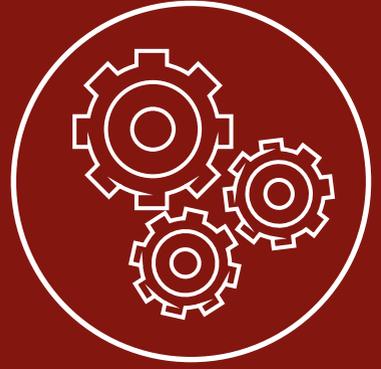


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# Systems



## 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).

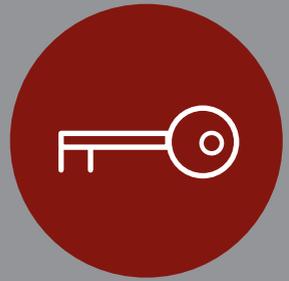
This comprehensive IPDS framework enables **governance and regulatory innovations** to go hand in hand with technological solutions, and also takes into account the importance of human resources to strengthen data foundations. The IPDS framework is **agile, flexible, and scalable to cities with varying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



This work received financial support from the Swiss State Secretariat for Economic Affairs (SECO) through the Indonesia Sustainable Urbanization Multi-donor Trust Fund (IDSUN MDTF). Technical support also received from European Space Agency (ESA)'s Earth Observation for Sustainable Development (EO4SD-urban) initiative.

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All content, design, text and other materials presented belong to the World Bank's City Planning Labs (CPL), which should be clearly attributed for the use of the context, products and graphics. For clarification or further inputs, please contact Gayatri Singh at [gsingh9@worldbank.org](mailto:gsingh9@worldbank.org)



“Access to spatial data is one of the most prominent demands of the information age.”

– Fatih Sari, Ali Erdi <sup>1</sup>

# CPL- IPDS Framework: The Systems Pillar

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The use of geospatial data can allow rapidly growing cities to leverage the full benefits of urbanization. Data-led planning can enable city officials to target resources in ways to boost revenue and multiplier effects for the economy, create jobs, drive public sector cost savings and minimize the negative externalities of urbanization. However, for data to engender change, it needs to be validated and exist within a system alongside other datasets allowing users to derive information and insights in the face of complex problems.

Unfortunately, across the globe, prevailing urban planning practices at the municipal level favor sectoral approaches. Agencies collect their data individually resulting in fragmented data, data duplication, and confusion as to which version of a dataset should be used for analysis. Inefficiencies are further exacerbated by tedious processes, including the need for written permission letters for one agency to request data from another and ad-hoc data sharing on external disk drives.

These issues have prevented cities from fully reaping the benefits of a data-driven approach to planning. **Mitigating these challenges requires municipal agencies to have a common data platform that has search and query functionalities as well as data sharing capabilities. Integrated Data Platforms (Geoportals), have been internationally recognized as an effective solution to consolidate and catalogue datasets within a single platform.** Geoportals allow users to search for and access available datasets, while providing a platform for one agency to share their datasets with other agencies and institutions. This promotes inter-departmental coordination and ease of data sharing between multiple levels of government e.g., national and local levels. In several cities across the world, Geoportals have helped economize on the cost of producing data, design, execute, and maintain investment projects and spatial policies.

However, ICT and software solutions alone are not enough to enable the sustainability of data sharing and evidence-led urban planning. Recognizing this, World Bank's City Planning Labs (CPL) has undertaken an ecosystem approach to develop and operationalize a robust and innovative Municipal Spatial Data Infrastructure (MSDI) in partner cities through its comprehensive and implementable IPDS framework. ►

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*This document details the 'Systems' pillar of the IPDS approach and aims to provide local governments with technical advice to develop adequate ICT infrastructure and software applications to enable evidence-led planning.*

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I

*Institutional Arrangements*

P

*People*

D

*Data*

S

*Systems*

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# Geoportals

## OVERVIEW

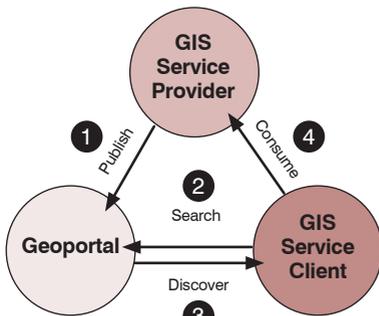
The Systems pillar refers to software, hardware, and physical IT-related infrastructure required to support the operationalization of MSDI. One of its key components is a city-level Geoportal with a user-friendly interface.

A Geoportal is defined as a single point of reference for the search and discovery, access (view and download), analysis and sharing of location-based information and services. Typically, a Geoportal is a web platform that acts as a one-stop shop for different users to access geospatial information and services. It consists of back-end and front-end functionalities, which allow users to upload, store, document, and archive geospatial data, as well as search for and use geospatial information and services. Along with customizable

levels of access to datasets themselves, descriptions of how datasets are produced and attributes of the data (metadata) are also stored in the Geoportal. This information is organized into a web catalogue, which data consumers can use to search for relevant datasets.

The Geoportal serves as a data repository, receiving data contributions from government, non-government, and private agencies, and in turn, disseminates data, processed as information, to all stakeholders of the city. In this sense, a Geoportal anchors both the **Institutional Arrangements** pillar by providing a place to actualize data sharing and the **Data** pillar by allowing overlaying and integration of multiple datasets to enhance their analytical potential.

## THE ROLE OF A GEOPORTAL IN SPATIAL DATA INFRASTRUCTURE



(Maguire and Longley, 2005)

Typical usage of a Geoportal can be described in the following operational steps:

- First, public and private data producers and service providers publish **1** the data along with the metadata records of their geospatial datasets on to the Geoportal, or only metadata records, depending on the context.

- Users can then query **2** this database for geospatial data relevant to their needs.
- Upon discovering **3** a useful dataset, users can either directly access data or submit a data request **4** via the Geoportal, depending on the chosen storage and access arrangements.

**In the absence of a centralized Geoportal, data might be dispersed across various websites, organized in incompatible ways, and not necessarily standardized or accompanied by a metadata record. The establishment of a Geoportal makes it easy for users to conduct searches and discover geospatial data**

**by organizing diverse datasets on to a consolidated platform.**

A Geoportal enables the following:

- *Fosters interagency partnerships* by allowing them to leverage existing datasets and reduce duplication of efforts
- *Allows for the sharing of data resources* and encourages data custodianship to enable a more efficient data production process
- *Eases the utilization of geospatial data* for policy and business decision making purposes

# Lessons from Indonesian Cities

Indonesia has an advanced spatial planning system which, in principle, interlinks sectoral, national, and local-level plans. However, integration of these plans is hindered by agencies compiling datasets from multiple sources and geospatial data being produced in incompatible formats. The current practice of individual agencies collecting their own datasets with limited cross-sectoral coordination has contributed to several problems. These issues also plague cities in many middle and low-income countries as described in this section.



City Officials at Semarang Discussing the Importance of Integrating Data within One Platform



## *Data Duplication Example:* Municipal Road Network Data

Both the Spatial Planning and Public Works agencies in Indonesia deal with urban management and administration that is inherently spatial.

Therefore, both agencies often need the same kind of spatial datasets, although they may use them in a different manner.

These common spatial datasets include land use, location of public buildings, and road networks. Ideally, both agencies should share each other's spatial datasets, and focus on collecting missing datasets instead of duplicating work.

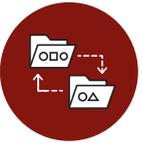
However, without a platform for seamless data sharing, both agencies create datasets independently, leading to overlapping efforts in data collection processes, discrepancies, and incompatibility between created datasets.



### DATA DUPLICATION

Agencies are often unaware that a dataset they need has been created by another agency. Consequently, the limited resources available for the creation of new datasets are wasted as agencies duplicate efforts.

◀ For example, in one CPL partner city, the Public Works department and the Spatial Planning Department have both invested in creating extensive geospatial data pertaining to road networks, including detailed alignment through primary surveys, street hierarchy, street right of way and related attributes.



### NATIONAL SDI POLICES NOT YET FULLY REALIZED AT THE CITY-LEVEL

The Government of Indonesia has issued several important policies, regulations, and standards that guide SDI development at the national, provincial, and municipal levels. Despite advances at the national level, the implementation of Geoportals at the municipal level remains a challenge.

Absence of local level data governance frameworks (see Institutional Arrangements Booklet) and inadequate human resource capacity (see People Booklet) and ICT platforms continue to inhibit data sharing practices between agencies. Lack of budget allocations for data and system maintenance is another key challenge.

Taken together, **these factors contribute to underutilization or absence of Geoportals at the municipal level, hampering evidence-led planning.** The National Geospatial Agency (BIG) is accelerating the strengthening of municipal geoportal nodes linked to the national Geoportal, and the CPL Systems pillar is fully aligned with this effort.



### INCONSISTENT DATA

Duplicate datasets may have different values, parameters, or even geometries caused by variances in data collection, methodology or validation.



### LACK OF CLARITY

Duplicate and inconsistent datasets give to rise to confusion in planning and guiding urban development.



### DELAYS

Most data exchange is done manually, with agencies needing to submit a formal, paper-based request for data from other agencies, thereby causing delays.

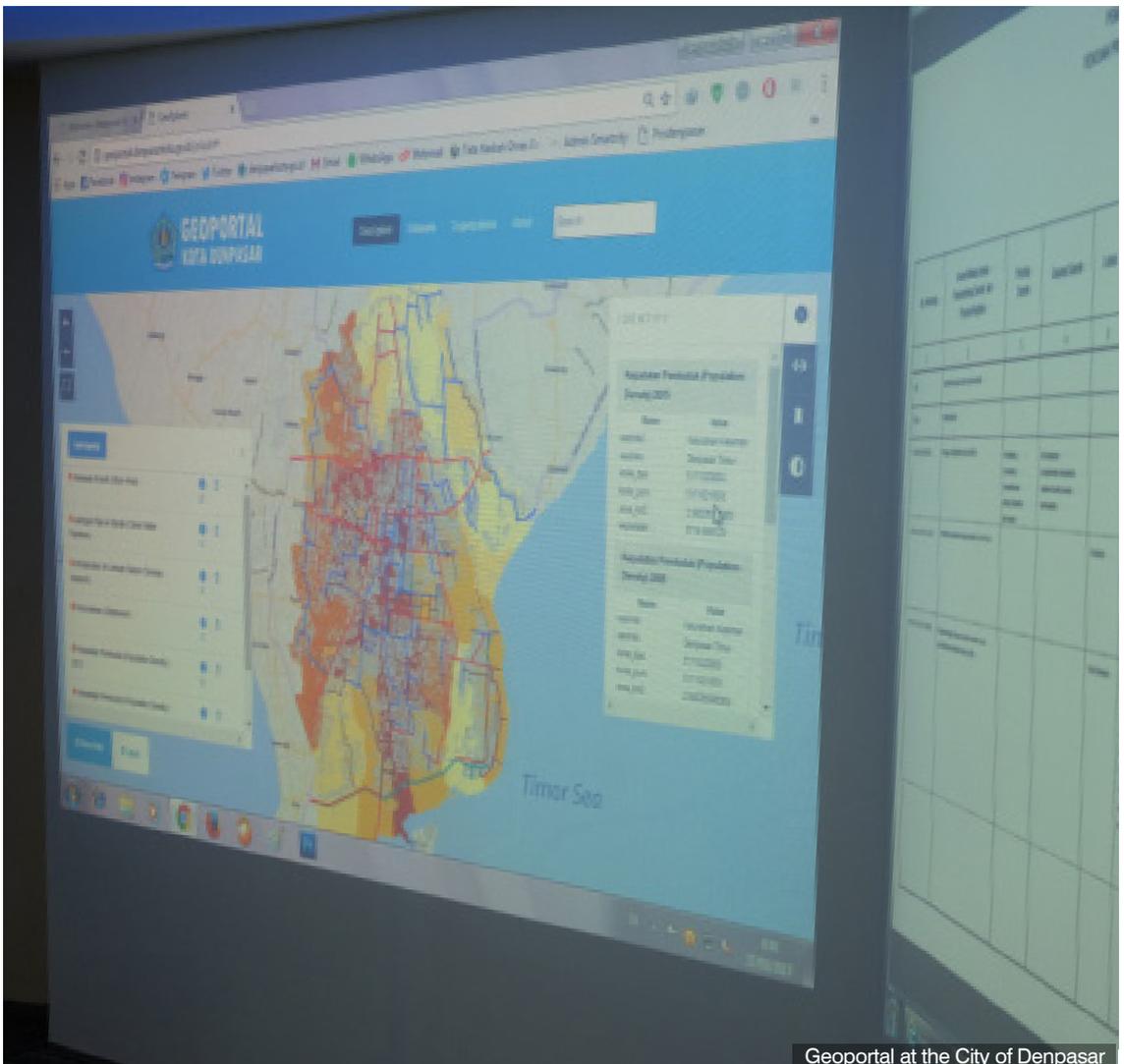
# The CPL Approach

In collaboration with its partner cities and in accordance with international good practice, CPL has developed a vision and specifications for a municipal-level Geoportal, where line departments can publish geospatial data for internal use and meet public demands for access to geospatial data.

CPL's Geoportal is conceptualized as an Integrated Data Platform for both geospatial and tabular data, providing a one-stop shop for agencies and citizens that links geospatial data

producers, consumers, and custodians within the broader MSDI framework. The initiative uses open-source software and technologies, is supported by a capacity-building module and detailed manual to ensure ease of utilization.

The Geoportal is ideally accompanied by a testing environment, both for testing the functionality of new analytical tools before publication to the Geoportal and potentially as a space to clean and manage various data inputs.



Geoportal at the City of Denpasar

## Design Considerations

### OVERALL DESIGN

A CPL Geoportal is designed to maximize flexibility of use by municipal governments who operationalize the Geoportal and by extension the MSDI. A second key consideration is ease of integration between the Geoportal and other applications and portals, which has led to the adoption of standard specifications, terms, and technical definitions.

### INTEGRATION WITH OTHER CITY PORTALS

CPL outlines the components, functionalities, and architecture of data portals currently used by the city governments, analyzing their suitability to integrate with the Geoportal. Integration of the Geoportal with other data portals may be facilitated by either proprietary or public APIs.



Geoportal at the City of Denpasar

## Budget Considerations

### FINANCING:

The CPL team assists the city in estimating a preliminary budget for maintenance of the Geoportal to ensure its sustainability.

During CPL's initial assessment of the SDI readiness of cities, local officials expressed apprehensions about perceived high development and maintenance costs. Their assumption was that Geoportals were inflexible, since local commercial providers would provide only bundled packages with limited possibility to expand and customize if improvements were necessary.

In response to these concerns, CPL developed the Geoportal using open-source products and software to maintain flexibility and minimize maintenance costs.

The benefits of using Free and Open Source Software (FOSS) over commercial software are:



Transparency, which leads to reliability and security



Code quality and speed of improvement – updates, bug fixes, and improvements are done quickly



Customizability/ extendability – minimum legal obstacles to modify and extend existing functionality, allowing community-developed extensions to be created



Quality and efficiency of technical support via forums, mailing lists, and other similar community-based channels

Source: Hengl, McMillan, and Wheeler (2018)

## Regulatory and Governance Considerations

To allow for smooth integration between the proposed municipal-level Geoportal and the other data portals at various government sectors and levels, it is crucial for the Geoportal to be developed in accordance with national

regulations and standards. This alignment is especially necessary when the implementation of the National SDI is not fully established and the integration with city-level SDIs is incomplete or absent.



### *Spatial Data in Indonesia:* Current Regulatory Framework

In the Indonesian case, the following specific regulations have been considered in the development of the Geoportal:

#### **LAW NO. 4/2011 ON GEOSPATIAL INFORMATION**

lays out the broad framework within which the government must facilitate the development and implementation of geospatial information. Article 53 of this law specifies that Spatial Data Infrastructure (SDI), shall consist of policies, institutions, technologies, standards, and human resources. It specifies the content of geospatial information, base geospatial information and base maps, and the scales of topographic maps. It also indicates that BIG manages the base map creation, while all government agencies and local governments organize “thematic” maps.

#### **PRESIDENTIAL DECREE NO. 27/2014**

on National Geospatial Information Network established the national network of geospatial information (JIGN). The network designates two institutions for data governance namely the Simpul Jaringan (SJ, network nodes) as the institution responsible for collecting, updating, exchanging, maintaining and disseminating geospatial information and the Penghubung Simpul Jaringan (PSJ) as the institution that performs integration of SJs at the national level. The SJs consist of two units:

- production units, and
- management and dissemination units

BIG, at the national level, is synonymous with the PSJ, while also being responsible for supporting the development and management of SJs at the local level. All other national government ministries and local governments are SJs. Each SJ is required to host its own Geoportal.

#### **TECHNICAL GUIDE FOR SDI DEVELOPMENT**

defines the five main components for the development of SDI:

- Regulations and policies
- Human resources
- Standards (Indonesian National Standards (SNI) developed or adopted from ISO19000 series)
- Technology
- Geospatial data

These components broadly align with the IPDS framework. The Geoportal forms part of the ‘technology’ component of the Indonesian definition of the SDI.

## Institutional Considerations



BAPPEDA (City Planning Agency) using the Geoportal to Inform Planning Decisions

CPL's Geoportal is designed to facilitate regulatory innovations and institutional arrangements conceived as part of the IPDS framework. This dual focus aims to foster both data sharing and a shift toward a more strategic urban planning approach where investments are channeled to sectors that demonstrate the most need. Thus, the design and development of the Geoportal emphasizes scalability and sustainability at the institutional, technical, and financial levels.

To this end, a **Geoportal Administrator Group** and the identification of a relevant agency as the **Geoportal Technical Coordinator** (the ICT agency at the city level, in the case of Indonesia) are recommended within the broader MSDI Institutional Arrangements organizational chart (See Institutions Arrangements Booklet), to enable the effective management and maintenance of the Geoportal.

## Technical Considerations

**International OGC** (Open Geospatial Consortium, <http://www.opengeospatial.org/>) and **ISO technical standards** have been considered in the development of the Geoportal to ensure compliance with international standards of both the system and the data hosted. In the case of Indonesia, BIG has also adopted many of these international technical standards, incorporating them into technical guidelines, recommendations, and regulations. A few examples of these standards include:

- Geospatial feature data storage format (ISO: 195-2 Simple Feature Access Option)
- Standard for metadata (ISO 19115:2003 on Geospatial Metadata)
- Metadata format (ISO/TS 19139: 2007 on Metadata – XML schema implementation)
- Standards for dissemination of spatial data such as Web Map Service, Web Feature Service and others

### CAPACITY BUILDING FOR GEOPORTAL USE AND MAINTENANCE:

Address key geospatial competency gaps through capacity building sessions with line departments, and build awareness among senior officials on the importance of data sharing for effective management of the Geoportal.

The CPL team has developed Master Terms of Reference that can be utilized by any team interested in implementing the CPL Geoportal approach.

# Outcomes and Impact in CPL Cities



DKIS-Agency of Communication, Information and Statistics Officials Explaining the Benefits of the Geoportal to the Minister of Home Affairs (Tjahjo Kumolo)



## *The City of Denpasar Geoportal Story*

Linking Systems to Institutions and People

With technical guidance from CPL, the City of Denpasar launched its Geoportal in February 2017. The Geoportal included interactive mapping features that would enable non-GIS users to quickly explore Denpasar's catalog of spatial and other data and download available datasets. Following the launch, CPL held multiple capacity building trainings and developed detailed manuals, metadata data documentation, and other resources to help Denpasar manage its Geoportal. DISKOMINFO (ICT Agency) took significant steps toward establishing a supporting data warehouse. Nevertheless, six months after the launch of the Geoportal, its utilization was not optimal. Reasons for this included:

- Multiple reorganizations across line departments
- The establishment of a Geoportal administrator group was hampered by the absence of a clearly defined roles and responsibilities for the involved agencies

- The capacity of the sectoral agencies to meaningfully engage with geospatial data for decision making was limited.

To address these challenges, upon the Mayor's request, the CPL team began the following activities in parallel: (1) development of the MSDI Roadmap, (2) supporting the development of a MSDI Decree based on the lessons learned in Semarang, and (3) most importantly, launching a multi-agency capacity building effort. To date, the Geoportal has recorded the existence of 14 agency accounts, and consolidated 101 layers of spatial data divided into 8 thematic data groups. The city is exploring the possibility of integrating the Geoportal with other existing and proposed municipal government applications. Through CPL's assistance, the city is also evaluating data security and the relative benefits of different hosting environments such as local servers versus cloud services.

Over the last two years, CPL partner cities have tailored the IPDS framework and paved their own way forward to develop System innovations and technological solutions. Key highlights include:

	Activity	Product/ Outcome	Impact on Cities
1	<b>conduct a Deep-Dive MSDI Capacity Assessment</b>	Readiness assessment for adopting MSDI	Awareness on capabilities and gaps in the geospatial domain of cities including data gaps, organizational and regulatory needs, technical skillsets, human resources, and financial strength
2	<b>Design and develop the Geoportal. Key considerations:</b> <ul style="list-style-type: none"> <li>• Needs assessment</li> <li>• Data collation</li> <li>• Stakeholder consultations</li> <li>• Integration with existing data portals of the city</li> <li>• Estimating capex and opex budgets for launch and maintenance</li> <li>• Integration of Urban Planning Tools (UPTs)</li> </ul>	<ul style="list-style-type: none"> <li>• Geoportal</li> <li>• Launch of Geoportal</li> <li>• Functioning Geoportal administrator group</li> <li>• Capacity building sessions on the architecture and applications of the Geoportal</li> </ul>	<ul style="list-style-type: none"> <li>• Budgetary provisions for launch and maintenance of a sustainable Geoportal</li> <li>• A technically capacitated city government, willing to cultivate the culture of data sharing</li> <li>• Strengthening the city government to embrace a strategic spatial planning approach; stronger links across departments at the city government levels as well as between the national and city government</li> </ul>
3	<b>Conduct workshops with the city government of to build consensus on prioritization of the Geoportal</b>	List of required components and a complete scope of work to design and launch the Geoportal	Awareness of the strategic benefits of the Geoportal, in particular, the significance of data sharing in promoting integrated spatial planning and service delivery; effective coordination and leadership from BAPPEDA to foster consensus among line agencies on the importance of data sharing
4	<b>Develop Terms of Reference (ToRs) for the development of a Geoportal</b>	Master ToRs for Geoportal Development	Key resource available to all interested stakeholders

# Coming up

The Geoportal, like any other system, can only be effectively utilized if integrated as part of standard practices and operations. To this end, several efforts are underway in CPL partner cities, including ►

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*A well-functioning Geoportal along with physical or cloud servers and related ICT infrastructure enables more open and efficient spatial data production, dissemination, and utilization.*

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1

## **INSTITUTIONAL AND REGULATORY FRAMEWORKS:**

- With the successful launch and operationalizing of its Geoportal, the City of Denpasar is finalizing the composition, roles and responsibilities of its Geoportal Administrator Group.
- Semarang and Balikpapan have proactively committed to establishing Technical Working Groups to develop the Geoportal's technical contours through consensus building and develop a culture of data sharing between departments.

2

## **CAPACITY BUILDING:**

CPL partner cities recognize the importance of having competent staff who maintain and update the Geoportal. As such, they are actively making budgetary provisions for strengthening the skill sets of their technical staff

3

## **VERTICAL PROCESS INTEGRATION:**

Beyond the municipal context, the existence of regulations such as the Indonesian Presidential Decree No. 27/2014 also means that municipal Geoportals will need to be integrated with a wider network of Geoportals at all levels of government. While consolidating collaborative governance at the local levels, CPL and city governments have also jointly initiated collaborative efforts with national ministries to enable vertical process integration.

# CPL Systems Product List



## *Master TORs for Geoportal Development*

### **Baseline ToR to guide the development of an open-source Geoportal**

A key resource to guide the development of an open-source Geoportal. The ToRs (Terms of Reference) contains a detailed list of points that provide guidance to consultants when developing a Geoportal to serve city needs.

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## *Geoportal Source Code*

### **Source code folder**

A folder containing all of the source codes and resources that were used in the development of CPL's Geoportal. The folder includes all image files, fonts, css, scripts, and plugins that are necessary to install, and deploy a baseline open-source Geoportal to the web.

CPL is currently developing this product into an executable file, which could be run to install an open-source Geoportal with ease within physical or cloud based servers.

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



# GEOPORTAL KOTA DENPASAR

Geopori

Home

Geopori

Geopori



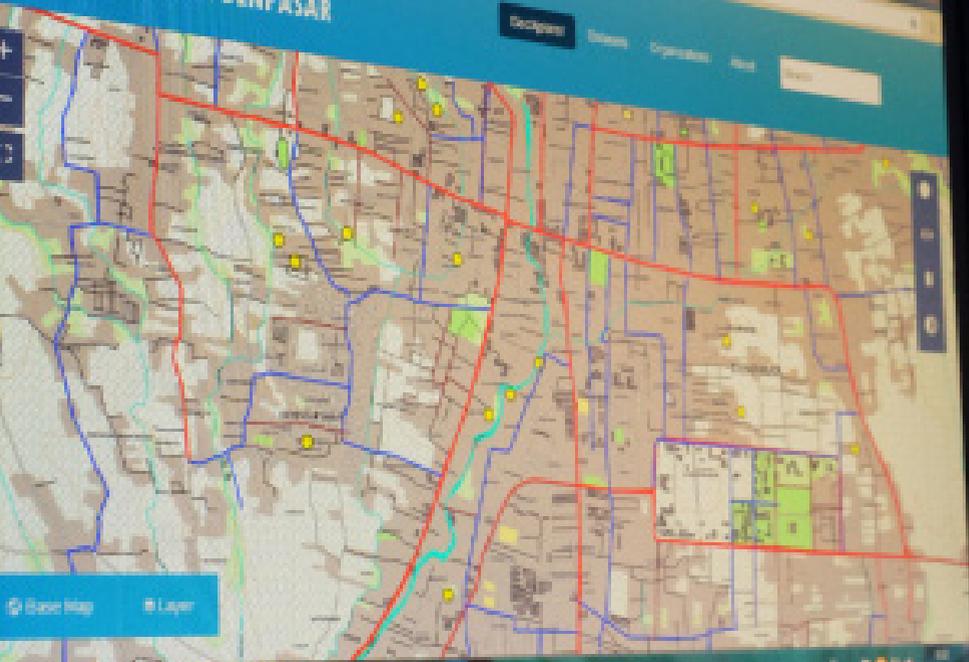
# GEOPORTAL KOTA DENPASAR

Geopori

Home

Geopori

Home



Geopori

Home

Geopori

SAMSUNG

