

SINGAPORE GEOSPATIAL MASTER PLAN

2018



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Foreword by Co-chairs of the GeospatialSG Working Committee

Geospatial information and technology underpins many of the solutions that we need today. Geospatial is increasingly recognised as an essential tool to make decisions, enhance productivity and improve daily convenience. Our government, businesses and citizens are advancing new ways of living and working based on geospatial technology. Public agencies are using geospatial applications and platforms for policy planning, operations and public service delivery. Businesses are optimising their processes or even creating new business models using geospatial technology to add value for consumers. Citizens are using maps to improve daily convenience, from locating facilities and amenities, to learning more about their environment and heritage.

Geospatial information and technology will continue to grow in importance in supporting Singapore’s transformation into a digital economy and vision towards a Smart Nation. The rapid advances in geospatial technology will deepen its impact across our economy and society, and we need to maximise the opportunities that arise. This sets the impetus for the development of Singapore’s first Geospatial Master Plan. Formulated in consultation with more than 110 agencies and organisations across sectors, the plan represents our collective aspirations for the geospatial sector. We are proud to put forward our new vision, a ‘Geospatial-Powered Singapore’, as well as a set of strategies and initiatives to galvanise the whole-of-nation towards geospatial transformation.

We would like to take this opportunity to encourage all stakeholders to partner us in implementing the Master Plan. A whole-of-nation approach is essential in tackling the challenges ahead and in achieving the outcomes of the Master Plan. If you did not have the opportunity to participate in the Master Plan consultation process, we welcome you to share with us your feedback and inputs. The Master Plan is a living document that will continue to evolve as we incorporate new geospatial developments, innovations and ideas for spurring the community and our society.



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Chief Executive,
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Executive Summary

This document articulates the Singapore Geospatial Master Plan’s key outcomes, strategies and initiatives over the next 5 years to support Singapore’s vision to be a Smart Nation. The Master Plan adopts a whole-of-nation approach, bringing together government agencies, businesses, academia and citizens to participate in the next phase of Singapore’s geospatial development. This development is spearheaded by the Singapore Land Authority and the Government Technology Agency of Singapore under Geospatial Singapore, our National Spatial Data Infrastructure programme. Under this programme, SLA and GovTech developed the platforms, policies, standards and capacity to enable the use of geospatial information and technology. In guiding the Geospatial Singapore or in short, the GeospatialSG programme, the Master Plan will play a significant role in supporting our Smart Nation vision and Singapore’s future economy.

We envision a ‘Geospatial-Powered Singapore’; which aims to empower businesses, people and the government to use geospatial information and technology to enhance decision-making, create opportunities and lead better lives. This vision rests on the 3 pivotal pillars of the private, people and public sectors, which provide the framework for defining key outcomes, strategies and initiatives. Correspondingly, the Master Plan aims to develop a thriving GeoIndustry with a regional GeoHub status and a vibrant enterprise ecosystem; a Nation of GeoEmpowered People with geospatial competence and savviness; as well as a GeoSmart Government that is driven by geo-enabled processes in policy-making, planning and operations.

First, a thriving GeoIndustry will be achieved through co-creative networks that build the geospatial ecosystem, strengthening the geospatial industry and driving adoption across focused sectors. One key initiative is GeoWorks, an industry centre to foster a vibrant geospatial ecosystem in Singapore and for the region. Second, we will nurture a Nation of GeoEmpowered People, endowing our citizens to use geospatial data through open data-sharing platforms such as OneMap, and through education pathways in our Geospatial Engagement and Lifelong Education programme. Third, a GeoSmart Government will be achieved through enabling policy and data-rich environments that support the use of geospatial information and technology. Key initiatives are the Geospatial Capability Centre that aims to deepen geospatial capabilities across the government; and the Virtual Singapore Platform, a 3D platform that will enhance agencies’ planning, operations and public service delivery. Together, these initiatives address the institutional, policy, technology, and capacity-building aspects of Singapore’s geospatial development.

Geospatial information and technology is a broad umbrella term for all information, technologies and services that have a location element.

Introduction

In an increasingly complex world, citizens and policymakers constantly need to ask the question of 'where' to make well-informed choices. At the heart of the post-2015 United Nations Development Agenda is the worldwide recognition that "everything that happens, happens somewhere"¹. Cities and countries progressively realise that knowing 'where' people and things are located is central to making smart and informed decisions. As Singapore continues her journey in becoming a Smart Nation, location will be essential to the meaningful integration of information for insights and holistic understanding. Geospatial information and technology is pivotal to our Smart Nation initiatives by connecting businesses, citizens and government digitally based on location. By intersecting data across space and time, geospatial information and technology discovers relationships and creates situational awareness for powering daily convenience, business decisions and government services.

Geospatial information and technology is a broad umbrella term for all information, technologies and services that have a location element. It has become an integral part of Singapore's society and economy; and encompasses the familiar taxi-booking applications, car navigation devices, location-based services for accessing lifestyle and entertainment options, to even drones for collecting aerial imagery. Even while you are reading this sentence, numerous actors are working behind the scenes to gather, process and distribute geospatial information. Satellite Remote Sensing, Geographic Information Systems (GIS), and Global Positioning Systems (GPS) stand out among these. These geospatial technologies process and deliver location information seamlessly, and converge with other digital technologies naturally, including mobile technology, Artificial Intelligence (AI), Machine Learning, Internet of Things (IoT), Autonomous Vehicles (AV), and Robotics.

This convergence represents a disruptive force that is fast transforming local domains and society, from urban management and emergency response, to healthcare and sustainable development. The ability to interconnect people and transactions digitally is multiplied by the expanding location-based data and geospatial analytics. Smart, seamless ways of planning and operations based on location are remodelling processes in businesses and government agencies. The sharp increase in geospatial information, as well as sophisticated processing methods and devices, has produced a quiet revolution². This evolving landscape brings much excitement, and promises limitless opportunities for scientific breakthroughs and improvement of lives. Government, the industry, and society, have arrived at a new paradigm of living and working.

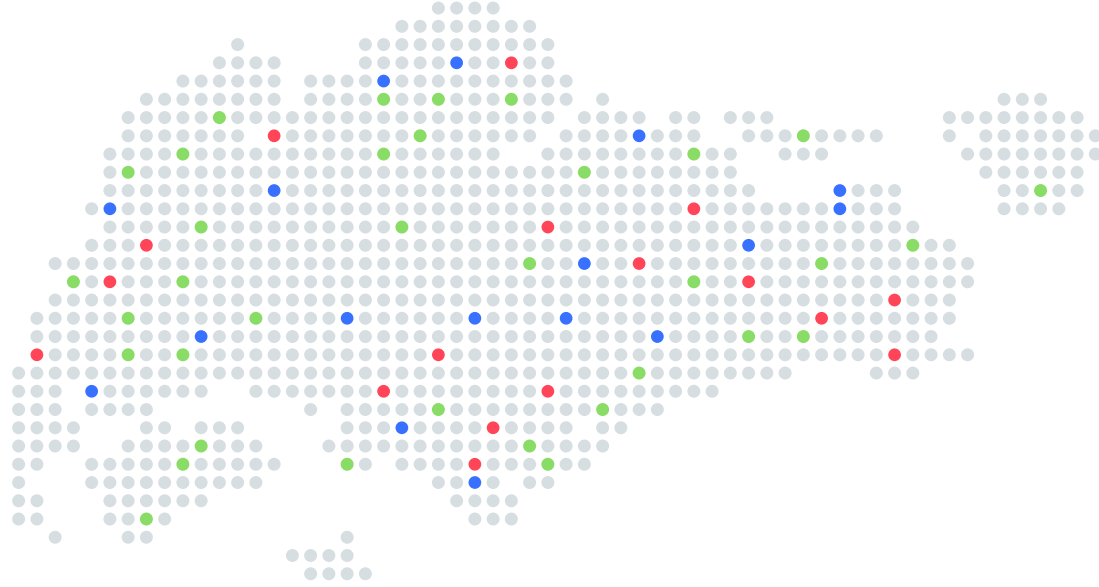
The above trends have attracted growing interest and demand to advance geospatial capabilities and renew our direction for using digital technologies. In order to harness emerging opportunities as a whole of nation, various sectors need to re-assess and rejuvenate strategies for geospatial information and technology. The Singapore Geospatial Master Plan is hence timely to help us make the leap towards creating value geospatially.



¹ United Nations side event "Unleashing the power of "Where" to make the world a better place: How geographic information contributes to achieving the SDGs". 22 April 2015. http://ggim.un.org/docs/Geographic%20Information%20Fact%20Sheet_22%20Apr%202015.pdf

² McKinsey Center for Government. Grant, Razdan, and Shang. 2013. Transforming cities through GIS technology and geospatial analytics. www.mckinsey.com/~/media/~/Singapore/MCG-Transforming%20cities_GIS.ashx

Geospatial Information and Technology: Unlocking New Opportunities for Growth



With location as the common language, geospatial information and technology is highly valuable to the Industry, People and Government for decision-making, service provision and daily living:

Hailing Rides in Real Time

Grab, a ride-sharing company, connects drivers and commuters in real time based on their locations. Using an app, commuters can search for nearby drivers who receive and respond to the commuters' requests for rides on the go.

Intuitive Property Search and Transaction

SRX Property, a Singaporean company, incorporates location-based information and search functions into its property search and transaction portal to enhance service delivery for its customers.

Maximising Value Capture through Location

Starbucks leverages geospatial information, such as consumer demographics, traffic patterns and businesses, to determine optimal locations for its stores. The strategy has enabled Starbucks to locate its stores in close proximity to each other without self-cannibalising sales.

Efficient Fleet Management and Route Planning

Through geospatial technology, UPS identifies the shortest and quickest routes to deliver packages, leading to significant savings in fuel and mileage. It even manages to avoid unnecessary left turns where facing oncoming traffic is more common.

A Thriving GeoIndustry

Growing Closer to Our Natural Heritage

Trees.sg connects citizens to their natural heritage, by providing an online interactive map to discover interesting information about trees in Singapore, such as their species and conservation status, as well as contribute tree photos and flowering sightings.

Improved Social Service Delivery

Food From the Heart, a non-profit charity in Singapore, uses geospatial technology to allocate bread delivery routes to volunteers. By allowing volunteers to visualise these routes and commit to them more readily, Food from the Heart improves the coordination of its delivery operations.

Collective Knowledge from Open Data

The OpenStreetMap project is a crowdsourcing initiative aimed at creating a free, editable global map. Anyone from local governments to citizens and humanitarian organisations can contribute and update community-defined geospatial data. This benefits various applications such as service delivery and disaster rescue.

Cherishing Shared Locations and Memories

The SG Heart Map Tour app allows Singaporeans to discover shared memories of cherished places, based on stories crowdsourced as part of Singapore's 50th birthday celebrations. By detecting users' locations, the app provides interesting information and stories about the places along self-guided trails.

A GeoEmpowered People

Enhanced Municipal Services

The Municipal Services Office's OneService app coordinates the handling of municipal issues among agencies. It offers a one-stop shop for citizens to report and geotag these issues, which can be routed to responsible agencies in the shortest possible time.

Everyone's a Lifesaver

The Singapore Civil Defence Force's myResponder app assists CPR volunteers to locate victims of cardiac arrest or heart attack within their vicinities. This gives them the ability to render first aid to the victims before ambulance arrival.

Location Intelligence for Urban Resilience

In Rio de Janeiro, Brazil, the Rio Operations Centre monitors daily life and manages crises by integrating location information such as weather conditions and traffic flows. This helps the city anticipate solutions and reduce emergency response times, thus minimising risks from events such as floods and traffic accidents.

Integrating Smart City Functions

Incheon, Korea, organises city information and services on the Smart GIS Incheon system, which allows government agencies and the public to use and analyse geospatial data seamlessly. This boosts real-time collaboration in information sharing and city operations monitoring.

A GeoSmart Government

Shifting Global Paradigms in the Geospatial Landscape

Internationally, geospatial information and technology is recognised to be a vital tool for solving global and national issues. Several worldwide programmes lead and promote the management of geospatial information. The United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) is a leading example. It is an inter-governmental effort that coordinates geospatial policies and initiatives, and supports technical and institutional schemes for harnessing critical geospatial information across domains. The UN-GGIM, as well as the outcome document of the Rio+20 United Nations Conference on Sustainable Development, acknowledges the importance of Earth Observation and geospatial data for measuring and monitoring the Sustainable Development Goals³. Such information improve data quality and timeliness for disaster management, climate change and poverty issues.

Various World Bank programmes, such as the City Planning Labs and the Global Platform for Sustainable Cities, help cities share and use geospatial data for sustainable, evidence-based planning as well. Espousing its importance, the World Bank partnered the UN in 2017, to formulate an Integrated Geospatial Framework for countries to develop their National Spatial Data Infrastructures (NSDI), and to implement country-level Action Plans to operationalise the Integrated Geospatial Framework⁴.

In the industry, geospatial information and technology is increasingly recognised as an enabler for making decisions, optimising processes, and generating services for customers. Global market size and value of geospatial solutions and services have grown considerably in recent years, as they interact with key technologies and business workflows in the market. In 2017, the economic value of the cumulative geospatial industry stood at about US\$300 billion, and is projected to reach about US\$439 billion by 2020, growing at a compound annual growth rate (CAGR) of 13.6%⁵. Geospatial services alone drive almost US\$75 billion in revenues in the United States⁶, while that in China stands at about 50 billion yuan⁷.

The above shifts in the global geospatial sector are framed by 4 main components of its value chain. They are Mapping and Remote Sensing; Geospatial Data and Database Management; Geospatial Information System Design, Development and Management; and Geospatial Modeling and Analysis.

The first, Mapping and Remote Sensing, is an important upstream component. It provides the technologies for collecting raw imagery of the Earth's surface for the mapping of forests, land use, and land forms, to name a few. Satellites, aerial photography, drones, and Radar Imaging are common remote sensing tools used to acquire Earth Observation data, which provide near real-time information about the Earth's changing surface conditions. Using the data, mapping experts design, produce and update 2D and 3D maps, which form the base maps of downstream geospatial applications.

Geospatial Data and Database Management governs and structures these base maps. This midstream component oversees the life cycle of the map data and organises them appropriately in databases. Data managers oversee policies and standards that guide the preparation, use and maintenance of the data, as well as metadata documentation. Accordingly, specialists develop databases that optimise data storage and exchange at the same time. This involves designing and reviewing database structures and management systems according to user and system requirements, as well as resolving database performance issues.

Geospatial applications extract value from geospatial data and databases. These applications operate within GIS platforms, which coordinate both front-end user functions and back-end database processes. GIS Design, Development and Management pertains to the planning and operationalisation of GIS platforms. In this component, specialists engineer the conceptualisation, deployment and use of GIS systems and applications; as well as their daily management that includes functionality enhancements, system upgrades and user feedback management. These activities sustain the applications' delivery of insights to users downstream. Geospatial Modeling and Analysis represents this process. Analytics experts build geospatial models that enable applications to manipulate data for decision-making. This allows policymakers, businesses and citizens to visualise and analyse geospatial information for various purposes, such as navigation and tracking, simulation of planning scenarios, and location-based services.

³ United Nations Division for Sustainable Development. (2017). Future We Want – Outcome Document. Retrieved from <https://sustainabledevelopment.un.org/rio20/futurewewant>.
⁴ United Nations Committee of Experts on Global Geospatial Information Management. (2017). Roadmap for Collaboration Between World Bank's Global Practice on Social, Urban and Rural Development and United Nations Statistics Division to Assist Countries to Bridge Geospatial Digital Divide. Retrieved from http://ggim.un.org/ggim_20171012/docs/meetings/GGIM7/UNSD-GSRR%20Roadmap%20for%20Collaboration-July17.pdf.

⁵ Geospatial Media and Communications. 2018. GEOBUIZ: Geospatial Industry Outlook and Readiness report.

⁶ Boston Consulting Group. Geospatial Services: A \$1.6 Trillion Growth Engine for the U.S. Economy. 2012. <https://www.bcg.com/documents/file109372.pdf>

⁷ Zhang, Du and Qiao. 2015. Present State and Trends of the Geoinformation Industry in China. www.mdpi.com/2071-1050/7/3/2871/pdf

The Components of Geospatial Information and Technology

Refers to the collective knowledge, processes, systems and manpower that underpin geospatial information and services.



Mapping and Remote Sensing

Satellites and sensors collect raw imagery of the Earth's surface, which provide near real-time information about the Earth's changing surface conditions. These data are used to produce 2D and 3D base maps for downstream applications.



Geospatial Data and Database Management

Geospatial data management guides activities throughout the data lifecycle, such as data preparation and maintenance, and metadata documentation. Accordingly, specialists develop and review database structures and management systems, as well as resolve database performance issues.



Geospatial Information System Design, Development and Management

Geospatial systems and applications coordinate front-end user functions and back-end database processes. Geospatial specialists engineer the architecture for database updates, system integration and upgrades, as well as user feedback management, in these systems and applications.



Geospatial Modeling and Analysis

Geospatial models and analytics tools deliver insights for decision-making. They allow policymakers and citizens to visualise and analyse geospatial information for various applications, such as navigation and tracking, simulation of planning scenarios, and location-based services.

Trends in Policy and Technology

Various policy and technological trends can be discerned throughout the value chain of the global geospatial sector⁸. Governments are establishing National Spatial Data Infrastructures (NSDIs) to facilitate geospatial data sharing and use across domains and sectors. The tracking and availability of geospatial data from new sources have expanded significantly. Stakeholder roles shift as private companies supply data and resources actively, and citizens share information through crowdsourcing and social media. Governments, on the other hand, are becoming both custodians of information and facilitators of geospatial development. Intelligent machines and cloud-based architecture for integrating and deploying geospatial data across distributed environments have emerged at the same time. The spread of smart devices and sensor-web enabled infrastructures have made digital geospatial information accessible on an exponential scale and in real time. These trends have resulted in a paradigm shift from mere mapping to a wide variety of online and real-time analytics and modeling.

Technology

Emerging digital technologies have transformed the traditional domains of geospatial technology. By enhancing these technologies with its integrative nature, geospatial technology produces powerful applications that accelerates improvements in service quality and living standards. Through these applications, governments are rapidly embracing the “Smart City” agenda, which aims to optimise resources and provide more responsive services to citizens. In this regard, various developments can be discussed.

As geospatial technology ushers in an era of real-time information discovery, it helps us ingest voluminous feeds from a variety of sensors, IoT devices, social media and smartphones. Advancements in online “Big Data” geoanalytics, AI, and “Machine Learning” enhance our ability to make sense of diverse, complex geospatial data

simultaneously. These help us paint a real-time picture of events, which improves situational awareness of events and operations, such as traffic control and infrastructure management.

Geospatial technology is also evolving into a 3D one. This is crucial in helping planners visualise our living environment virtually for modeling and analysis. New data capture technologies, such as aerial and terrestrial Light Detection and Ranging (LIDAR), drones, pictometry, photogrammetry and high-resolution satellite imageries, allow us to produce photo-realistic 3D city models for integrated planning. Other notable geospatial technologies, such as Ground Penetration Radar (GPR), enable the 3D mapping of our underground spaces and utilities for the optimisation of these assets. Similarly, “Indoor Mapping and Positioning” technologies allow us to capture detailed indoor models of buildings. This allows us to perform sophisticated analysis and simulation of our dense urban environment, using variables such as noise propagation, heat dissipation, energy utilisations, and wind circulation. These 3D technologies are critical to the successful adoption of other tools for downstream applications. They provide the input for “Augmented Reality” and “Virtual Reality” programmes, such as remote construction monitoring and safety drills, as well as support the tracking and navigation of AVs and mobile robots.

Furthermore, capabilities in data storage, maintenance and use, support the advancements in analytics. Flexible and usable databases, such as NoSQL and Linked Data, ease the storage and querying of unstructured geospatial data, while cloud computing hosts the large amounts of geospatial data sustainably. Furthermore, open source software and open standards support the rapid set-up of applications and widespread interoperability of geospatial data among diverse users.

Legal and Policy Development

The connected nature of geospatial information demands legal and policy developments. Many cities and countries recognise the economic value of sharing geospatial data with businesses and citizens, leading to the emergence of “Open Data” initiatives globally. On the other hand, issues of privacy, security, quality, proprietorship and funding have grown increasingly complicated with the interlocking of dynamic geospatial datasets. Ensuring accountability has become a challenge for many decision-makers. Metadata documentation and standards compliance are recognised to be critical policy components in addressing these issues. Legislative measures are also increasingly crucial for balancing security and access.

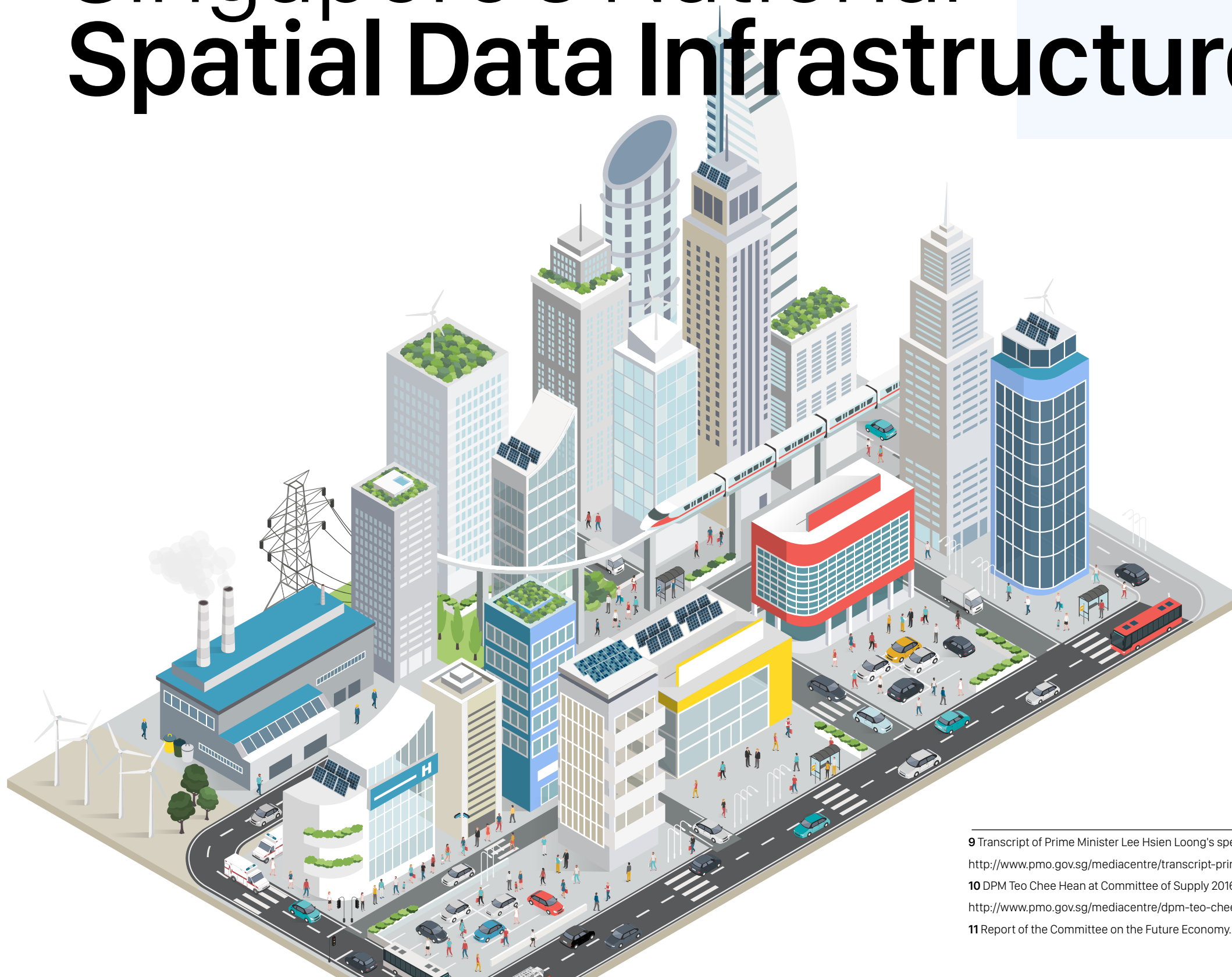
Skills Requirements

In order to ensure effective and responsible data use, NSDIs have identified capacity building as a core policy area. Investments in formal training schemes have grown to equip professionals with technical skills in data acquisition, production and analysis. These engagements complement rising academic offerings in geospatial science at the tertiary and secondary education levels. More importantly, geospatial awareness is growing within the broader communities of developers and users.

⁸ Norris, J. (2015). UN-GGIM Future Trends in Geospatial Information Management: the Five to Ten Year Vision. Second edition, December 2015. Retrieved from <http://ggim.un.org/knowledgebase/Attachment1311.aspx?AttachmentType=1>.



Singapore's National Spatial Data Infrastructure



Singapore's National Spatial Data Infrastructure (NSDI), or Geospatial Singapore, is our national programme that drives and coordinates geospatial activity across sectors. Previously known as the Singapore Geospatial Collaborative Environment or SG-SPACE, Singapore's NSDI was set up in 2008 and forms the mechanism through which technologies, policies, and human resources operate to manage and use geospatial data. Co-driven by SLA and GovTech, Geospatial Singapore or in short, GeospatialSG is led by a Working Committee that oversees various technical working groups, and is represented by more than 30 agencies. The GeospatialSG Working Committee (WC) reports to the Government Data Steering Committee (GDSC) under the Smart Nation Digital Government Office (SNDGO). The industry, community and government are GeospatialSG's key pillars. GeospatialSG has built the foundation for today's geospatial institutional arrangements, data policies and standards, as well as technology and applications.

The reconceptualisation from SG-SPACE to GeospatialSG reflects the important role that geospatial information and technology plays in supporting and realising Singapore's Smart Nation objectives. Our Smart Nation vision is to make Singapore an economically competitive global city and a liveable home through connected technologies⁹. It recognises the importance of geospatial information and technology for enabling informed decisions and facilitating meaningful interactions. To reinforce our Smart Nation goal, the Public Service launched plans to rebuild its engineering capabilities, and establish Centres of Excellence for critical knowledge clusters. Deputy Prime Minister Teo Chee Hean affirmed that geospatial information and technology would be one of these clusters, alongside data science and cybersecurity¹⁰.

Yet, in February 2017, the Committee on the Future Economy (CFE) committed to capability-building and technological development in the local economy. This involves strategies to acquire deep skills, strengthen digital capabilities, build enterprise capabilities, and enhance partnerships for innovation and growth¹¹. GeospatialSG will support these strategies by building a national geospatial ecosystem for innovation and collaboration, as well as deepening geospatial skills through capacity building and training.

⁹ Transcript of Prime Minister Lee Hsien Loong's speech at Smart Nation launch on 24 November 2014. Retrieved from <http://www.pmo.gov.sg/mediacentre/transcript-prime-minister-lee-hsien-loongs-speech-smart-nation-launch-24-november>

¹⁰ DPM Teo Chee Hean at Committee of Supply 2016 on 13 April 2016. Retrieved from <http://www.pmo.gov.sg/mediacentre/dpm-teo-chee-hean-committee-supply-2016-13-april-2016>.

¹¹ Report of the Committee on the Future Economy. 2017. Retrieved from https://www.gov.sg/~/-/media/cfe/downloads/mtis_full%20report.pdf.



Baseline Assessment of GeospatialSG

An assessment of GeospatialSG’s progress and achievements forms the basis of the Singapore Geospatial Master Plan. 3 aspects are crucial: Policy, Data and Institutions; Capacity and Adoption; as well as Platform and Technology. While GeospatialSG exhibits strong foundation in these aspects, we recognise the need for leapfrogging into a next-generation geospatial ecosystem. Opportunities exist to deepen our technological capabilities for meeting emerging response needs related to 3D and dynamic geospatial data, as well as support ongoing Operations and Technology integration initiatives within the government. Programmes for heightening capacity through workforce and academic engagements have room for expansion too. Our Institutes of Higher Learning and professional development schemes need to offer more geospatial courses, while our geospatial enterprise ecosystem needs greater vibrancy across products and services. In addition, further efforts to scale up the local geospatial industry and penetrate new user domains are needed for Singapore to realise global opportunities effectively.

Policy, Data and Institutions

Robust institutional structures for implementation are well-defined among key stakeholder agencies. Specifically, the GDSC, GeospatialSG WC, and their respective working groups, provide a

well-institutionalised structure for inter-agency coordination. This has facilitated extensive discourse and collaboration for building an active data-sharing landscape. One result is the ISO standardisation of fundamental geospatial datasets across key domains. This supports widespread data interoperability for applications, such as ongoing underground geospatial information management and 3D modeling. In addition, more than 1,300 data layers are shared within the government, and about 100 thematic data layers are shared with the public through our data-sharing portals today. Other outcomes are a Data Request Mechanism to make available datasets in the government; a data access framework that balances accessibility with security; as well as a “Geotag by Default” policy to mandate the collection of location attributes for government datasets.

Platform and Technology

GeospatialSG’s technology and platforms have enabled the effective operation of data policies and wider data sharing. Both GeoSpace and OneMap, our central data-sharing portals for the government and public respectively, have matured as one-stop shops for authoritative, updated geospatial data. On top of promoting data availability, the portals cater to users’ information needs through

GeoCommunities and services. These specialised features promote data discovery and analysis for decision-making. GeoSpace’s GeoCommunities support agencies’ collaboration in information exchange and modeling within target domains. Examples of these GeoCommunities are those related to management of slope failure and coordination of Unmanned Aerial Vehicles flight path requirements. OneMap’s services engage citizens in daily geospatial visualisation for meeting localised needs. These include the ‘School Query’ and ‘Population Query’ functions, which allow discovery of demographic parameters and nearby services on various levels of aggregation.

Nevertheless, further needs for higher-precision and processing capabilities are arising. Our platforms require enhancements to support large volumes of high-resolution data for work and daily processes. The Virtual Singapore (VSg) platform is being developed to transition our data-sharing portals to a 3D data-sharing environment. At the same time, integrated tools and processes are being introduced to maximise efficiency and insight. These include the New OneMap, and the incorporation of new functions into GeoSpace, such as real-time access to targeted data sources and big data analytics, and a suite of geospatial productivity tools

for public service officers.

Capacity and Adoption

Various manpower efforts, outreach events and educational initiatives, demonstrate GeospatialSG’s commitment to planting geospatial know-how throughout sectors. The Central Geospatial Expert Service team supports government officers to conduct geoanalytics pilot projects. Our GeoFund and GeoInnovation Fund schemes extend these efforts by sponsoring longer-term geospatial projects in the government and private sector respectively. Our Singapore Geospatial Challenges and GeoHackathons cultivate interest and awareness among students and citizens too. Young adults increasingly receive coursework exposure to the geospatial field through partnerships with the National University of Singapore (NUS)’s Master of Science in Applied GIS programme, and Nanyang Polytechnic’s Geospatial and Mobile Innovation specialisation track. Nevertheless, geospatial capacity and adoption remain limited in scale, and outcomes mainly dwell within the awareness level among the wider community. Much opportunity remains for capability-building efforts to be strengthened through wider academic and workforce engagements.

Envisioning a Geospatial-Powered Singapore

The trends and opportunities discussed in the earlier chapters reveal the timely need for the Singapore Geospatial Master Plan. SLA and GovTech held 9 consultation sessions with government agencies, the industry, non-governmental organisations, and academia. In total, more than 190 representatives from 110 agencies and organisations participated in the sessions. These were conducted in the form of a visioning exercise, which articulated broad outcomes and strategies; and roundtable discussions, which facilitated deeper conversations around needs and opportunities. From the consultation outcomes, 13 initiatives were developed to address the key need and gaps in geospatial development across sectors.

Our vision for the Singapore Geospatial Master Plan is to create a 'Geospatial-Powered Singapore'. This captures the pervasive partnerships and solid grounding of geospatial elements across sectors. Geospatial information and technology needs to form the core of how we operate and make decisions, in order for us to be a full-fledged information society. In accordance with the challenges and trends discussed earlier, 3 strategic pillars frame our Master Plan. These are a: 1) Thriving GeoIndustry, 2) Nation of GeoEmpowered People, and a 3) GeoSmart Government.

VISION

A Geospatial-Powered Singapore

Empowering the Industry, People and Government with Geospatial Information and Technology to Enhance Decision-Making, Create Opportunities and Lead Better Lives

A THRIVING
GEOINDUSTRY

Singapore as the GeoHub of the region with wider adoption and a vibrant enterprise ecosystem

A NATION OF
GEOEMPOWERED PEOPLE

A geospatially-savvy population and competent workforce for increased productivity and better lives

A GEOSMART
GOVERNMENT

An effective and trusted public service driven by geo-enabled processes in policy-making, planning and operations

Expected Outcomes

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|--|--|--|
| <ol style="list-style-type: none">1. Businesses in targeted sectors use geospatial information and analytics in decision-making and services2. Deep GeoTech businesses and R&D established3. MNCs, SMEs and startups thrive in an environment brimming with geoinnovation, capital and opportunities | <ol style="list-style-type: none">1. Workforce in the public and targeted sectors equipped with geospatial skills and competencies2. Steady supply of local and overseas talent3. Widespread access to location apps and services, improving convenience and decision-making | <ol style="list-style-type: none">1. Better policy decisions and services delivery enabled by geospatial information and analytics2. Greater productivity and savings achieved through avoidance of duplicated resources and data collection3. Data-rich environment, supported by a robust policy environment enabling data sharing and accessibility |
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Strategies

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| <ul style="list-style-type: none">• Promote the use of geospatial information and analytics in targeted business sectors• Drive geospatial-based businesses and start-ups actively• Create an environment brimming with geospatial innovation, investment and talent | <ul style="list-style-type: none">• Build an entrepreneurial and skilled workforce with geospatial capabilities• Open multiple channels of diverse geospatial learning• Nurture an active community of geospatial adopters | <ul style="list-style-type: none">• Leverage geospatial technology in decision-making and service delivery• Foster a collaborative environment that nurtures geospatial research and innovation• Create a conducive data policy environment |
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Initiatives

GeoWorks

Develops an industry centre to foster a vibrant geospatial ecosystem, promoting business growth, innovation and fostering a well-connected geospatial community

- Geospatial Industry Schemes
- Geospatial Marketplace
- Geospatial Industry Network

Geospatial Engagement and Lifelong Education

Introduces geospatial educational and training programmes to build awareness and proficiency at all levels

- Geospatial Workforce Training Schemes
- Community of Geospatial Interest Groups
- New OneMap

Geospatial Capability Centre and Virtual Singapore

Provides agencies professional expertise, resourcing strategies, R&D, and a central 3D platform

- Geospatial Productivity Suite
- Geospatial Technology Alliance
- Geospatial Policy Best Practices



A Thriving GeoIndustry

The entrepreneurial spirit and financial capacity of the industry plays an important role in generating geospatial activity and supporting the government's sector-specific Industry Transformation Maps. Building Singapore into a regional GeoHub with a vibrant enterprise ecosystem and high adoption in key sectors is the main outcome of a Thriving GeoIndustry. This includes the proliferation of geospatial information and analytics among businesses in target sectors for decision-making and operations. Examples of these target sectors include logistics/transportation, retail and real estate. The establishment of businesses and research in deep geospatial technologies, such as indoor positioning, remote sensing and 3D modeling, is also an important aim. On the other hand, an innovative environment for these activities to flourish is essential. A diverse ecosystem of geospatial start-ups, small and medium-sized enterprises (SMEs), and multi-national corporations, is needed to drive applications and investments.

3 strategies are key to developing a Thriving GeoIndustry: a) Promote the use of geospatial information and analytics in targeted business sectors; b) Drive geospatial-based businesses and start-ups actively; and c) Create an environment brimming with geospatial innovation, capital and business opportunities. These strategies will be operationalised by 4 initiatives, spearheaded by GeoWorks, an industry centre set up by SLA to foster a vibrant geospatial ecosystem in Singapore and for the region.

4.1.1 GeoWorks: Building a Geospatial Industry Centre to Foster a Vibrant Ecosystem

GeoWorks is a geospatial industry centre aimed at fostering a vibrant geospatial ecosystem in Singapore and for the region. It brings together geospatial companies, corporate users of geospatial technology, academia and government agencies to promote business growth, drive innovation and foster a well-connected geospatial community. GeoWorks aims to grow the local geospatial industry and sectoral digitalisation by facilitating business events and networks, providing outreach and resources, and matching solution providers with clients through GeoChallenges. SLA and other government agencies will play a facilitative role in contributing data, expertise, problem statements, and access to other networks and global opportunities. By collaborating closely with the industry and users, GeoWorks enables us to better understand the data needs from the industry and share high-value datasets with the wider community. These collaborations will jumpstart much-needed innovation and

growth for a digital economy.

More specifically, GeoWorks will curate and facilitate programmes for industry partners and geospatial companies, through Partner Events, thematic GeoChallenges and the GeoInnovation Programme for start-ups. First, Partner Events will be organised to bring together users of geospatial technology with geospatial companies to discover new collaborations and business opportunities. Second, GeoChallenges such as competitions and international challenges, will be held where participating start-ups, SMEs and larger geospatial companies can build prototypes to address industry challenge statements. Government agencies can also contribute challenge statements to test solutions and unlock insights related to Singapore's challenges. Third, the GeoInnovation Programme, which will be co-developed by SLA and the Action Community for Entrepreneurship will provide budding geospatial start-ups resources to scale up their solutions.

These resources include coaching and mentorship, networking, and business opportunities. SLA will also provide access to geospatial data and expertise, and software and tools, in a shared geospatial laboratory. Start-ups in deep technologies such as location intelligence/AI, navigation and positioning, and 3D, will be represented, and have opportunities to pitch their Minimum Viable Products (MVPs) on Demo Days to potential users and investors. Through these programmes, GeoWorks plays an important role in anchoring home-grown talents and boosting business opportunities for a thriving GeoIndustry.

4.1.2 Geospatial Industry Schemes: Supporting Adoption and Growth Through Incentive and Funding Schemes

The Geospatial Industry Schemes will drive local geospatial entrepreneurship, adoption and long-term growth through targeted incentive and funding programmes. These schemes will tap existing programmes from our economic agencies, and will be implemented through 3 tracks: 1) Support for Start-ups, 2) Geo-adoption for SMEs, and 3) Geospatial Companies. The first will offer geospatial start-ups mentorship and support to develop business ideas. This track focuses on ideas relating to deep geospatial technologies, such as 3D, remote sensing, indoor positioning and geospatial analytics. In this track, promising start-ups receive support from GeoWorks, or where applicable, receive capital grant and seed funding from Enterprise



Singapore's funding programmes, such as the Startup SG Founder, Startup SG Tech, and Startup SG Equity programmes.

The second track aims to encourage geospatial adoption in SMEs. The target SMEs for this track are those in relatively mature sectors, such as logistics, transportation and retail, which have potential to leverage geospatial technologies for the next phase of growth. IMDA's Go Digital Programme offers a structured programme to help these SMEs assimilate location-based technologies into their processes to improve productivity. This involves identifying and inventorising the SMEs' stages of digitalisation, and facilitating geospatial digital solutions and advisory services for them accordingly. Enterprise Singapore's Capability Development Grant will be available to support the adoption of targeted solutions and services.

The third track focuses on attracting emerging foreign geospatial companies with deep geospatial technologies to the local geospatial industry, in order to bring in long-term innovation and value-added capabilities. SLA will collaborate with economic agencies to identify potential companies, and tap existing grants and incentive schemes to enlarge their operations locally and regionally. This is critical to anchor

Singapore as a regional GeoHub.

4.1.3 Geospatial Marketplace: Facilitating Data Sharing & Data-Driven Innovation Across Sectors

The Geospatial Marketplace initiative will provide a trusted platform for data and services exchange, among the government, private sector and academia in the geospatial community. This acts as a space for collaborators to discuss data requirements for common use cases, and match supply and demand for data availability. The Geospatial Marketplace will help both private and public sectors to exploit their datasets further to create new applications, products and services.

A Proof-of-Concept will first be conducted to test actual data exchange based on industry needs. The initial concept will then be scaled up to a full-fledged Geospatial Marketplace. Eventually, the Marketplace will facilitate wider exchange of data, services, and applications, for industry-wide needs and large-scale collaboration across sectors. Such an arrangement will stimulate the availability of high-quality, timely and interoperable data for innovation. SLA will also work with IMDA's Data Innovation Programme Office to explore how companies can better leverage the Geospatial Marketplace for data-driven innovation.

4.1.4 Geospatial Industry Network: Connecting Professionals Around Shared Interests and Opportunities

The Geospatial Industry Network will connect geospatial professionals for collaboration and industry promotion. This is a platform for the discovery of shared objectives and advancement of opportunities within and across domains. GeoWorks' events and activities, such as workshops and networking sessions, will foster initial links among industry players. Over time, as the pool of core participants grow, potential champions could lean in to lead the formation of a Geospatial Industry Network. Through familiarity with key trends, these champions are critical in driving industry interests and establishing strategic contact with partners and resources. The Geospatial Industry Network will then underpin various professional and outreach activities, such as seminars and workshops, as well as interface the private sector with potential job-seekers. By this time, the Geospatial Industry Network will be wholly industry-driven with diverse representation of geospatial business pursuits, and sustained commitment towards growth.

Initiatives for a Nation of GeoEmpowered People



Singaporeans form the lifeblood of the local geospatial sector. A competent workforce and geospatially-savvy population are fundamental outcomes of a Nation of GeoEmpowered People. Specifically, education, workforce development, and accessibility to geospatial tools, are important aspects of these outcomes. These aspects involve building a steady supply of graduates with deep skills in the government and industry, engaging citizens at all levels of education, and achieving widespread availability of everyday geospatial applications and services.

3 strategies are key to shaping a GeoEmpowered population: a) Open multiple channels of diverse geospatial learning; b) Build an entrepreneurial and skilled workforce with geospatial capabilities; and c) Nurture an active community of geospatial adopters. These strategies will be operationalised by 4 initiatives, which are underpinned by the New OneMap discovery and data-sharing platform, as well as Geospatial Engagement and Lifelong Education programmes that will cultivate geospatial learning across levels comprehensively.



4.2.1 New OneMap: Citizen Platform for Exploring and Sharing Geospatial Information

On the ground, communities are the foundation for geospatial adoption to take root meaningfully. Our New OneMap can foster such ground-up adoption. It will be an interconnected, agile portal for the collective exploration and co-creation of geospatial information. Through this platform, Singaporeans will be able to access detailed and authoritative map content, which are customised to their daily contexts. Examples are the Multi-modal Journey Planner, and the School Query functions. The Multi-modal Journey Planner will not only deliver public transportation options for point-to-point travels, but also walking routes through covered walkways and HDB blocks' void decks. Furthermore, the 'School Query' function will allow parents to search for potential schools for their children within specific radii of their homes, as part of the local school registration process. The New OneMap also offers Application Programme Interfaces (APIs) for citizens and developers to discover data for daily decision-making and create value-added products. These offerings will empower citizens with improved access to location data and applications, and provide daily convenience.



4.2.2 Geospatial Engagement and Lifelong Education Programmes: Providing Multiple Pathways for Geospatial Training

Geospatial Engagement and Lifelong Education programmes will engage students at various educational levels according to their learning needs. At the primary and secondary levels, schools will immerse students in geospatial concepts through interactive, project-based activities. This will help students explore and appreciate varied uses of geospatial tools, as well as apply them to real-world scenarios across disciplines. These programmes include the Geospatial Young Scientist Badge, which will be awarded to students upon completion of geospatially-focused quizzes and activities; and the Geospatial Applied Learning Programme, which will enable students to solve problems geospatially through critical thinking and inquiry-based learning.

Next, geospatial modules and electives will be incorporated into Institute of Higher Learning courses. Here, the focus shifts to specialised and advanced knowledge areas. Geospatial-related courses, such as those in business, ICT and engineering, will add tracks that allow students to grasp geospatial application within these domains. Beyond academia, geospatial engagement will extend to the working world too. Outreach and training opportunities can be packaged to give professionals modularised geospatial skills for their jobs. These can come under continuing education programmes, such as SkillsFuture and Silver InfoComm, which give employees access to diverse, flexible courses.

4.2.3 Geospatial Workforce Training Schemes: Building Manpower Competencies through Conversion and Re-skilling Courses

Through the Geospatial Workforce Training Schemes, a wide range of conversion and re-skilling courses will groom professionals to build geospatial careers in collaboration with Institutes of Higher Learning and the wider industry. A foundational Geospatial Competency Frame-

work will articulate key knowledge and skills for defining industry training requirements. Accordingly, different courses will be designed for trainees' varying geospatial proficiency levels and job functions. These courses will cater to corresponding geospatial job opportunities, and provide possible certification of course graduates who attain qualifications in specific competencies. An online portal will be set up to publicise the courses to potential trainees as well. The Schemes will ensure ready availability of well-trained geospatial professionals, and nimble adaptation to labour needs.

4.2.4 Community of Geospatial Interest Groups: Achieving Vibrant Participation through Ground-up Initiatives

Building a community of geospatial interest groups involves organising networks of active citizen participation in grassroots geospatial activities. In these networks, passionate individuals are needed to champion opportunities for enhanced geospatial use in everyday causes. These individuals will be identified through initial activities, such as talks and networking sessions, which aim to encourage ideas about geospatial information and technology in different circles. Emerging community leaders and topics will anchor the formation of focused interest groups. Larger commitments, such as knowledge sharing sessions and hackathons, can then benefit from the wider connections and resources gained.



Initiatives for a GeoSmart Government

A key outcome of a GeoSmart Government is an effective Public Service driven by geo-enabled processes. Government use of geospatial data and analytics to make sharper decisions and deliver better services is a key goal. This is supported by further goals to achieve more efficient workflows and information infrastructure. These include higher productivity and cost savings in geospatial data processes, and a data-rich environment that links producers and users of geospatial data through reliable information ‘highways’. Robust policies that enable data collection, sharing and accessibility represent these aims.

3 strategies are key to building a GeoSmart Government: a) Leverage geospatial technology in decision-making and service delivery; b) Foster a collaborative environment that nurtures geospatial research and innovation; and c) Create a conducive data policy environment. These strategies will be operationalised by 5 initiatives, of which the Geospatial Capability Centre and the VSg platform are vital to driving expertise and technological capabilities.

4.3.1 Geospatial Capability Centre: Deepening Geospatial Capabilities Across the Public Sector

Emerging smart and connected technologies are a huge force in optimising processes. The Geospatial Capability Centre is one important initiative to build capabilities in using geospatial technology for public decision-making. Spearheaded by SLA, the Geospatial Capability Centre will be an expert pool that provide agencies with professional expertise and resources for conducting geospatial projects. This will involve professional services for fulfilling government-wide needs, such as geospatial demand aggregation and project prioritisation. At the agency level, the Geospatial Capability Centre will advise on corporate needs for project goal formulation, resourcing strategies and project implementation. These efforts will be developed within the 4 core components of geospatial information and technology, i.e. Mapping and Remote Sensing; Geospatial Data and Database Management; Geospatial Information System Design, Development and Management; and Geospatial Modeling and Analysis. Specialised skills will be dedicated to each component for maximum effectiveness in solutions delivery.

In the long term, targeted programmes for training, talent development and R&D are planned. This includes tailoring competency strategies to agencies’ human resource needs, and identifying emerging

technologies for strategic adoption in the Public Service. Over time, the Geospatial Capability Centre’s engagement with agencies will shift from consultation to co-creation and capacity building. Through this process, officers will not only be equipped to conduct projects independently, but also appreciate the realised benefits of geospatial technology. The build-up of know-how and adoption can then follow.

4.3.2 Virtual Singapore: 3D City Modeling Platform for Precise Planning and Simulation

Growth in geospatial proficiency and awareness has to be matched by higher technological capabilities. As part of the Smart Nation initiative, the VSg platform will provide one-stop access to high-resolution 3D geospatial data for precise planning, modeling and simulation. This will take place within a rich virtual environment of Singapore’s cityscape, which combines 360-degree views with real-time information and semantically-enriched details about the texture and geometry of city objects. Using these data, agencies will be able to perform advanced analytics and develop solutions for sectors such as urban planning, environmental management and homeland security. For example, fine-grained information about buildings’ surface materials and land cover will help agencies analyse noise propagation or heat island effect in a complex urban environment. Solar potential analysis will also take place more accurately using 3D information such as roof angle and amount of shadow cast by surrounding buildings.

In addition, the VSg platform promotes collaboration and knowledge-sharing across agencies, businesses, citizens and researchers. Its versatile functionality supports virtual experimentation and decision-making through multiple urban scales and perspectives simultaneously. Various users will be able to derive insights by creating realistic visual models and large-scale scenarios of Singapore collaboratively. For instance, multiple agencies will be able to coordinate requirements when planning drone flight paths or infrastructural works, in a 3D digital space. Community decision-making between government agencies and the public will also benefit from the VSg platform. This will take place through geo-tagged plans and feedback about communal amenities or neighbourhood upgrades. By aiding seamless information sharing and processing, the VSg platform will meet multi-sectoral needs for an integrative and collaborative tool.



4.3.3 Geospatial Productivity Suite: Offering Convenient Tools and Resources for Analysis

The Geospatial Productivity Suite aims to provide public officers with user-friendly and practical tools to conduct analysis with geospatial data, as well as centralised resources for the wider implementation of geospatial technology. In particular, the GeoSpace Analytics Suite will be a consolidated toolkit that presents a ready set of functions for geospatial analysis and modeling. The functions include one-stop access to GeoSpace data, guided templates for visualising and investigating spatial patterns, and Do-It-Yourself mapping tools for representing findings in a comprehensible way. The functions will be offered through an end-to-end service in the GeoSpace intranet environment, which guides users through entire workflows, from online workspace management and selection of analysis methodology, to delivery of results and sharing of workflows. Officers will also be able to create project groups for sharing their findings. The Geospatial Productivity Suite enables officers to host and design projects conveniently according to specific work requirements. This will not only streamline work processes, but also raise officers’ capabilities for making informed policy decisions using geospatial information in the long term.

Another feature in the Geospatial Productivity Suite is the GeoExcel software for geo-coding data, or in other words, attach location reference to data. It will assist users to convert tabular data from Excel spreadsheets into maps, which can then be exported to other programmes for further analysis. This will be useful for increasing the availability of geospatial data within the government. Other offerings of the Geospatial Productivity Suite focus on supporting knowledge, funding and procurement services. These include a comprehensive playbook for the set-up of geospatial systems, and assistance in calling for bulk tenders.

4.3.4 Geospatial Technology Alliance: Forging Networks for R&D and Technology Adoption

In addition to technological infrastructures, a GeoSmart Government needs a structured environment for constant growth and renewal. A Geospatial Technology Alliance will consolidate strategic linkages between the government, academia and businesses for leading research in future-oriented geospatial technologies and driving their adoption. This will be a collaborative network of local and overseas research institutes and Institutes of Higher Learning. The Geospatial Technology Alliance will be a focal point for like-minded researchers to formulate common agendas, and monitor their implementation and progress in a concerted way. Specifically, this initiative will enable a GeoSmart Government to investigate trends, test-bed solutions, and share perspectives across key partners, in target cutting-edge technologies. They include underground geospatial information, 3D modeling, indoor positioning, remote sensing, and real-time analytics. This will help us achieve better use of geospatial information, and operationalise new technologies for planning and service delivery.

4.3.5 Global Policy Best Practices: Reviewing Leading Data Policies and Legal Frameworks

A policy environment that promotes leading practices in data governance and management is crucial in exploiting geospatial information for decision-making. In order to build an effective data ecosystem, we need parity with global best practices. A regular, concerted effort will be undertaken to review adopted geospatial data policies and laws, according to leading developments around the world. This will stretch across data management domains, from collection and standards, to licensing and privacy.



Conclusion

Geospatial information and technology is critical to our social and economic development as Singapore continues her journey to becoming a Smart Nation. Higher awareness of the value of geospatial information for problem-solving, growing widespread means to contribute and use geospatial information, and stronger analytics and processing capabilities, have led to new information needs and stakeholder dynamics. This has pervasive effects on the local geospatial sector. To ensure continued relevance, Singapore needs to expand its technological capabilities, and engage all sectors in data sharing and usage more inclusively and extensively. The Singapore Geospatial Master Plan is hence timely for re-positioning our strategies for proliferating geospatial development. Our renewed strategies are crucial to achieving the broad networks and deep insights needed to overcome our challenges.

We conducted a series of stakeholder consultation sessions that informed our vision, outcomes and strategies, and identified opportunities for the Singapore Geospatial Master Plan. Our vision of ‘A Geospatial-Powered Singapore’ reflects our target of a smart society and economy driven by geospatial information and technology through a whole-of-nation approach. The Master Plan proposes 3 strategic outcomes of the vision: 1) A Thriving GeoIndustry, 2) A Nation of GeoEmpowered People, and 3) A GeoSmart Government. These represent the main pillars of geospatial development. 13 initiatives have been identified to achieve the strategic outcomes.

The industry offers vibrant sources of capital and entrepreneurial drive. Achieving thriving geospatial adoption in target business sectors and an innovative enterprise ecosystem are key to the Singapore Geospatial Master Plan. Both start-ups and established corporations alike will underpin growth in innovation and opportunities. GeoWorks provides a central mechanism to cultivate the geospatial ecosystem by promoting business opportunities, driving innovation and fostering a well-connected community. Next, citizens form the heart of the local geospatial sector, and empowering them with geospatial skills through multiple channels of learning and access to applications and services, is essential to

building ‘A Geospatial-Powered Singapore’. Channels and platforms for education and engagement will grow geospatial talent and community adopters. Examples are the New OneMap platform and Geospatial Engagement and Lifelong Education programmes, which will offer widespread access to geospatial information and services for exploration and co-creation, and opportunities for geospatial learning and professional training at various educational levels.

On the other hand, geo-enabling government agencies’ workflows and information ‘highways’ is critical to promoting smart decisions and efficient citizen service delivery. Leveraging technology, and nurturing collaboration through conducive policy and research environments, form fundamental approaches to our aims. The Geospatial Capability Centre will build capabilities in the government through a central professional service, which will transfer knowledge and project expertise, and provide resourcing strategies. Virtual Singapore, our national 3D platform will provide collaborative tools for geospatial visualisation, analysis and simulation, in order to enable better decision-making and co-creation of solutions. Through these initiatives, we aim to chart a new path of solving problems geospatially and grow opportunities in an evolving digital landscape.

The Singapore Geospatial Master Plan marks the beginning of a transformation process. The geospatial sector will be well-positioned to contribute even more substantively to Singapore’s economic growth and Smart Nation objectives. The Master Plan is a living document and it will evolve according to changing trends, disruptive innovations and new ideas. We invite all stakeholders from public agencies, businesses, academia and the wider community to continuously share with us your ideas and participate in accelerating the growth of the geospatial sector. Collectively, we can address the exciting challenges ahead and maximise the value and impact of geospatial information and technology across Singapore’s economy and our broader society.



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GeospatialSG Working Committee

Singapore Land Authority
Government Technology Agency
Accounting and Corporate Regulatory Authority
Building and Construction Authority
Central Provident Fund Board
Department of Statistics
Energy Market Authority
Housing and Development Board
Inland Revenue Authority of Singapore
Land Transport Authority
Ministry of Culture, Community and Youth
Ministry of Home Affairs
Ministry of Defence
Ministry of Health
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