
Municipal Spatial Data Infrastructure



City Planning Labs

The last decade has witnessed an urban data revolution, as cities internationally have started mobilizing geospatial data to harness the potential of urbanization and address its challenges.

City Planning Labs (CPL) is a Technical Assistance program of the World Bank, which aims to enhance the technical and institutional capacity of municipal governments to produce, share, and utilize geospatial data for evidence-led urban planning. The foundation of CPL includes the establishment of a robust and innovative **Municipal Spatial Data Infrastructure (MSDI)** platform. An MSDI ensures the sustainability of geospatial innovations being introduced, and is being pioneered by partner cities in Indonesia. In addition, agile and adaptable **Urban Planning Tools** are aimed at empowering cities to make informed decisions to improve the quality of life of their residents.

CPL's approach is aligned with the **World Bank's Build, Boost and Broker framework** as it Builds critical municipal spatial data foundations and institutionalizes them; Boosts their capacity to utilize information for evidence driven planning, and; Brokers the relationships between city governments and the private sector to leverage innovation in technology.

Municipal Spatial Data Infrastructure

Municipal Spatial Data Infrastructure (MSDI) is the platform that facilitates the organization, sharing and utilization of geospatial information to tackle the challenges to achieve sustainable urban development. It is the cornerstone of any strategy for cities aspiring to embrace digital transformation and for the long-term success of smart city initiatives.

Clear action plans for MSDI operationalization i.e., **MSDI Roadmaps**, have been developed by CPL partner cities using a **four-pillar IPDS framework**. IPDS pillars correspond to **Institutional Arrangements** (local regulations and data governance protocols), **People** (competency frameworks and skill development), **Data** (collection, processing, management, utilization, and data driven tools), and **Systems** (Integrated Data Platform i.e., Geoportal).

This comprehensive IPDS framework enables **governance and regulatory innovations** to go hand in hand with technological solutions, and also takes into account the importance of human resources to strengthen data foundations. The IPDS framework is **agile, flexible, and scalable to cities with varying levels of capacity within Indonesia and globally**.



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Gayatri Singh, Task Team Leader – gsingh9@worldbank.org Seetha Raghupathy – sraghupathy@worldbank.org
Champaka Rajagopal – crajagopal@worldbank.org Aurora Dias Lokita – alokita@worldbank.org Tony Hartanto Widjarnarso – twidjarnarso@worldbank.org Irene Arifin – ikarifin@gmail.com Rebekka Hutabarat – rhutabarat@worldbank.org

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“In the 21st
Century,
data is
infrastructure.”

– National Infrastructure Commission, United Kingdom

Municipal Spatial Data Infrastructure

Building foundations for smarter, sustainable cities

Geospatial Data as the Cornerstone for Urban Planning

Cities today are increasingly utilizing the power of geospatial data to leverage the positive impacts of urbanization. The unprecedented creation and dissemination of data is a driver of growth and change, and a key resource for social and economic development. Geographical references provide constant information to help with daily decision-making. At the city level, mapping urban services together with population distribution and movement patterns enables decision-makers to harness insights to support evidence-led planning.

Geospatial Data: Making it Possible To Do More With Less

Adding digital intelligence to urban service delivery systems makes it possible for governments to do more with less. The use of geospatial information is known to have clear, tangible benefits for the socio-economic growth of countries, not only by driving public sector cost savings, but also by generating revenues and multiplier effects for the economy and providing jobs. These benefits cannot be achieved without strong spatial data infrastructure that is technologically robust, agile, and institutionally grounded.

Spatial Data Infrastructure (SDI)

SDI functions as the platform by which geospatial information can be organized, shared and leveraged to tackle the many challenges of sustainable development. Human, legal and technical aspects are an integral part of the SDI framework, which is rapidly gaining importance as a strategic investment for governments to support coordinated data driven planning efforts.

At the national level, the establishment of a National Spatial Data Infrastructure (NSDI) with policies and frameworks has been recognized as an effective vehicle for facilitating seamless data development, information sharing, and collaborative decision making across multiple sectors of the economy. Many national governments, including the Government of Indonesia where the CPL initiative has advanced, have an overarching NSDI in place. Implementation varies across countries, however in many cases, NSDI has remained at the policy level. Despite the usefulness of an overarching national mandate, efforts to develop SDI at the national level are not sufficient for addressing bottlenecks to data informed decision-making at the city level. With dynamic forces of urbanization and rapid uptake of geospatial data and technology, cities are ideally placed to become SDI champions. Against this backdrop, the World Bank's CPL initiative is committed to supporting city governments to develop and operationalize the much-needed Municipal Spatial Data Infrastructure (MSDI).

This booklet describes the MSDI framework, its components and the implementation roadmap developed under CPL, which offers city governments a practical, well-structured, and agile approach to operationalize MSDI.



<https://www.smartcitiesworld.net/transport/transport/atkins-and-inrix-team-for-transport-data-revolution>

Data as Infrastructure

With SDI, data is essentially treated as a piece of infrastructure. If we take the example of a common type of infrastructure such as roads, and think about the elements that enable a road to function, we can understand that roads (or any infrastructure) are not able to operate without supporting elements. Road infrastructure needs regulations that determine mutually agreed upon, acceptable driving behavior (for example, drunk-driving or texting while driving is illegal). Roads also need workers for repairs and regular maintenance (through Public Works) and traffic and public transportation management (through the Transportation agency). Lastly, roads must be planned, managed, and treated as part of a system. Roads can only function as part of a road network - a single road segment offers limited benefits to its users. All of these supporting elements need to be in place to enable the responsible and efficient use of road infrastructure.

Proper data utilization requires similar supporting elements. Much like roads,

the use of data should be regulated by policies (for example, making it illegal to access private information without necessary authorization). Staff with the relevant educational background are required for data maintenance and updates, validating datasets (a role currently taken up by the Statistical Agency), or verifying that data complies with certain standards (often the Geospatial Agency in the case of spatial data). Lastly, just like roads, data need to exist within a system, alongside other datasets.

Creating an environment where validated data can be freely accessed and shared will allow users to access information, complete analysis and derive insights beyond what is feasible with a single dataset. 'Road infrastructure' can be used interchangeably with 'roads' to refer to all of the combined elements that make up road infrastructure. In the case of 'data', we refer to data and its enabling components collectively as Spatial Data Infrastructure (SDI), or Municipal Spatial Data Infrastructure (MSDI) at the city level.

MSDI:

The Institutional Arrangements- People-Data-Systems (IPDS) Framework

CPL has developed an MSDI implementation framework organized across four pillars: Institutional Arrangements, People, Data and Systems, or I-P-D-S. These four pillars offer an ecosystem approach to the establishment, functioning and monitoring of MSDI implementation across the short, medium, and long-term horizons. **The four pillars do not stand alone but function in an interconnected manner.** Interaction across the components of the IPDS framework is crucial to establishing an effective MSDI.

Within **Institutional Arrangements**, CPL supports the development of regulatory frameworks and organizational structures to promote inter-sectoral coordination (e.g., by establishing roles and responsibilities of line departments) and encouraging the generation of protocols for data sharing among governments, industry, and society thereby increasing access to geospatial information. Such sectoral coordination is only successful if **People**, across line departments and even within communities, share the same vision and develop their ability to produce and use data for planning. When these skills increase, it also augments the ability of the city to collect, process, produce,



Discussion at the City of Balikpapan on the MSDI IPDS Framework

manage, and analyze **Data** to perform evidence-based urban planning. The last component of this framework aims at establishing ICT **Systems** that integrate spatial and tabular data within a single platform. The Systems component provides a tangible space for the data sharing practices established under the Institutional Arrangements pillar. When institutional arrangements, staff competencies, quality of available data, and an integrated data platform for data sharing and analytics work together, data can be converted to information and insights for better urban planning and management.

Developed in collaboration with the Singapore Land Authority (SLA), the IPDS framework is based on a thorough review of global good practices from more than ten countries, but calibrated for the challenges faced by urban local governments. Our partners in the development of this framework are Indonesian cities who have not only pioneered its implementation but have actively contributed to its development and refinement to make it relevant for urban local governments internationally.



Discussion at the City of Semarang on IPDS Priority Recommendations

I

Institutional Arrangements

Refers to the capacity of the city to develop and sustain formal policy, regulatory and governing structures that support geospatial related activities, and to the role of the city government in fostering the growth of the broader geospatial ecosystem. Activities under this pillar aim to establish enabling mechanisms for inter-agency coordination and, in the long run, alignment with the National-SDI. These activities span the institutionalization of organization structures such as MSDI steering committees, GeoCommunities etc., and a complete data governance framework.

Working collaboratively under the coordination of a city planning agency (or equivalent), a suite of mayoral decrees, protocols, and inter-agency service level agreements are developed. The process of developing these protocols, roles and responsibilities is as important as the outputs themselves for emphasizing collaboration. Organizational structures and regulations established under this pillar address the needs of the other three pillars. Thus, “Institutional Arrangements” is a foundational pillar.

P

People

Refers to creating an awareness of capacity needs, identifying gaps in human resource supply, and developing competencies and skill sets for ensuring the effective production, maintenance, and utilization of spatial data. A weak 'People' pillar can limit the development of MSDI due to a lack of awareness or a shortage of skilled manpower to collect and analyze geospatial information, and to maintain the Geoportal (or integrated data platform) under the 'Systems' pillar.

D

Data

Activities under this pillar assess the current state of data availability and quality, and related policies regarding formats, analysis, and sharing of geospatial information. This diagnostic also considers the business case for investment in data and the extent to which the use of geospatial information can add value to existing line department Key Performance Indicators.

S

Systems

Refers to any software, hardware, and IT-related infrastructure required to support MSDI. A key component lies in the adequacy, functionalities and user interface of the city-level Geoportal that combines GIS and spatially referenced tabular data. The Geoportal makes it possible for data sharing decrees and protocols to be actualized.

IPDS:

A Comprehensive and Scalable Approach

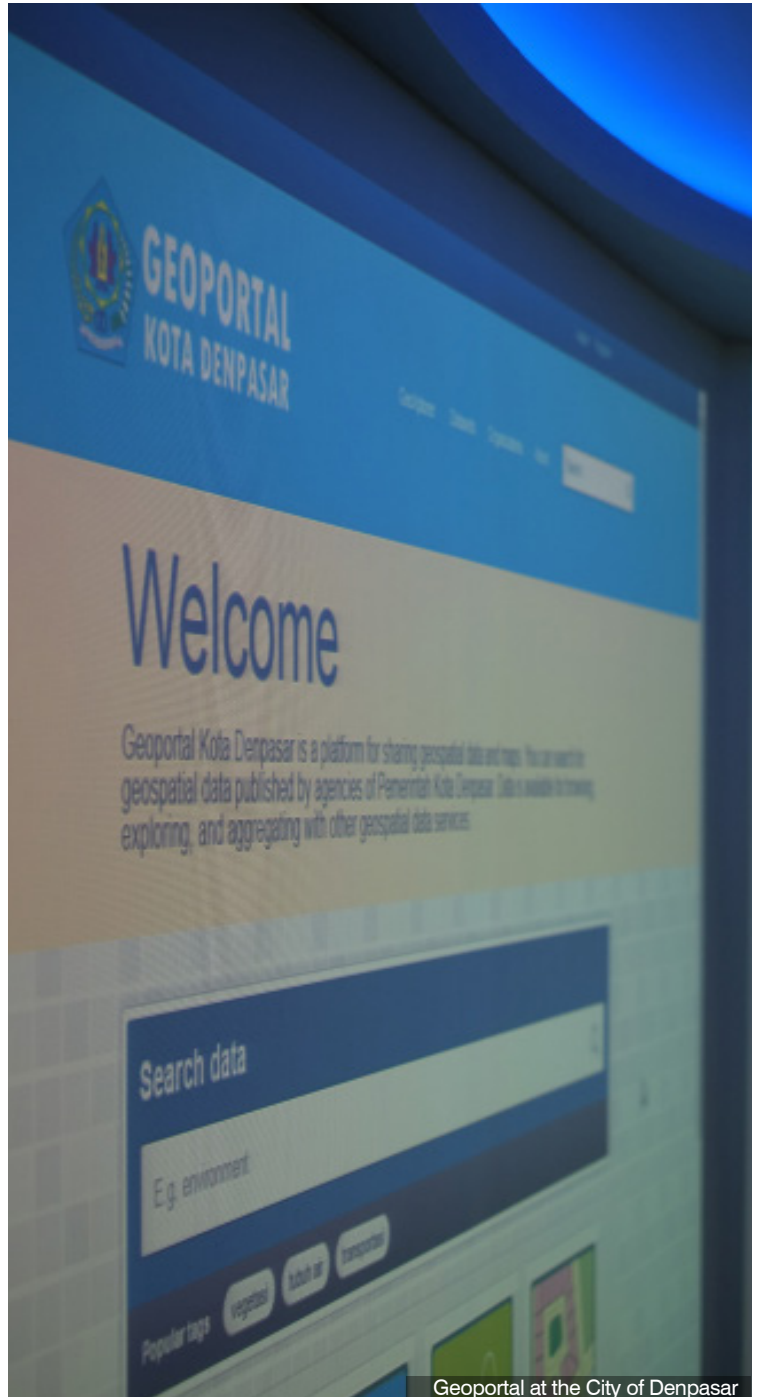
The adoption of IPDS will shift the city planning and decision-making processes toward an evidence-led spatial planning paradigm. The IPDS framework is strategic for tracking the operationalization of MSDI, and has two innovative aspects:

1. *Comprehensiveness*

The IPDS framework considers governance and regulatory functions alongside technology solutions but also takes into account the importance of human resources to boost data foundations.

2. *Scalability*

The IPDS framework is flexible and scalable, meaning that cities with varying levels of capacity and at different stages of MSDI development can leverage and build upon this framework, as evidenced by the three current CPL partner cities of Balikpapan, Denpasar and Semarang in Indonesia.



Geoportal at the City of Denpasar

MSDI Roadmap

CPL is operationalizing MSDI in Semarang, Denpasar, and Balikpapan through the following four primary tasks:

1

ESTABLISH A BASELINE AND DEFINE PROBLEMS: MSDI READINESS ASSESSMENT

The first step is to conduct an MSDI readiness assessment comprising two surveys and follow-up interviews, to establish a baseline understanding of the city's geospatial readiness. The first is the **Rapid MSDI Readiness Assessment and Deep-Dive MSDI Capacity Assessment**, organized across the IPDS pillars to diagnose the city's current state of geospatial implementation, its challenges and requirements for future development. The second one is the **Geospatial Prioritization Survey** which aims to find out the city's current state of development and long-term goals and visions. It will inform recommendations for monitoring MSDI progress. Together, these surveys help evaluate the geospatial readiness and competency gaps of the line departments

2

DEFINE A BENCHMARK AND HIGHLIGHT CONCRETE OPPORTUNITIES

A completed baseline assessment facilitates the review of each of the four IPDS components. This review allows cities to benchmark their current status and conceptualize potential solutions best suited to their institutional arrangements, people, data, and technological needs. This activity includes prioritizing recommendations and developing a set of enabling actions to accomplish them in the short, medium, and long term.

3

DEVELOP AN MSDI IMPLEMENTATION ROADMAP WITH PRIORITIZED RECOMMENDATIONS

Through a series of collaborative workshops, the CPL team and partner city government develop a roadmap for MSDI implementation, including phasing priority recommendations across three time horizons. Budgetary and timing considerations are included for all proposed activities, and solutions are evaluated and prioritized accordingly to ensure a fully implementable and sustainable MSDI.

4

DEVELOP A MONITORING AND EVALUATION (M&E) FRAMEWORK

City governments develop indicators based on the four IPDS components for each of the key recommendations, to monitor and track MSDI implementation. These indicators are included as part of strategic mid-term and annual targets for all line departments and staff involved in executing the activities.

Key Considerations for the MSDI Roadmap

- MSDI roadmaps are developed collaboratively with line departments led by the city planning agency (or equivalent) for short, medium, and long-term horizons with an emphasis on clear action plans that can be tracked through the M&E matrix.
- The approach is, at all times, consultative with an emphasis on with an emphasis on establishing a culture of inter-agency collaboration.
- Three workshops associated with steps 2,3 and 4 facilitate collaboration and emphasize the importance of collective knowledge and the experience of city officials, who provide their perspectives to prioritize relevant sectors for MSDI development.
- City stakeholders narrow down a list of ten city-specific opportunities to realize the MSDI in a phased approach and with relevance to their context. Out of the ten, three primary recommendations and associated actions items are agreed upon for immediate work.
- Phased approach to implementation allows for the work to be done incrementally but retain a long-term vision, acknowledging and accommodating for limited time and human resources.
- Prioritizing activities and actions is key to realistically facing core problems and focusing resources on the opportunities cities wish to harness. Doing so allows the cities to identify local strengths and key criteria for successful implementation of MSDI.
- Each recommendation is associated with a clear structured organizing framework and implementation plan. To kick-start each recommendation, four factors are required: roles and responsibilities, key actions, metrics to track progress, and output/deliverables.

By implementing MSDI, city governments will assume a lead role as the facilitator to access quality data internally as well as for the private sector, academic institutions, and citizens. Establishing MSDIs will be critical for ensuring that National SDIs evolve from policy to reality.

Multiple Entry Points for Introducing MSDI: A Flexible Approach

Within the IPDS framework, city governments can identify and prioritize activities that will serve as entry-points for introducing, operationalizing and socializing MSDI activities across all stakeholders.

While developing their MSDI Roadmap, and armed with the results of baseline assessments, some cities may first decide to focus their efforts on developing legal and regulatory foundations for data management activities – these may include formulating local government decrees for data governance and management, or protocols for data sharing or framing data standards to improve coordination between line departments. Other cities may prioritize preparation of citywide base maps and other data development activities to help assess infrastructure needs. Still others may use skills development, capacity building or establishing the Geoportal as entry points to introduce citywide MSDI. All of the CPL participating cities in Indonesia have chosen different pathways within their Roadmaps.

Regardless of the entry point, the CPL experience shows that city governments should pay attention to the initiation and parallel progress of activities under the Institutional Arrangements Pillar in the short-term horizon.

Such an agile approach allows cities to develop a fully implementable MSDI Roadmap, which translates the opportunities identified into specific activities and tasks required for implementation. It also allows external parties facilitating the process to be attentive to the existing initiatives within the cities as entry points rather than prescribing a rigid set of linear recommendations with inflexible start and end points.

Once the priority activities are established, cities include relevant key performance indicators (KPIs) for each activity and allocate manpower and financial resources strategically. This approach helps cities to channel limited public finances to the most essential activities, while keeping longer-term goals in mind. The roadmap also establishes lines of collaboration among government, academia, the private sector, and communities—all of whom are spatial data and information producers and consumers.

CPL: MSDI Product List



Rapid MSDI Readiness Assessment

Survey Instrument

This brief survey provides a means for the city's decision makers to develop a common perception on the status of enablers for the operationalization of MSDI. Delivered as part of the initial engagement workshop, it allows the facilitators to generate rapid scores on IPDS pillars.



Geospatial Prioritization Survey

Survey Instrument

This survey provides a quick benchmarking exercise with the city's decision makers to establish a broad consensus on sectors that would need to be prioritized from a geospatial development perspective. The findings inform recommendations for monitoring MSDI progress by aligning MSDI with the city socio-economic priorities.



Deep-Dive MSDI Capacity Assessment

Survey instrument and methodology document

This survey provides MSDI delivery teams an instrument to gather detailed information and make an assessment of city's baseline capacity for each of the individual IPDS components.



MSDI Roadmap

Step-wise Methodology and Resources for Developing the MSDI Roadmap Collaboratively

Sample MSDI Roadmaps

How-to guide for developing a detailed MSDI implementation roadmap which adopts a business case approach to identify key actions required across short, medium and long term horizons for materializing MSDI. It provides collective accountabilities and milestones for city government agencies to deliver the implementation of MSDI, along with an M&E matrix



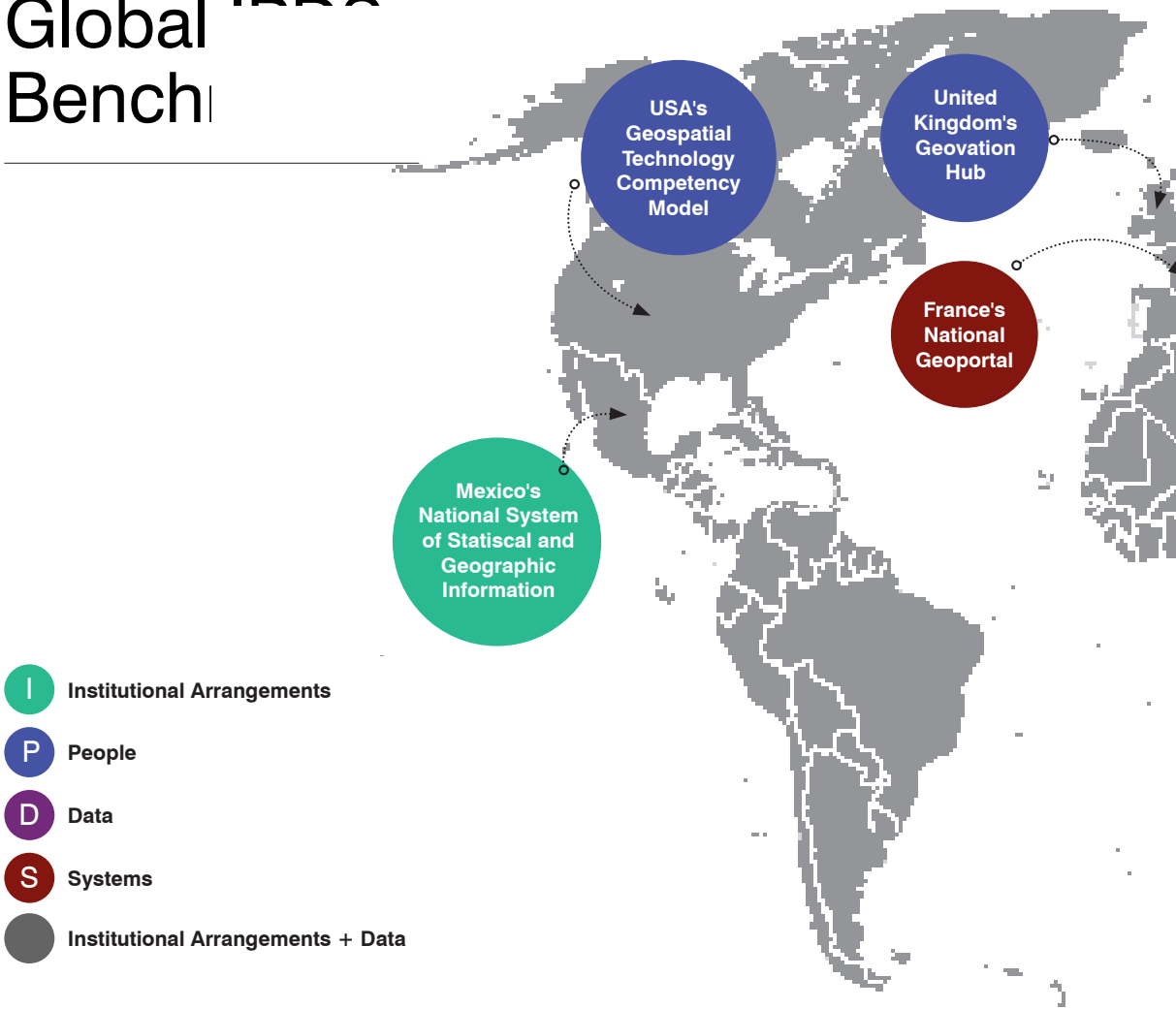
International Benchmarking

Summary of Findings from Ten Global Case Studies of Good Practices across IPDS Pillars

Orientations on good practices for city governments to draw upon and establish robust organizational structures, regulations and protocols for data governance, capacity building frameworks, data production and management practices and design and development of Geoportals that meet established standards.

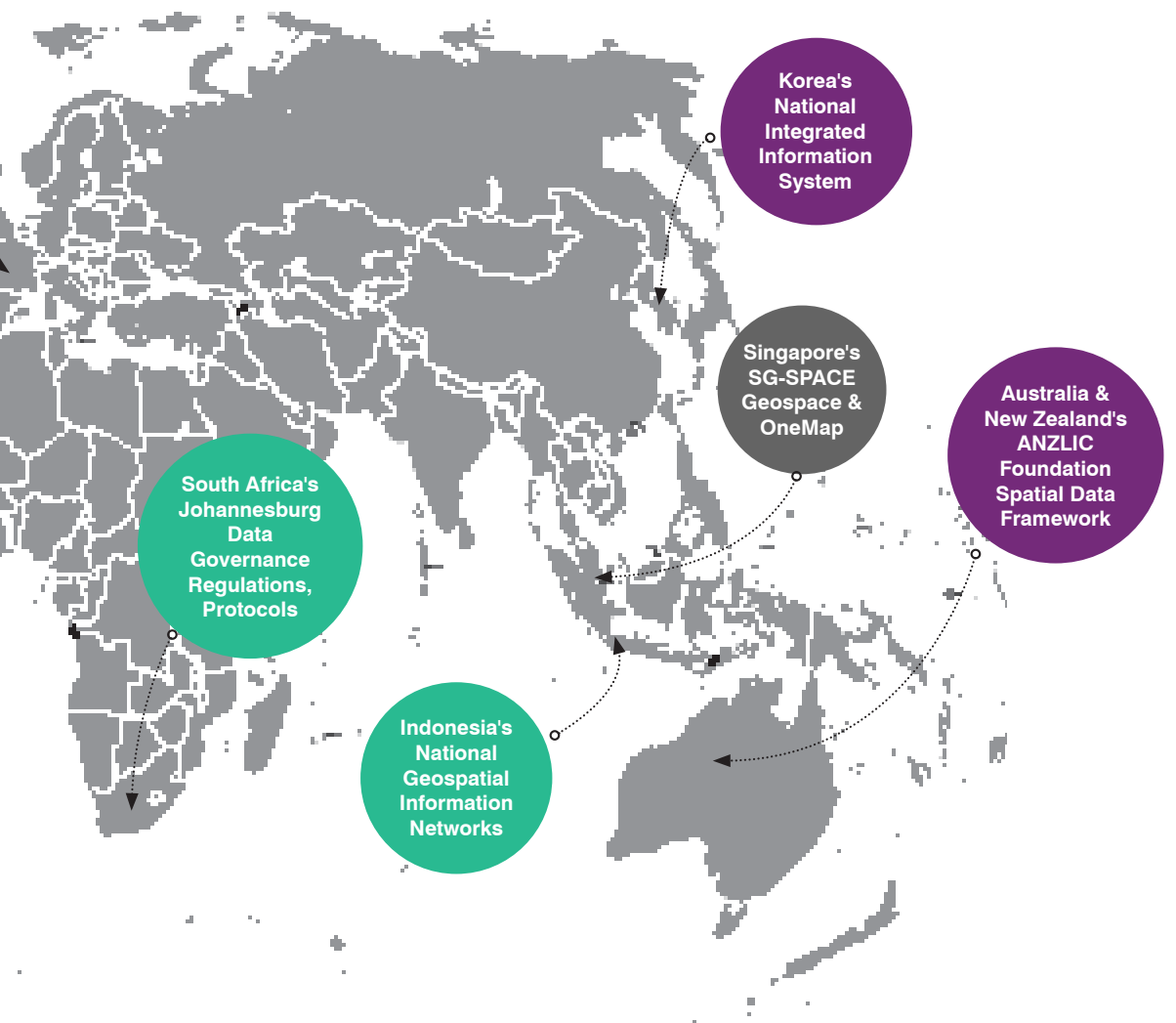
These products have been developed by CPL and are available for use by any interested stakeholders.

Global Benchmark



Ten international benchmark cases were drawn from cities across the world as part of the research work to identify good examples across the IPDS components. Cases ranged from examples of effective organizational structures, regulatory frameworks, to innovative approaches towards capacity building and data sharing. For instance, Singapore's SDI Governing Body, known as the Singapore Geospatial Collaborative Environment (SG-SPACE), has set up the **SG-SPACE Coordinating Committee (SG-SPACE CC)**. This is equivalent to a working committee and is empowered through a high-level mandate to carry out SDI-related initiatives. The **City of Johannesburg's Corporate Geo-Informatics Directorate** has developed a comprehensive spatial information policy which encompasses both organizational arrangements and regulations. Linking Institutional Arrangements to data updating and maintenance, the City of Johannesburg has institutionalized 'Data Champions' across all line departments who are departmental representatives accountable for ensuring their department's data is updated with the city planning agency's repository.

From a skills perspective, USA's Department of Labor uses a comprehensive **Geospatial Technology Competency Model (GTCM)** for building geospatial competencies among students and the workforce. GTCM highlights nine tiers of competencies in their competency model, including core



and advanced geospatial technical competencies, and two tiers featuring a set of soft skills such as teamwork, initiative, creative thinking, problem solving etc. Extending the focus on capacity development beyond the government, the **United Kingdom's Geovation Hub established by the Ordnance Survey** (UK's national geospatial agency) an incubator programme that mentors, coaches and funds entrepreneurs to grow and launch their ideas in the industry.

On the data and systems, the **Republic of Korea's National Integrated Information System (NIIS)** achieves efficient integration of geospatial information across central and local governments. The **Australian New Zealand Land Information Council (ANZLIC)'s Foundation Spatial Data Framework (FSDF)** ensures the seamless exchange and widespread accessibility of national-level foundational spatial data in Australia and New Zealand. **France's National Geoportal** acts as a building block for other SDI initiatives, and provides the basis for regional and thematic platforms, such as the **Géoportail de l'Urbanisme** for land planning. **Singapore's data-sharing platforms, GeoSpace and OneMap**, create value beyond data exchange by engaging users to deliver services and build communities.

Experiences from Indonesia

Indonesia's National Geospatial Information Network (JIGN) demonstrates a high-level political commitment to overcoming coordination challenges in geospatial data sharing. The Presidential Decree No. 27/2014 on this stipulates the coordination of data sharing and processing across a network of nodes spanning 57 ministries, 34 provinces, and 514 regencies/cities.

These nodes comprise the Badan Informasi Geospasial (BIG) at the national level as well as production units and management and dissemination units at the local level.

JIGN forms a key part of the One Map policy, which aims to produce a national base map, using a single geo-reference model, geodatabase, and a set of geo-standards.

CPL's partner cities (Semarang, Denpasar and Balikpapan) in Indonesia have demonstrated the commitment and capacity to translate the national policy into comprehensive, functioning MSDIs. Each of the cities have embarked on distinct trajectories to implement the IPDS framework, but all of them maintain institutional arrangements as foundational to their journeys.



SEMARANG

Semarang was the first among CPL partner cities to establish **data governance** to coordinate regulatory and technical geospatial initiatives and solutions. However, this was not the starting point. The city started with data analytics and innovations in data generation, including leveraging remote sensing data for its spatial plan development. In parallel, the Mayor launched the Smart Cities Initiative that intensified the need for inter-departmental coordination. Jointly, the need for quality data for the spatial plan development and the Smart City initiative highlighted the need to establish seamless and sustainable data sharing mechanisms.

Consequently, an **MSDI policy framework** was established through the relentless efforts of the key city agencies, especially BAPPEDA (City Planning agency), DISKOMINFO (ICT agency) and DISTARU (Spatial Planning agency). Semarang has rolled out several strategic initiatives to create the right policies, frameworks, and organizational structures across all line departments. The **Mayor's Regulation on the Integrated Data Management System** clearly articulates the MSDI coordination structures required to support Semarang's MSDI development. This regulatory intervention has been foundational for Semarang's Smart City Initiative. The city is now tracking progress on



various fronts of IPDS using the **MSDI Roadmap**.

The existing decree is being developed further to include regulatory data standards that **combine both statistical and geospatial domains** to produce high-quality, integrated data. In parallel, the city has prioritized the development and linkage of a centralized Geoportal in DISTARU to other agencies' portals, and initiated capacity building activities for all key line departments to utilize Urban Planning Tools for infrastructure land suitability identification and better service delivery.

For example, the Health Department and BAPPEDA recently used the Land Suitability Tool developed by CPL to identify the optimal location for a new hospital.

The city has initiated the setting up of MSDI committees and working groups to leverage geospatial information for decision making and enhance productivity by collaborating across sectors and local government hierarchies.

DENPASAR

Denpasar demonstrates a strong institutional and organizational commitment to overcoming coordination challenges in geospatial data sharing. Early in their partnership with CPL, Denpasar launched its Geoportal in February 2017 to facilitate shared and efficient use of inter-sectoral data as a building block for e-governance and Smart Cities.

A year later, a fully functional Geoportal is encouraging **data sharing and inter-departmental coordination** for evidence-led planning. It is also playing a role in expediting

the city's digital transformation by supporting integration of the city's geospatial data and web services into broader e-governance strategies.

However, this journey was not straightforward. With the Geoportal launch, the city essentially chose the Systems pillar as the starting point for its MSDI. However, city stakeholders soon realized that the Geoportal's functionality was dependent on a culture of inter-agency data sharing as well as the capacity of line agencies to analyze the data and draw insights from it.

At the time, without an MSDI Roadmap, the priority tasks were not established to ensure that the Geoportal was embedded in a set of enabling and supportive actions.

By 2018, the city had commenced MSDI Roadmap development, and identified capacity building as a priority for utilization of geospatial information by all agencies. Upon the Mayor's request, CPL has developed a Capacity Building Program based on a competency assessment, involving strategic and hands-on sessions that **build up departmental competencies**.

The training modules range from the most general geospatial competencies to sector specific skillsets and analytical abilities. The city staff have exhibited high levels of motivation to augment their core abilities and work functions.

Bolstered by their accomplishments, Denpasar is presently developing a holistic data governance regulation in the form of an MSDI Mayoral Decree, which will encompass communication protocols for data access, sharing, and policies, and regulations for data standards, along with MSDI coordination organization structures.



City of Denpasar

BALIKPAPAN

The city government has played a major role in fostering the growth of the **broader geospatial ecosystem** in Balikpapan, and has selected multiple entry points to the process of institutionalizing MSDI from the onset. Balikpapan exhibits a very high level of motivation and collaborative work ethic to drive the process of realizing the MSDI and has embraced the lessons learned from prior CPL engagements in Semarang and Denpasar.

Balikpapan has initiated the establishment of recommended Institutional Arrangements to support the development of MSDI. Strong existing collaboration across the agencies has allowed the city to expedite the drafting of a **local government decree for MSDI**, which includes the city's commitment to setting up an MSDI Working Group. Balikpapan is the first city to have initiated partnership with the National Geospatial Agency in Indonesia (BIG) to align its local initiatives for setting up MSDI with recommended national-level policies like the One Map policy.

In balancing competing demands for limited resources, the city prioritized the development of the **MSDI Roadmap** with phased initiatives over a period of five years. The city identified key problems to address

by mobilizing geo-spatial data, and assigned priority departments to participate in the city's first GeoCommunity. This **agile working group** is responsible for production, maintenance, and sharing of data. In one example, for addressing seasonal flooding affecting a socially vulnerable population, the city is using the **GeoCommunity on Flooding** as a means to document disaggregated demographic data (age, gender, and education) on affected families, and has started the task of creating its Fundamental Data Set to support the initiative.

As a significant expression of political backing, the Mayor

of Balikpapan has issued directives to BAPPEDA (city planning agency) for integrating priority activities from the MSDI Roadmap as **Key Performance Indicators** for all departmental Data Champions in the city's Mid-Term Development Plan (RPJMD) and Sectoral Strategic Plan (RENSTRA).

This incorporation of the roadmap into the city's existing planning cycle will enable the development of a M&E system for measuring implementation of the MSDI and its intended and unintended outcomes.

Such a mainstreaming of the MSDI Roadmap will enhance its sustainability and effectiveness.



City of Balikpapan

