People

City Planning Labs

Municipal Spatial Data Infrastructure

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 drive planning, and; Brokers the relationships between city governments and the private sector to leverage innovation in technology.

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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"After a decade of trial and error, municipal leaders are realizing that smart city strategies start with people, not technology. 'Smartness'... is about using technology and data purposefully to make better decisions and deliver a better quality of life."

– McKinsey Global Institute (2018)

CPL- IPDS Framework:
The People Pillar

OVERVIEW

In the face of rising urbanization challenges, cities around the world are increasingly adopting a data-driven approach to urban planning and policymaking. Geospatial information is a key enabling factor in this journey. However, data-driven planning involves more than just installing new technologies to visualize data, and relies heavily on trained technical staff with the capacity to leverage data and technologies for day- to-day municipal operations and decision-making processes. Thus, high-quality human resources with a diversity of geospatial expertise is a key requisite to reap the benefits of the data dividend.

Apart from technological innovation and human resource expertise, there are many other elements that contribute to successful implementation and long-term sustainability of evidence-led planning, including well-defined regulatory and institutional frameworks, and a single data platform for enabling data sharing and collaboration.

CPL aims to holistically boost the technical and institutional capacity of municipal governments to produce, share and utilize geospatial data for better urban planning and service delivery.

To enable this, CPL has developed an ecosystem approach that operationalizes a robust Municipal Spatial Data Infrastructure (MSDI) in partner cities through its comprehensive and implementable IPDS framework ▶

This document details the 'People' component of the framework, and addresses workforce considerations such as availability, quality and diversity of expertise required to undertake geospatial data analytics.

The following sections outline the key human resource challenges cities face in their spatial planning functions, describe the CPL approach to addressing these challenges, relate outcomes from the initiatives undertaken in partner cities in Indonesia and briefly describe upcoming activities.

I

Institutional Arrangements

P

People

D

Data

S

Systems

Capacity Gaps in Unlocking the Power of Geospatial Data

Human resource capacity is one of the key challenges that cities face when developing an MSDI. In a decentralized system like in Indonesia, municipal governments are responsible for providing a broad range of urban services. While larger cities may have the necessary resources to fulfill this responsibility, most other cities lack the technical capacity to even develop the required spatial plans as mandated by local or national regulations.

Like in smaller cities in Indonesia, many cities around the world also lack the capacity to utilize spatial datasets in their planning processes. Consequently, local staff often rely on intuition when making planning decisions rather than concrete evidence. This prevailing intuition-driven culture leads to a vicious cycle by negatively impacting the motivation of cities to address human resource capacity gaps. ▶

1 Lack of Awareness and Understanding of the Benefits of Geospatial Information at the Strategic Level.

In the short-term, this contributes to the lack of directives that would enable the utilization of spatial datasets. In the long-run, officials face difficulties in articulating the nature of geospatial expertise they require, and are under-capacitated to plan their workforce to accommodate this need.

2 Inadequate Technical Capacity to Analyze Spatial Datasets.

Technical staff are unfamiliar with spatial data characteristics, and are therefore unable to fully leverage existing datasets to support their technical analysis. Since data-driven planning is yet to be adopted as the norm, the demand on local officials to conduct spatial analysis remains relatively low. Even when such demands exist, city officials are not well equipped to pinpoint the kinds of datasets required to conduct an analysis themselves.

3 Outsourcing to External Consultants.

Given the relatively low technical capacity among municipal officials, spatial data analytics and related work such as the development of municipal spatial plans is outsourced to consultants. Municipal officials generally only review the resulting reports and hard-copy maps. This practice is problematic in a couple of ways:

GEOSPATIAL CAPACITY OF THE LOCAL OFFICIALS WHO REVIEW THESE PLANS IS NOT ENHANCED, since local officials typically only receive end products. While it is common globally for governments to contract external consultants to conduct data analytics, municipal officials should still be equipped with adequate knowledge of spatial data models and analytical methods to effectively review and manage the products developed by consultants.

DATASETS ARE OFTEN NOT SUBMITTED IN A MACHINE-READABLE FORMAT, instead provided as hard copies, which prevents city officials from investigating the data by themselves. This practice also means that officials are dependent on the services of external consultants for both data and technical analysis.

The CPL Approach

Working in close collaboration with partner cities of Semarang, Balikpapan and Denpasar, CPL has developed a customized MSDI implementation roadmap with activities to build the capacity of local officials to handle geospatial data and help close the human resources gap. Key activities are described in this section.
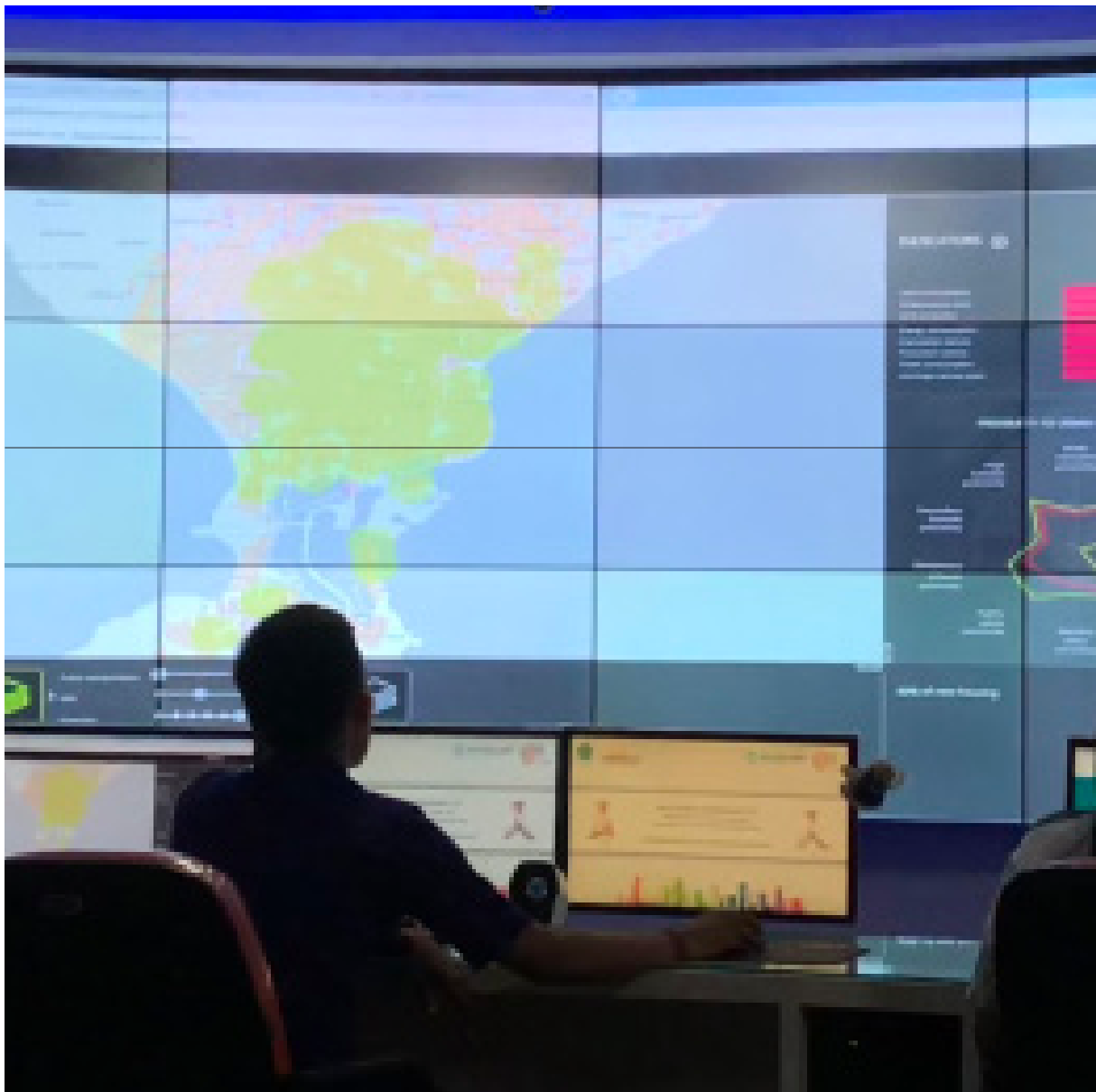
1 Develop a Geospatial Competency Framework

Spatial analysis can be very simple or very sophisticated. Using simple spatial data analysis, officials can easily identify and map disaster-prone areas, infrastructure gap hotspots, and accessibility to services. At a more complex level, spatial data analytics can be used to find statistical correlations between spatial incidents, estimate the demand for a particular facility based on its location, analyze change in urban built-up area, and even project future urban growth based on multiple development scenarios and policies.

Given that evidence-driven spatial planning is a relatively new responsibility for local governments, agencies have yet to develop a clear understanding of the competencies required to enable a desired set of analytical outputs. This makes it difficult for municipal agencies to assess their geospatial manpower needs, or measure the gaps in their staff composition.

A competency framework helps officials articulate their need for geospatial manpower and skillsets. This framework is defined as "an instrument for managing human resources, which defines the competencies [and roles and responsibilities] relevant for the development of both organizations and employees" (Ernst and Young, 2016). It can be used to define the standard competencies relevant for the utilization and management of spatial datasets and supporting infrastructure.

Staff at the Denpasar Damamaya Command Center Utilizing Urban Planning Tools

Level	Educational Attainment	Title/Position	Competency Units	Occupational Competency
9	**Doctorate Degree**	Chief Expert	GIS	Strategic
8	**Masters Degree**	Mid-level Expert	H, P, RS, GIS	Strategic
7	**Continued Professional Education**	Junior Expert	H, P, RS, GIS, C	
6	**Bachelor's Degree/ D4 Diploma**	Chief Analyst	ST, H, P, RS GIS, C	Managerial
5	**D3 Diploma**	Mid-level Analyst	ST, H, RS	Managerial
4	**D2 Diploma**	Junior Analyst	ST, H, P, RS	
3	**D1 Diploma**	Chief Operator	ST, H, P, RS, GIS, C	Supervision
2	**High School/ Vocational High School**	Mid-level Operator		Supervision
1	**Primary-Junior High School**	Junior Operator		Technical

To develop a competency framework, CPL draws upon relevant competency models from both national and international sources. The Geospatial Technical Competency Model (GTCM), which the Singapore Land Authority (SLA) references in their geospatial competency framework, divides the qualification levels of US GIS professionals into 9 levels (DiBiase, et al., 2011). These GTCM standards are further complemented by the Urban and Regional Information Systems Association (URISA) standards for GIS professionals which outline the different roles and responsibilities for GIS professionals across each of these levels (URISA, 2000).

In the Indonesian context, the Ministry of Labor and Employment (Kementerian Tenaga Kerja) has enacted a Ministry of Labor Regulation No. 331/ 2013 that outlines the tasks and responsibilities associated with geospatial professionals, while also subdividing the qualification levels of Geospatial professionals into 9 distinct levels.

In the long-term, the competency framework will contribute to broader strategic workforce planning of the geospatial sector. This will require extensive work including a thorough study of existing geospatial academic programs, private actors, as well as a forecast of future geospatial trends. Nonetheless, the competency framework exercise is the first significant step toward a future where cities do not struggle to find the geospatial talent they need, as it equips municipalities with a baseline list of positions and competencies needed to start leveraging spatial datasets for urban development objectives.

Workshop on Assessing MSDI Readiness

City Officials Using CPL Products

A second but more immediate step is to conduct a comprehensive survey to assess the current capacity of the city to develop and sustain an MSDI. Deep-Dive MSDI Capacity Assessment (See Institutional Arrangements Booklet) that assesses the following factors:

- General manpower availability
- Educational backgrounds (with information on geospatial background, if applicable i.e: geography, geodetics, urban planning and Information Technology)
- Level of GIS skills and experience
- Current tasks in which GIS operations are required; methods and analysis associated with these tasks
- Spatial data collection system; methods and frequency of collection
- Spatial data storage and management: current protocols for storing and retrieving geospatial information

By cross-referencing this information with the competency framework exercise, cities can have a clear idea of the extent of geospatial capacity gaps at the municipal as well as at the individual agency level.

Upon identifying the geospatial capacity needs and gaps, CPL has developed a capacity-building program with a two-pronged approach, in consultation with its national and municipal counterparts. The program aims to foster awareness of data-led planning among senior staff in the agencies while simultaneously equipping technical staff with the skills necessary to execute that vision.

At the strategic level, the very process of creating the MSDI roadmap and executing its key activities helps cities to internalize regulatory innovations and technological solutions that support evidence-led planning. Each activity is accompanied by capacity building sessions across all agencies, enabling absorption of the products developed. These sessions cover a broad range of strategic topics such as MSDI, data sharing protocols, and benefits of Geoportals, providing senior city officials with a common understanding of the potential benefits of MSDI and its enabling components.

At the technical level, periodic stakeholder consultations and the MSDI readiness survey exercise help CPL identify key municipal staff who are familiar with their agency's capacity

for geospatial data analysis. These staff help formulate a comprehensive series of targeted capacity-building modules covering the full range of skills needed to implement and maintain an effective MSDI. Unlike sector-specific academic training that line department staff may have completed before, these modules are designed for the specific work programs of each city from a cross-sectoral perspective. Starting with the basics of GIS, the modules match new skills and tools with the tasks of the planning cycle. In Indonesia, this approach has resonated with the National Geospatial Agency (BIG), Ministry of Planning and Regional Development (BAPPENAS) the Ministry of Spatial Planning (ATR) at the national level, and scale-up is being discussed.

OVERALL CAPACITY BUILDING MODULES

The overall capacity building modules aim to equip senior officials, technical staff, and mid-level administrative staff with basic skills for operationalizing MSDI, which covers a broad range of topics such as:

- Introduction to spatial data and spatial data production
- Geoportal concepts and Urban Planning and Management Tools
- Advanced spatial data analysis
- Urban planning concepts
- MSDI Concepts –data as formal infrastructure
- Data processing, cleaning, maintenance, etc.

During the first two modules, technical staff work directly with QGIS, and are encouraged to apply the learning in their day-to-day tasks.
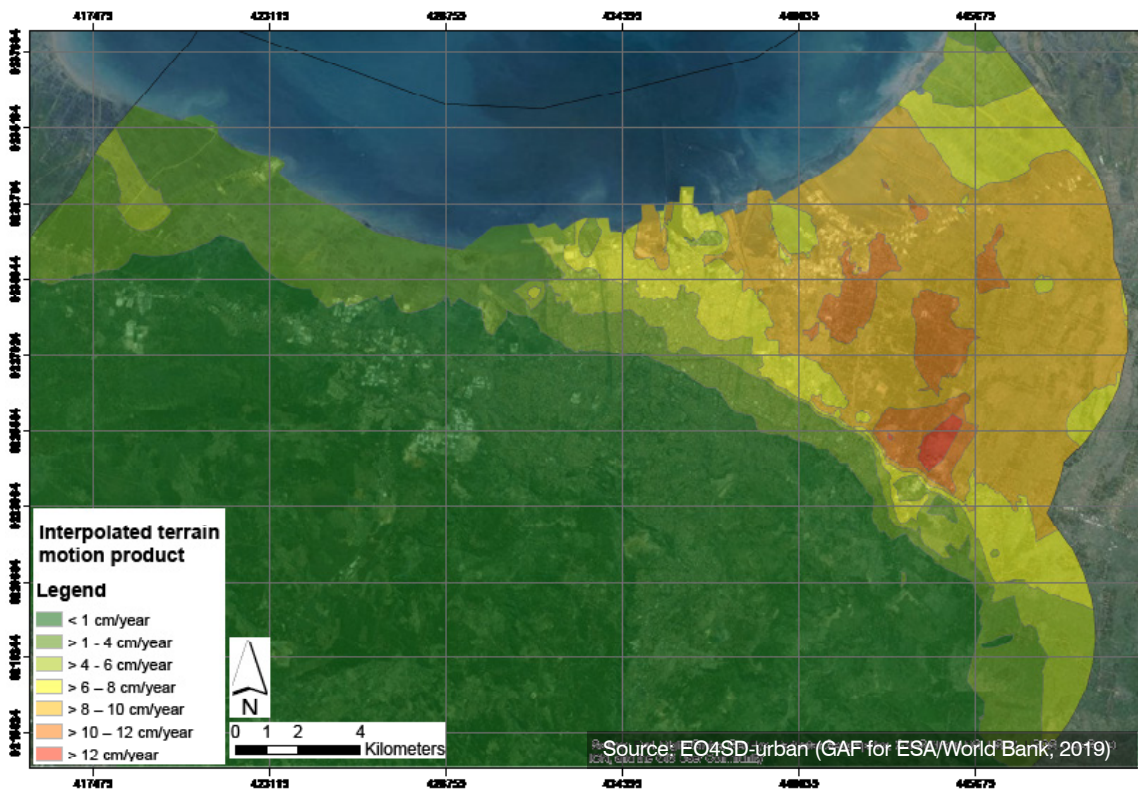
A comprehensive 'Train the Trainers' effort helps identify knowledge partners for the municipal government. These may include local universities or domain experts with knowledge of local issues. Once local knowledge partners are identified, CPL collaborates with them to conduct a detailed needs assessment for targeted teams within the agencies.

THEMATIC CAPACITY BUILDING MODULES

In addition to the formulation and delivery of comprehensive capacity building modules, CPL provides training to help technical staff absorb and maximize use of interventions on various aspects of the IPDS framework e.g., software tools for spatial data analytics, policy assessment at the People and Systems levels, and a Geoportal for each city at the Systems level. The objectives of these interventions and their accompanying capacity building exercises are two-fold:

- To build awareness and advance the implementation of MSDI components: within the IPDS framework, the establishment of a Geoportal represents an advancement of the 'S' component (and not P). However, a capacity building exercise on the Geoportal can educate strategic and technical level officials on the benefits and importance of data sharing, and therefore also contribute to the 'P' component of IPDS.

- To improve technical capacity while building knowledge of geospatial analytics and urban development approaches. The Suitability (ST) and Urban Performance (UP) tools were designed to ease the process of conducting advanced spatial data analytics for municipal officials. As such, a capacity building exercise that introduces the use cases of these tools will enhance the capacity of municipal officials to conduct more advanced spatial data analytics, while also expanding knowledge of the methods and kinds of analyses that are possible with spatial datasets and tools.

The following sub-section offers discrete examples of thematic capacity building from CPL interventions in Indonesia.

Interpolated terrain motion product

Legend
- < 1 cm/year
- > 1 - 4 cm/year
- > 4 - 6 cm/year
- > 6 – 8 cm/year
- > 8 – 10 cm/year
- > 10 – 12 cm/year
- > 12 cm/year

N

0 1 2   4
Kilometers

Source: EO4SD-urban (GAF for ESA/World Bank, 2019)

COLLABORATION WITH THE EUROPEAN SPACE AGENCY (ESA): EARTH OBSERVATION TOOLS

The World Bank has partnered with the European Space Agency (ESA) under its Earth Observation for Sustainable Development (EO4SD) initiative's dedicated activity cluster on urban development. GAF, one of the consortium partners under EO4SD-urban, provided support to develop several data products using remote sensing techniques, such as changes in urban green areas and land use, flood risk mapping, and terrain motion datasets. Using the newly developed data, the CPL team worked closely with the city of Semarang to increase awareness of how radar data can be used to map these occurrences. In coordination with the city planning department (BAPPEDA), Semarang's spatial planning department (DISTARU) has already used the land subsidence data that was produced from this activity in the preparation of their spatial plan (RTRW) to support vital decisions on demarcation of areas unsuitable for habitation.

TRAINING ON THE USE AND BENEFITS OF THE GEOPORTAL

CPL provided assistance for setting up a Geoportal (Systems component) in Denpasar that mobilized interest in enabling data-driven planning across various line departments. The design and development process entailed a series of workshops and capacity building sessions.

URBAN PLANNING TOOLS

In collaboration with an international analytics firm, CPL has developed two Urban Planning Tools i.e., Land Suitability Tool (ST), and Urban Performance Tool (UP) for use by partner cities. Customized capacity building modules were developed for the technical staff of Semarang and Denpasar on the use of these tools. Training materials were delivered through a traditional workshop, as well as through an open-source online learning platform, to provide an online communication channel between CPL and the participants. (See the Urban Planning Tools Booklet)

4 *Establish GeoCommunities*

IDENTIFYING GEOSPATIAL SOLUTIONS FOR URBAN PROBLEMS THROUGH INTER-AGENCY COLLABORATION

After assessing geospatial competency gaps and the baseline skills to start leveraging spatial datasets, CPL proposes the establishment of a GeoCommunity in its partner cities to establish, operationalize, and sustain an MSDI.

A GeoCommunity can be defined as a forum that convenes experts across agencies and institutions to develop geospatial solutions for a specific issue faced by the city. Ideally, the GeoCommunity should be led by relevant agencies with the responsibility to address the issue at hand or in possession of specific data or knowledge about it. Other city officials who are interested in or responsible for that issue are welcome to participate as members. In the long run, this GeoCommunity could also involve stakeholders beyond the government. The community will help solve the city issue in question by aggregating geospatial data and resource needs and developing practical strategies to meet these needs. Its goal is to propose innovative solutions by leveraging geospatial data while breaking sectoral silos and encouraging the culture of collaboration to address cross-cutting city issues.

A GeoCommunity solution was proposed in Indonesia due to its alignment with an existing governance unit within the Indonesian municipal government system. A Pokja (Kelompok Kerja – Working Group) is a unit that is typically formed to convene and discuss a specific issue in the city, ranging from flood mitigation to urban planning and design.

Pokja memberships are not exclusive, and can include public officials as well as academic or even private actors. The findings of a Pokja are summarized in a policy brief that contains recommendation for city executives.

Due to flexible membership requirements, Pokjas are empowered to provide recommendations, and perform the tasks and responsibilities commonly associated with a GeoCommunity or other knowledge-based communities. In performing these functions, a Pokja may further advance the development of the municipal-level geospatial sector by providing recommendations on policies, manpower needs, ICT infrastructure, and data standards that are relevant to the establishment of a complete MSDI.

Workshop on GeoCommunities

Outcomes and Impact in CPL Cities

	Activity	Product/Outcome	Cities	Impact on Cities
1	**Develop a Geospatial Competency Framework**	Completed Baseline Geospatial Competency Framework for GIS analyst	S D B	Baseline information on the levels of experience, competencies of GIS staff, and their typical tasks and responsibilities
2	**Conduct a Deep-Dive MSDI Capacity Assessment**	Completed MSDI Capacity Assessment Responses	S D B	Identification, and classification of geospatially-enabled staff based on their years of experience, educational background and understanding of geospatial data and associated analytical methods Improved understanding of the extent of geospatial manpower gaps within the agencies
3	**Formulate and Deliver Capacity Building Exercises**	A comprehensive capacity building plan for CPL partner cities	S D B	Enhanced knowledge on spatial data models and analysis
3a	**Delivery of Overall Capacity Building Exercises**	Delivered Capacity Building Modules	S D B *D underway *S and B to be rolled out	Basic competencies to start producing, sourcing, and conducting basic spatial data visualizations in QGIS
3b	**Delivery of Thematic Capacity Building Exercises**	• Earth Observation Reports • Geoportal Reports • Urban Planning Tools • Urban Planning Tools Capacity Building Modules	S D D S D S D	Semarang – Enhanced understanding of the use of geospatial information to support a data-driven approach to urban planning Denpasar – Greater understanding of the importance of data sharing, and successful operationalization of the Geoportal
4	**Establishment of Geo/ Knowledge Communities**	• Establishment of an MSDI working group • Establishment of a Geoportal Administrator group	S B D	Identification of key agencies to be involved in the Pokja Semarang – Creation of a draft mayoral regulation to establish a Working Group. Balikpapan – Creation of an issue-based Pokja
5	**Academic and Agency Partnerships**	Discussions in progress with PPIDS and BKPSDM*	D	Work-in-progress

S Semarang   **D** Denpasar   **B** Balikpapan

*BKPSDM- Badan Kepegawaian dan Pendidikan Sumber Daya Manusia – Human Resource Employment and Education Agency

Coming Up

Collaboration with Open Street Map (OSM) via the World Bank's Geospatial Operations Support Team (GOST)

This collaboration aims to compile satellite imagery datasets for 25 cities in Indonesia. This initiative is accompanied by parallel efforts to generate spatial data analytics products, such as urban green area identification and routing maps, as well as an OSM mapping capacity building exercise. The data products that are generated could potentially be used to increase municipal staff awareness on the importance of spatial data for urban planning, while the OSM capacity building exercise could further develop the capacity of staff and local communities to generate spatial datasets.

Academic and Agency Partnership

CPL's goal is to ensure that cities can maintain their geospatial operations sustainably. To fulfill this objective, the participation of local actors is crucial to integrate geospatial training into local training programs or academic programs.Discussions were held with BIG to align the overall direction of the capacity building exercises at the national level. Further discussions were held with the local PPIDS (Pusat Pengembangan Infrastruktur Data Spasial – Center for Spatial Data Infrastructure Development) in participating cities. A PPIDS is an extension of BIG whose task is to disseminate information regarding the national geospatial information network to local governments, while also supporting the institutional, technological, and geospatial manpower developments necessary for establishing an MSDI at the local level. PPIDS is usually hosted within a local university. For example in Denpasar, PPIDS is hosted by University of Udayana. PPIDS in Denpasar has shared its intention of developing a D3 program (equivalent to an associate's degree) on Geographic Information Systems in the University of Udayana, Denpasar. CPL, through its GeoCommunity, is well positioned to provide inputs to the development of this academic program, and to disseminate lessons learned from the development of this D3 program to other cities in Indonesia. CPL is also currently exploring a potential capacity building collaboration with Ikatan Ahli Perencana (IAP – Association of Planning Experts), and the World Resource Institute (WRI). Both organizations have a similar mandate to deliver capacity building modules for members/ counterparts and a partnership would help enrich the content and deepen the penetration of current efforts.

Facilitating Discussions on Strategic Workforce Planning

Having completed the competency framework and MSDI readiness survey, cities now have a clearer idea of their current geospatial capacity and gaps. The next step is to address these challenges through extensive and long-term Strategic Workforce Planning. This entails, among other elements, identification of geospatial manpower sources and projection of future demands for geospatial human resources. A more immediate solution is for cities to come up with a recruitment plan to quickly bridge their geospatial capacity gap while undertaking a longer-term study on geospatial manpower sources, such as with academic institutions and training programs.

CPL People Product List

GIS Competency Framework

Baseline list of roles and responsibilities of GIS analyst at various levels

A GIS competency framework has been assembled in accordance to various international standards, and can be used to define baseline competencies as well as the roles and responsibilities of GIS staff. The framework enables users to articulate GIS skill needs within a Terms of Reference (ToR) to guide GIS analyst recruitment processes

Geospatial Training Modules

Capacity building on how to utilize spatial datasets and operationalize MSDI

These capacity building modules are designed to impart knowledge and technical skills crucial for the implementation and operationalization of an MSDI, with a focus on enhancing utilization of geospatial data. The content targets local governments rather than academic audiences. The modules are complemented by a how-to-guide for using spatial data for urban planning, along with other information that is crucial for the sustainability of MSDI
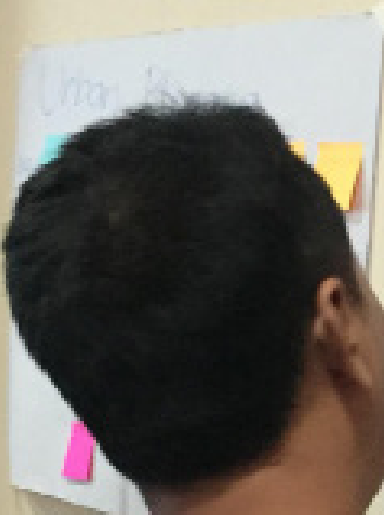
Urban Planning Tools Training Modules

Capacity building on how to use the Suitability Tool and Urban Performance Tool

The Suitability (ST) and Urban Performance (UP) Tools capacity building modules help agencies understand the usefulness and methodologies behind both the ST and UP tool, as well as how to deploy and maintain them

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