain a traditional geodetic network of reference marks – e.g. small Pacific Island Nations?
2	The above plus knowledge of: • Constructing, building and running a small CORs network • GNSS processing using standard software - e.g. Trimble, Compass Solution (ComNav), LGO(Leica),.... • Least squares processing and provision of datum access • Geoids models, precision, determinations and basic implementation • Implementation of a vertical datum including use of geoid models	• Educational institutions – universities and polytechs • UN-GGIM Geodesy Capacity Group • FIG • Government mapping agency • Private companies	Countries with small CORs network and those who adopt global Reference frames for their nation reference frames – e.g. Fiji?
3	The above plus high knowledge of: • Implementing and running large CORs networks • High end GNSS processing and datum access • Geoid model computation and implementation into a vertical datums • Monitoring earth dynamics and including in datum realization • Geodetic database management	• Specialized courses – e.g. geoid school • UN-GGIM Geodesy Capacity Group • IAG and FIG • Government mapping agency • Private companies	Countries with a more extensive CORS and developing their own specialized national and vertical datum – e.g. New Zealand and Sweden?
4	The above plus expert knowledge of: • Reference frame determination and computation • High end GNSS analysis and processing • SLR including analysis and processing • VLBI including analysis and processing • Gravity collection, processing and geoid determination • Analysis centre – combining various geodetic techniques to determine reference frame parameters • Use of other potential geodetic techniques – e.g. DORIS and InSAR	• IAG • Specialist training courses run by NASA/JPL – e.g. on VLBI or SLR • Private companies • Specialized software training courses – e.g. Bernese	Countries engaged in Global Reference frame determination and Geodesy Science - e.g. US, Australia and Germany?

Picture 8

To assist countries to identify their GRS technical capability needs and to estbalish a capacity development plan, the Education, Training and Capacity Building (ETCB) working group of the SCoG, have designed a geodetic competency matrix (refer to Picture 8). Although this table is not finalised nor exhaustive, it does provide a description of the skills, experience and knowledge required to build and operate a modern GRS, along with training and education requirements, and possible sources to provide capability. Please note, this matrix is based on the answers provided by relevant agencies responding to ETCB / UN GGIM AP / FIG AP

CDN questionnaires and specific reports, and thus will evolve as more information is gathered.

As previously mentioned, it is important surveyors and geospatial scientists have the capability to undertake these activities as a modernised GRS underpins a nation's "fundamental or foundation" datasets, and is integral to the interoperability and unification of geospatial data and information systems. To achieve this, it is imperative the GRS's and resultant positioning infrastructure or location intelligence adhere to international standards (includes metadata), practices /guidelines and protocols with respect to data exchange formats, and in particular the licensing and sharing of both godetic and geospatial information. In addition, the modernised GRS infrastructure and systems must have the technology to operate in a multi GNSS environment; utilise other space based measurement technology; take advantage of high resolution aerial / satellite imagery; and is aligned with new mass-market positioning (real time) technology and applications delivered by satellite, digital communications, and the Internet. Ultimately our professional capabilities, the infrastructure and systems we operate will need to be future proofed against the rapidly changing technological advancements and the associated user needs.

5. PERSPECTIVES on the WHY, WHAT and HOW

FIG AP CDN advocate that many agencies and organisations can breakdown their operations to three fundamental but simple levels - *what we do, how we do it*, and *why we do it*. With respect to operating a GRS it is evident our profession has a clear understanding of *what we do* and *how we do it*, however outside our geospatial sphere or environment, the *why we do what we do* is not so clear or known, especially to those decision makers setting strategic direction and influencing the allocation of resources.

Unfortunately in most agencies there are only a few personnel within an organisation who are conversant about the relevance and importance of GRSs and geospatial information, the professional services and advice we provide and the actual job we do. Consequently to articulate, advocate or promote the things that will differentiate *the what and how we do it* from others will rely on the explanation of *why we do what we do*. In other words it is important to clearly and concisely define *the why* or the purpose, the cause and the belief that will drive and motivate the organization to build a modern GRS. Accordingly, the formation, publicising and advocacy of *the why* are also critical and should be an integral part of a geospatial or surveying mapping agency's strategic or business plan, and policies that guide implementation and operations of a GRS.

To develop *a why* statement for building GRS capabilities, an agency should initially undertake an evaluation of its business operations. This action could involve a SWOT analysis (critical assessment of strengths, weaknesses, opportunities and threats) to identify and understand the internal and external factors or key issues affecting the development of GRS capability. Although this type of analysis does not necessarily offer solutions it does

provide the opportunity to align and unify other agency strategies and initiatives associated with a GRS. In addition to this the agency may consider the questions –

- Why do we need to develop our GRS capacity OR what will be its purpose and drivers – technical, social, economic, political?
- Whose capacities need to be developed and which groups or individuals need to be empowered at the local / national / regional level?
- What kinds of GRS capacities need to be developed to achieve both agency and broader development objectives (i.e. social / political national agenda)?
- What role in the geospatial information cycle does the agency play?
- What is the purpose and activity of the agency's foundation or fundamental datasets and how are they influenced by a GRS now and in the future?
- What is the status of the agency's present day GRS infrastructure and systems?
- How does the GRS interact with existing land and water administration, management and governance frameworks?
- What are the challenges or issues impacting GRS capability?
- How can your agency improve GRS capability?
- What will be your agencies contribution and impact?
- How will your agency know when GRS capabilities have been achieved?
- What does your agency do well? Not so well?
- What should your agency not be doing?

Overall, the most effective *why* statements are communicated through a simple, clear, and actionable message. This message needs to focus on how building GRS capability will contribute to development of others, the agencies objectives, and more importantly improve the livelihood or social dynamics of the community. Lastly *the why* message needs to be expressed in affirmative language that resonates not only to the GRS industry but also the decision makers and broader community.

Below is a list of why, what and how examples with respect to building geodetic capability.

The Why

- To support better livelihood, health and wellbeing of the community
- To improve government evidence based decision making, transparency and accountability
- To accommodate and benefit from global and regional geospatial trends / challenges and their impacts
- To facilitate the insatiable need for more reliable, accurate and real time geospatial information for decision making and applications
- To supply reliable geospatial information for disaster risk management – before, during and after an event.

- To monitor and measure the 17 SDGs and the 169 associated targets with 230 indicators.
- To evaluate the effects and impacts of climate change and sea level rise

The What

- Change the organisational culture, institutional paradigms, legal and policy matters associated with GRS and geospatial information
- Improve the perception; advocacy of the value and relevance of a modernised GRS
- Alignment of GRS objectives with specific national agenda
- Enhancement of the GRS, improvement of technical capabilities and data management, more investment in people development/ management
- Augment access to reliable (fit for purpose) geospatial data
- Develop interoperability, integration and application of geodetic measurements, geospatial data, earth observations and statistical information

The How

- Developing and implementing a GRS capcity building, education and training framework
- Obtaining political will, a champion to advocate the GRS
- Developing GRS or geospatial information strategic plans at the regional, national and agency level
- Understanding the agency role and the purpose of the GRS in the geospatial information cycle and "fundamental / foundation" geospatial datasets
- Integrating and ensuring the interoperability of the land / water information datasets and systems
- Establishing a geospatial information legal framework and developing relevant policy
- Building a culture of reliance and adherence to surveying and geospatial standards and practices
- Sharing data, information, experiences and knowledge
- Instituting a GRS "body of knowledge" and competency framework
- Increasing collaboration with like-minded agencies, academia, professional associations, and neighbouring countries to resolve issues, barriers and establishment of the necessary frameworks.
- Creating a more diverse workforce – age, gender, and other disciplines
- Developing and engendering ownership of GRS agenda with young professionals
- Technical development in GNSS and GNSS CORS, reference frames and datums, geodetic data management, unification of datum's, integration and interoperability of data.

6. CONCLUSION

Survey mapping and geospatial agencies need to develop their GRS capability to (a) better manage the dynamics of earth and the rapidly changing environment, (b) meet the positional needs of geospatial professionals and users, and (c) provide the geospatial analytics for todays decsion makers leading our social and community agenda. To achieve this the modern day professional surveyor will need to acquire or improve their technical and people management skills, knowledge and experience in –

- Establishing and maintaining GRS infrastructure and systems
- Using intelligent geospatial data (maps etc.) as a highly effective and advanced tool for decision making.
- Ensuring data is digital , interactive and has effective visualization
- Incorporating geospatial information and technology in workflow management
- Providing geospatial solutions for traditional sectors such as land / water administration and management, asset management, agriculture, construction, and disaster management, and also for specialized sectors like real-estate, building engineering, architecture, banking and financial services, retail and logistics, forestry etc.
- Forming geospatial information technology business strategies, plans and programs that are part of a national agenda
- Collaborating with a diverse group of industry bodies, professional member networks, and commercial institution in delivery of services, products / applications (hardware, software, and content)

Also, to support an agency's capacity development framework and its implementation plans it is critical to understand, and concisely define *why do we do what we do*. In the case of GRS and geospatial information, an effective why statement will need to inspire and motivate action, encapsulate drivers (objectives) outside the normal or tradtional sphere of business, unify geospatial information direction, and influence the decision makers.

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BIOGRAPHICAL NOTES

Rob SARIB, Director Survey / Surveyor-General, Survey Branch in the Land Information Group of the Northern Territory Government's Department of Infrastructure Planning and Logistics.

Rob Sarib obtained his degree in Bachelor Applied Science – Survey and Mapping from Curtin University of Technology Western Australia in 1989. He also holds a Graduate Certificate in Public Sector Management received from the Flinders University of South Australia. Rob was registered to practice as a Licensed Surveyor in the Northern Territory, Australia in 1991. Since then he has worked as a cadastral and geodetic surveyor, and a land survey administrator.

Mr. Sarib has been an active member of the FIG since 2002, and is now Chair of the FIG Asia Pacific Capacity Development Network. He is presently a Board member of Surveying and Spatial Sciences Institute; the Chair of the Surveyors Board of Northern Territory; and member of the Inter-governmental Committee on Survey and Mapping – Australia.

CONTACTS

Mr Rob SARIB
Department of Infrastructure Planning and Logistics
GPO Box 1680
Darwin NT
AUSTRALIA
Tel. +61 8 8995 5360
Email: robert.sarib@nt.gov.au or rob.sarib@gmail.com
Web site: https://dipl.nt.gov.au/