National Spatial Data Infrastructure

A Strategy for Geo-driven Digital Transformation and Innovation in Mongolia
2020-2025

WORLD BANK GROUP

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Urban, Disaster Risk Management, Resilience & Land

Korea Green Growth Trust Fund

GOVERNMENT OF MONGOLIA

Powering Digital Transformation, innovation and national sustainable development through the efficient and effective use of geospatial information.

Foreword

> Mongolia is taking a huge leap forward in land management, land use registration, urban planning, and transportation management by adopting digital maps and satellite images (referred to as geospatial information) to enable improved decision-making for the betterment of the community.

Geospatial information is of vital importance. Every decision we make, every event or activity we do in our daily lives occurs at a geographic location. Whether we are determining the best site for a new hospital, choosing the location for a new business venture, staging a community event or responding to an emergency – geospatial information is critical to our decision-making.

While government, businesses and research institutions collect, manage and analyse geospatial data, this information is often not easily accessed. This strategy delivers a new paradigm where our geospatial information assets are able to be accessed, shared, analysed and applied through strengthening national geospatial information management to create meaningful policy and robust decisions.

In short, "Everything Happens Somewhere". Our aim is to harness the power of geospatial information for eGovernance, innovation and national sustainable development using the best available information to make decisions that will lead to a more vibrant and resilient community, and prosperous country. Put simply, to become a geo-enabled eNation as part of a wider digital transformation agenda.

The NSDI Strategy will be driven by the NSDI Committee (created by Prime Minister's resolution No.167 in 2019), established to provide a whole-of government strategic approach to maximise the value and benefits of geospatial information for the whole community.

This National Spatial Data Infrastructure (NSDI) Strategy provides clear direction to a better future by providing a consistent geospatial information management framework, enriched by online web services, mobile apps and community mapping programs for decision-making, economic growth, planning and risk management across the country.

With access to integrated geospatial information, government will be able to make better informed choices about where to invest in infrastructure and services, businesses will be able to leverage geospatial information to create new products and services, and the community will have smart mobile and online access to information for everyday travel.

With better geospatial information we will be able to make better decisions and achieve better outcomes and in doing so, achieve a prosperous, healthy and safe lifestyle for all.

I encourage all government departments, businesses and citizens to embrace the vision, goal and actions in this strategy. Our future as a knowledge-based society depends on us getting our geospatial information framework right.

Munkhbaatar Begzjav
Minister of Construction and Urban Development

Feature

Understanding, Predicting and Mitigating Risk to People

The COVID-19 pandemic has forced our world to rapidly adapt to confronting social and economic changes and challenges, from local to global levels, across all industries and sectors, and in all areas of supply and demand. Further, the virus has no respect for political borders or physical limitations, no country is left unaffected. Mongolia is no exception and faces unprecedented challenges.

The conventional model of disaster response is predicated on the event being localized or contained within a certain footprint or impact area, and within a certain event window. Whether a flood, hurricane, earthquake, wildfire or building collapse, the response is broadly contained within certain geographic and time extents. With COVID-19, citizens are experiencing impacts at different times, in unpredictable patterns and to varying degrees of severity, due to complex interacting demographic and travel factors.

> **Many of the challenges are inherently spatial in nature, whether concerning the science of determining disease transmission and resource allocation:** ***where are ventilators most needed … which cities or towns should be under lockdown? … where are infection and mortality rates most rapidly increasing?***
>
> **Long-term planning to mitigate the social, economic and potentially environmental impacts is also geographically nuanced:** ***when it is safe to relax movement restrictions and where? ... what stimulus measures will be most effective and where should they be focused?***

The pandemic has thrown into sharp relief the need for a high level of cooperation from stakeholders across society, private sector and government; not just from the health and education ministries, but from amongst others, agencies that produce geospatial information.

It is imperative to measure and monitor what is happening where, when, and how. Geospatial information is the glue that provides the integrative platform enhancing all digital data with a location attribute and opening up new approaches to understanding, predicting and mitigating the risk to people, especially the most vulnerable population groups and also restoring the health and wellbeing of the economy.

Contents

Feature

Geospatial Digital Transformation for Enhanced Urban Planning

As humans we see the world in three dimensions (3D) and find it easier to understand policy and plans if visualized in this form. The ability to analyze data using the fourth dimension (time), and to illustrate urban sprawl, further aids decision making. Advanced technologies, particularly drones, satellite imagery and LiDAR (Laser ranging), are now making access to 3D and 4D geospatial information increasingly cost-effective.

The World Bank has been working with a wide range of stakeholders, coordinated by the Agency of Land Administration and Management, Geodesy and Cartography (ALAMGC). It has prepared a socio-economic impact analysis which quantified the use of 3D geospatial information for two urban use cases i) improving the efficiency and public participation of planning decision making and ii) improving the transparency of commercial property taxation in computerized mass appraisal assessment (CAMA).

> **The socio-economic value of enhanced 3D and 4D geospatial information for urban policy making is well-established and economically substantial. Projects proposed as part of the investment plan and roadmap (action plan) will enable Mongolia to leverage technological advances in geospatial information to improved urban policy making, increase efficiency of property tax collection and support many other priority projects.**

The urban planning department in Ulaanbaatar has recently acquired high resolution 3D data for part of the city using LiDAR and the Department of the Environment, has a ground receiving station capable of receiving satellite data from some of the many constellations. However, there is no 3D data available for the growing number of urban centers elsewhere in the country and there is currently no direct access to commercial daily revisit satellite imagery.

International studies[1] indicate that there is a strong business case for the acquisition of 3D geospatial information across a broad range of use cases relevant to urban policy in Mongolia. Additional use cases for 3D include flood mapping, utilities network design, construction fire response and air pollution modelling, agriculture, water catchment monitoring, disaster risk management, security and illegal mining.

[1]Assessing the economic value of 3D Geo-information, EuroSDR, 2017. http://www.eurosdr.net/publications/official-publication-no-68-2017

Introduction

> Mongolia faces many complex and interrelated social, economic and environmental challenges at both a local and regional level. Ulaanbaatar City, in particular, is vulnerable to climate change, atmospheric hazards and uncontrolled urbanisation.

The Government of Mongolia has committed to an ambitious digital transformation agenda. New decision-making tools are required to better understand the challenges faced and plan for the future needs of the community. It is currently difficult for the City to keep up with demands for infrastructure, such as roads, water supply and sanitation, and the increasing threat of air pollution, without vital information for decision-making.

Just as a modern road infrastructure is crucial to the growth of the transport sector; Mongolia requires a National Spatial Data Infrastructure[1] (NSDI) and geospatial information, as a key part of its wider national information infrastructure, to transform to a thriving digital knowledge economy and become an eNation.

Geospatial information enables digital transformation to occur. It provides the digital connection and fundamental links between all types of data including a place, its people and their activities. Geospatial information includes maps, satellite imagery, aerial photography, street addresses, property boundaries and road networks, which illustrate what is happening - where, how and why. In addition to the present situation, it also shows the impact of the past and can be used to forecast future scenarios.

Mongolia is well-positioned to take advantage of fourth industrial revolution technologies that are built upon the Internet of Things[2] and an infrastructure of fundamental geospatial information. Many government departments, businesses and universities collect geospatial information, and technology has advanced considerably in recent years. There is now a significant opportunity to use this information and computing power for evidenced-based policy setting and to deliver integrated citizen services. This involves integrating authoritative government datasets, such as key land and citizen registers, into a more coherent and integrated data infrastructure.

The Government of Mongolia has been working with the World Bank, with the support of the Korea Green Growth Trust Fund, to undertake an assessment of the value of geospatial information to the Mongolian economy. This strategy is a summary of the analysis and assessment work undertaken, which included: (1) a baseline assessment of existing geospatial information management practices; (2) a strategic alignment study of government policy drivers and community needs; (3) a socio-economic impact assessment to better understand the returns on investment in geospatial technologies; and (4) an action plan and implementation schedule to deliver these benefits.

The results of the World Bank analysis and assessment show that having an interconnected network of geospatial information is critical to decision-making and economic growth across a wide range of sectors. In the transport sector, geospatial information enables better coordination of road works, resulting in reduced traffic disruption, travel time efficiencies and less fuel consumption. It also underpins all aspects of land administration and management from registration of land rights and facilitating a vibrant land market to property taxation, land use planning and supporting sustainable pastoralism and livestock management. Geospatial information also improves utilities management across both the public and private sectors and improves disaster response by making mobilization quicker and more accurate.

[1]NSDI – refers to the technologies, standards, services, human resources and other factors that enable the sharing of geospatial information for evidence-based decision-making

[2]Internet of Things – a network of sensors, software and other technologies for the purpose of connecting and exchanging data with other devices and systems over the internet.

Current Challenges

> A National Spatial Data Infrastructure (NSDI) is required to deliver citizen services more efficiently, provide more opportunities for businesses to leverage government data commercially, and enable the community to better engage in government decision-making processes through easy access to social, economic and environmental information.

With an operational NSDI in place, organisations and community groups will have the ability to access the most-up-to-date information for decision-making from a single network of authoritative data sources.

Easy access to data is crucial. Being able to understand and recognise the geographic distribution of people throughout the country and respond effectively to their needs, is dependent on having access to information for decision-making.

However, advanced data management and coordination is currently impeded by the lack of an effective mechanism to share information publicly. Access to integrated information, such as topographic maps, traffic information, land boundaries and land use plans, is currently not possible. This is making collaborative planning and decision-making difficult.

In addition, multidisciplinary issues like climate change modelling, environmental management, emergency response and urban planning, require a significant level of coordinated effort across multiple government departments. This coordination can be time consuming using current methods.

Government departments currently have considerable volumes of geospatial information that form the basis for a NSDI. However, the quality (accuracy, completeness and currency) is variable and systems can't exchange data effectively - they lack interoperability. Outside the capital Ulaanbaatar, much of the mapping information dates from the 1970s and this level of currency is insufficient for current and future needs.

In addition, there is a lack of awareness and technical skills in geospatial information technologies and how data can be harnessed to benefit society. As a consequence, there is a need to increase awareness, capacity and skills in geospatial technologies through education and training programs, research, innovation hubs and outreach programs across a broad spectrum of stakeholders.

Through digital transformation, the NSDI will provide a unified capability for the acquisition, management, dissemination and use of geospatial information. By making geospatial information more accessible to government departments, businesses, academia and the community, the potential to maximise innovation is significantly increased – leading to new products and services and enhanced decision-making.

Reaping the full benefits of the opportunities, afforded through the use of geospatial data and technologies, requires continuous reform and innovation to modernize and support new ways of working, particularly across the public sector. The most significant challenges are to:

- Improve the quality of geospatial information, such as land parcel boundaries that have not been mapped resulting in expensive land disputes, and geocoded address data and topographic maps.
- Improve data accessibility so it can be leveraged more fully to generate economic growth through businesses and start-ups taking advantage of the power of geospatial information.

A New Era in Decision-making

> Mongolia is well-positioned to take advantage of modern technologies to advance decision-making and citizen services using the power of geospatial information.

Many government departments are familiar with geospatial information and are using this information on a daily basis. However, while Mongolia is actively working towards digital transformation using technological advancements, geospatial information, which is fundamental part of bringing digital divide, is often overlooked.

Technological advances in geospatial information management today, are influenced by the new fourth industrial paradigm; where individualized production, business integration, collaborative networks and digital integration of supply chains have emerged to create new ways of producing and distributing information products beyond a single enterprise.

Similarly, access to high quality satellite imagery, the success of crowd-sourcing initiatives and smartphone-derived location-based services has reduced the timescales and costs of NSDI data acquisition and the development of new products and services.

The following NSDI enabling technologies will move Mongolia beyond the collection of data and customary usages, to a thriving location-based services market, to become an eNation.

National Geoportal

The National Geoportal is the technology core of the NSDI. It provides a single online portal for accessing and querying geospatial information.

The Geoportal brings together and integrates geospatial information resources from across the government, business and academic sectors (Figure 1). It may also include crowd sourced data gathered through community mapping programs.

The Geoportal is central to achieving a vibrant market for location-based services. It allows stakeholders to contribute to, and access, a comprehensive catalogue of geospatial data that can be leveraged by government and businesses alike to develop new products and services.

One Map and Citizen Services

One Map is the community facing platform that is the conduit for public sector agencies to provide information to the private sector and citizens in a consistent, viewable and integrated manner. The aim is to spur innovation and the widespread adoption of geospatial information for Application development.

Figure 1: The Geoportal gives access to multiple layers of geospatial information to enable innovative citizen services

Common APIs

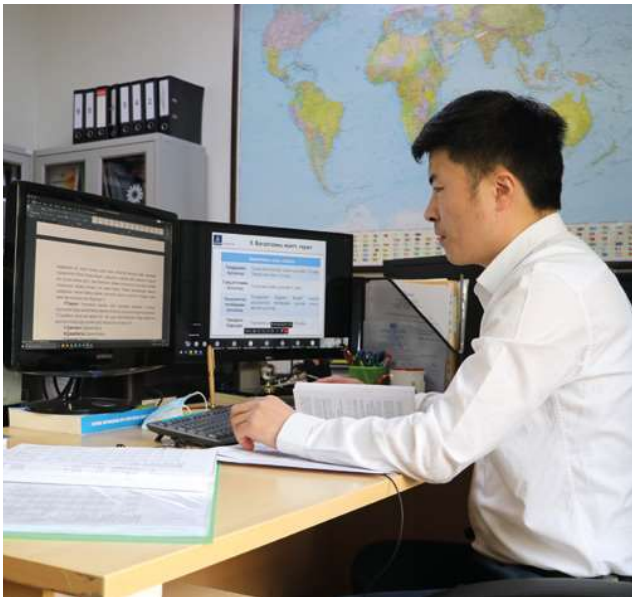
A NSDI enables the rapid development of programs and Apps using Application Programming Interfaces (APIs) built on top of the One Map platform. APIs make it possible to leverage geospatial data more readily to solve todays problems. With ready access to data, countries have recently shown how health-related Apps can be developed quickly to better manage the COVID-19 pandemic. These Apps were created by university students and businesses, either individually or through Public-Private Partnerships. Community tracing, quarantine surveillance, dashboards and alert systems were able to be developed quickly because the NSDI provided the foundation data and technology - putting capability well and truly in the hands of the developer community.

Community Participation

Users of social media technologies are creating an ever-increasing amount of spatially located information - just by sharing a picture. This same technology is now being used in 'community science' projects to enhance government services and improve the accuracy and quality of maps. The World Wide Web, smart devices and the increase in location-based services has ushered in an era where the community are not only consumers of geospatial information, but also producers of enriched geospatial data. This affords a significant opportunity to enhance the existing data infrastructure to engage the public to co-produce, distribute and consume geospatial information.

Centre of Excellence and Innovation Hubs

From mobile innovation to big data and artificial intelligence – technology today is enabling more personalized experiences for consumers of location-based products and services. Digital and mobile innovations have created new opportunities for businesses to get closer to their customers, by creating more convenient, secure and engaging touchpoints between products and end users. With innovation spurred initiatives, such as innovation hubs and centers of excellence, it is possible to stimulate a fast-paced spatial marketplace and invigorate the economy through the development of location-based services.



New Opportunities

The convergence of NSDI technologies (Geoportal, One Map, Common APIs) and their integration in community science projects, innovation hubs and the Centre of Excellence will be a significant part of our NSDI future; and the private sector and community will have a significant role to play.

In this future, the knowledge economy will be entrenched in society – with mobile applications and decision support systems used for everyday decision-making – creating a richer experience for our community.

Envisioning a New Future

> One of the primary components of a the NSDI is to identify the location of Mongolia's physical assets such as land parcels, natural resources, utilities and the built environment, as well as the results of high impact processes such as climate change and urbanization.

Without knowledge about these locations, decision-making on many matters of national importance is significantly impaired.

The strategic framework (Figure 2) and following vision, mission and goal statements recognise that 'everything happens somewhere' and that knowing what is 'happening' and 'where' is crucial to social, economic and environmental development planning.

Vision

The vision statement reflects a common aspiration to deliver optimal use of geospatial information to effectively measure, analyze, monitor and achieve sustainable social, economic and environmental development – leaving no one behind

Our Vision is for:

Geo-driven eGovernment and innovation that empowers efficient and effective use of geospatial information towards national sustainable development and economic growth.

Mission

The mission statement recognizes that leaders will promote and support innovation and provide the guidance, coordination and standards necessary to deliver integrated geospatial information so that it can be leveraged to achieve sustainable solutions to current and future challenges.

Our Mission is to:

Strengthen integrated geospatial information management and promote the value of geospatial information through leadership, coordination, partnerships, advanced technology and geo-standards.

Vision

Geo-driven eGovernment and innovation that empowers efficient and effective use of geospatial information towards national sustainable development and economic growth.

Mission

Strengthen integrated geospatial information management and promote the value of geospatial information through leadership, coordination, partnerships, advanced technology and geo-standards.

Strategic Alignment

- Land Administration and State Land Management
- National and Sectoral Development Planning
- eGovernance
- Mining
- Transport
- Disaster Management
- Agriculture
- Utilities
- Environment and Tourism
- Defense
- Health

Principles

- Strategic Positioning
- Collaboration
- Leadership
- Data Sharing
- Accountability
- Longevity

Goals

- Quality Information
- Accessible and Useful
- Good Governance
- Innovation and Capacity

Benefits

- Creating New Job Opportunities
- Improved Public Sector Efficiency
- Generating Citizen Services
- Stimulating Private Sector Investment
- Saving Lives in Emergencies
- Improved Adaptation to Climate Change

Action Plan Strategic Pathways

- Governance and Institutions
- Policy and Legal
- Financial
- Data
- Innovation
- Standards
- Partnerships
- Capacity and Education
- Communication and Engagement

Figure 2: The Strategic Framework

Feature

Sustainable Land Management

The effective management of state land requires a wide variety of geospatial information and associated management tools to be shared across many local and central government stakeholders.

Effective land management is a priority for the geospatial information strategy. It provides evidence for decisions that will deliver significant benefits for large sections of Mongolian society and the economy that are dependent on the use of state land. This includes land rights, land boundaries, pastureland allocations, protected areas, water source management and climate change monitoring such as desertification.

State land registration and management is crucial to support economic development and sustainable livelihoods. Ambiguous land rights are causing confusion over governance of state land. Land rights, both private and State/public have only been formally mapped and registered for approximately 4 percent of the country. Land use, possession and ownership rights are complex and their location needs to be accurately defined, and land information and services, managed by different authorities, need to be fully integrated/linked.

> **Rights and restrictions, especially environmentally protected areas, need to be mapped and registered to form a complete picture of rights that can underpin evidence-based decision making. There is increasing conflict in law courts between commercial/ development rights associated with mining and tourist development, and the protection of the environment.**

Mongolia has complex ecosystems to manage - with 18 million hectares of Special Protected Areas and plans to increase protected lands to 30 percent of the country's territory by 2030. In addition, 75 percent of Mongolia is covered by ecologically fragile grasslands that support more than 40 million head of livestock and half the country's working population - delivering 11 percent of Mongolia's GDP. Geospatial information can help herders track and trace livestock to support exports.

Soum and Aimag governors have responsibility for the preservation and use of pastureland. Currently, pastureland is overgrazed and overstocked. Geospatial information supports local authorities, in cooperation with relevant professional organizations, to take into consideration land use traditions and conservation requirements, to carry out land management activities for the preservation and rational use of national pastureland.

Goals

The four goals are statements of **what** needs to be accomplished to achieve the NSDI vision, and the objectives reflect **how** the goals will be accomplished.

Goal 1: Quality Information

Timely, reliable and fit-for-propose integrated geospatial information that is the point of truth and trusted source of information for government, business and the community.

The objective is to improve the quality of geospatial information for users by streamlining the collection and sharing of geospatial information through formal data governance processes, standards compliance, quality control and end-user stakeholder consultation.

Goal 2: Accessible and Useful

An integrated platform where people can access, visualise, query and use integrated geospatial information for policy setting and evidence-based decision-making.

The objective is to create a system that interconnects geospatial information from multiple agencies and supports a variety of data formats for analyzing complex relationships, trends and patterns across a broad spectrum of applications so that new insights and solutions can be derived to tackle socio-economic and environmental challenges.

Goal 3: Good Governance

A legal and policy framework, geospatial standards framework and business investment plan that coordinates and integrates geospatial information management across both the public and private sectors.

The objective is to formulate a policy, legal, financial and standards environment that accelerates cross-sector coordination, industry partnerships and stakeholder collaboration for the effective and efficient generation, processing, storage, protection, sharing, distribution and ethical use of geospatial information.

Goal 4: Innovation and Capacity

Geospatial information is used widely to improve government products and services, and stimulate new business opportunities for the benefit of all citizens.

The objective is to promote research and development, innovation programs and entrepreneurship by boosting technological capabilities and strengthening people's skills and knowledge capacity to use geospatial technologies innovatively.

Principles

The success of the NSDI is reliant on cooperation and commitment between organisations from across the government, private and academic sectors. The following principles will guide NSDI actions and make complex collaboration possible:

- **Strategic Positioning:** The NSDI focusses on national strategic and policy imperatives, as well as specific requirements of organizations.
- **Collaboration:** The NSDI governance mechanisms are designed to involve and encourage participation and cooperation between all stakeholders, through open and transparent communications and collaborative partnerships.
- **Leadership:** The NSDI leadership team provides strategic direction and advice, so that participating organizations are well supported and guided in their decisions where the NSDI is concerned.
- **Data Sharing:** The NSDI promotes best practice technologies, FAIR data principles[2], standards and methods for the collection and management of geospatial information so that it is easily shared and can be used innovatively.
- **Accountability:** The NSDI has clear delegated levels of authority, and roles and responsibilities for implementing the NSDI.
- **Longevity:** NSDI laws, policies and standards are adopted broadly to sustain NSDI operations in the longer term for the benefit of future generations.

[2] FAIR Data Principles – Findable, Accessible, Interoperable and Reusable

Strategic Alignment

More than 60 specific use cases have been identified in the Geospatial Alignment Report prepared by the World Bank. Sectors with positive impacts are those where geospatial information and the NSDI has shown to deliver a significant return on investment, support economic growth and yield practical and quality of life benefits to citizens. The sectors include:

- **Land Administration** – enables integrated state land management, valuation, land and property taxation and land use planning.
- **National and Sectoral Development Planning** – allows for a holistic approach that balance economic diversification and social needs across all aspects of the urban and rural built environment and the need to meet Sustainable Development Goals (SDG) and Vision-2050.
- **eGovernance** – leverages digitalization opportunities to make the state more efficient and reduce the burden on citizens in all interactions with citizen services.
- **Mining** – supports the largest sector of the economy by facilitating export activities and the growth of raw materials processed in-country through exploration.
- **Transport** – supports road network planning and intelligent transport systems that integrate alternative modes of travel.
- **Disaster and Emergency Management** – improves planning and response to all types of incidents.
- **Agriculture** – matches the need to improve food security whilst avoiding over-exploitation of the carrying-capacity of the fragile ecosystem.
- **Utilities** – provides access to water, electricity, heating and telecommunications information that is critical to the welfare of citizens and development of business.
- **Environment and Tourism** – supports the protection of the environment and is used to attract more visitors.
- **Defense** – underpins the security of the country.
- **Health** – supports epidemiological studies, social research and health care, as well as for decision-making contributing to the formulation of health-related policies and monitoring and managing the outbreaks of disease.

The overall outcome for the NSDI is for efficient, equitable and optimal utilization and management of geospatial information for the benefit of all sectors of the economy - with an initial emphasis on land administration where immediate benefits accrue to many sectors.

Impacts

The implementation of the NSDI will deliver the following government efficiencies, business growth, and social and environmental benefits:

- **Creating new job opportunities** – particularly in the Information Communications Technology (ICT) sector but also in real estate, retail and financial services.
- **Improved public sector efficiency** – of organizations responsible for land administration, property taxation, spatial planning, transport and agriculture.
- **Generating benefits to citizens** – through increased efficiency in road navigation, emergency services dispatch, and improved interactions with the public sector, particularly in respect to land transactions and fairer property taxation.
- **Greater private sector investment** – particularly in stimulating the land market and facilitating infrastructure development.
- **Saving lives in emergencies** – by improving planning and enabling quicker and better targeted emergency response.
- **Improved adaptation to climate change** – through reductions in carbon emissions from vehicles and improving flood risk assessment.

The Mongolia NSDI Socio-Economic Analysis Report (2020), prepared by the World Bank, identifies specific use cases and benefits accruing from the implementation of the NSDI Action Plan. These benefits are aligned with the United Nations 2030 Sustainable Development Goals. Benefits are illustrated in Figure 3.

Economic Impact of using Geospatial Information in Mongolia

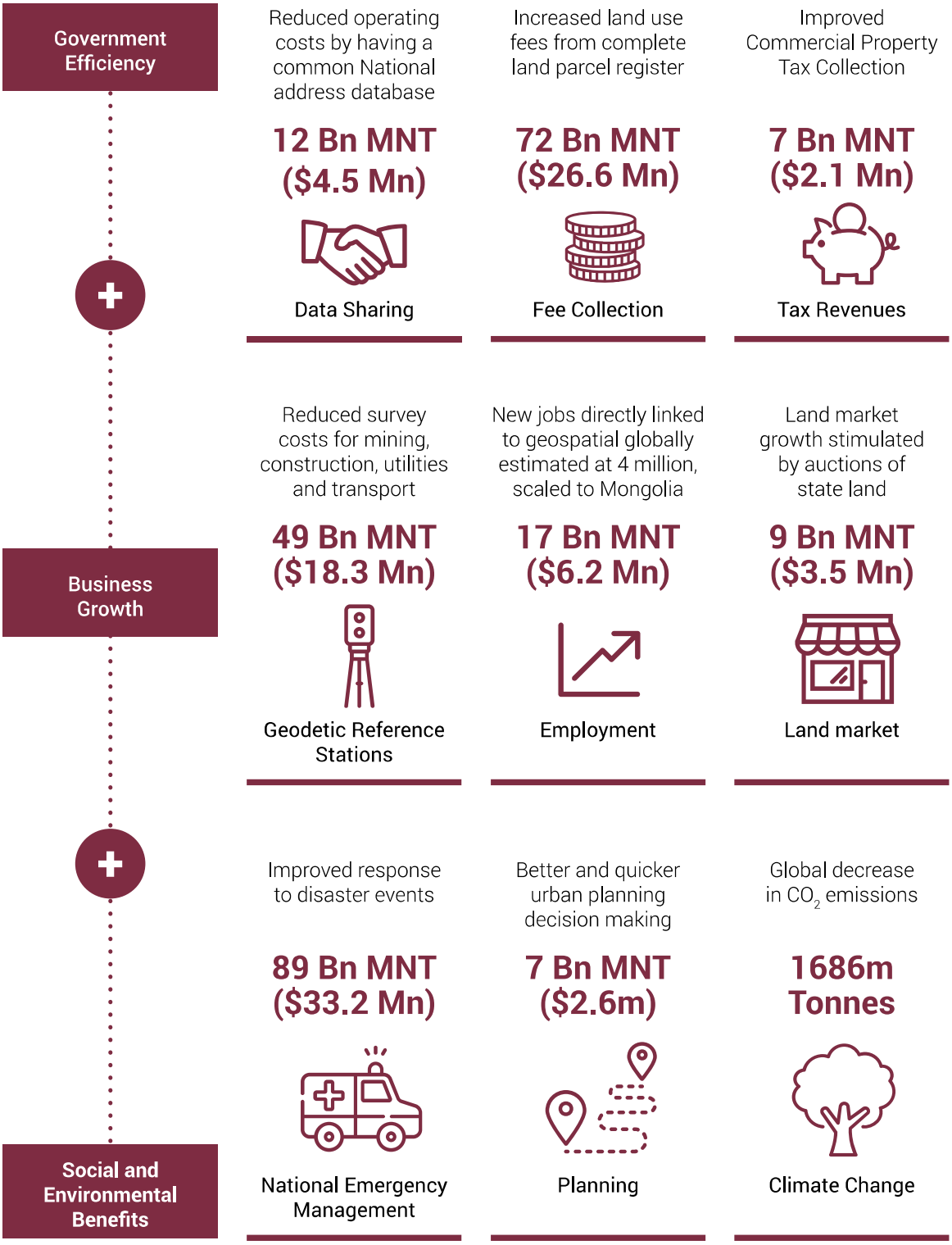


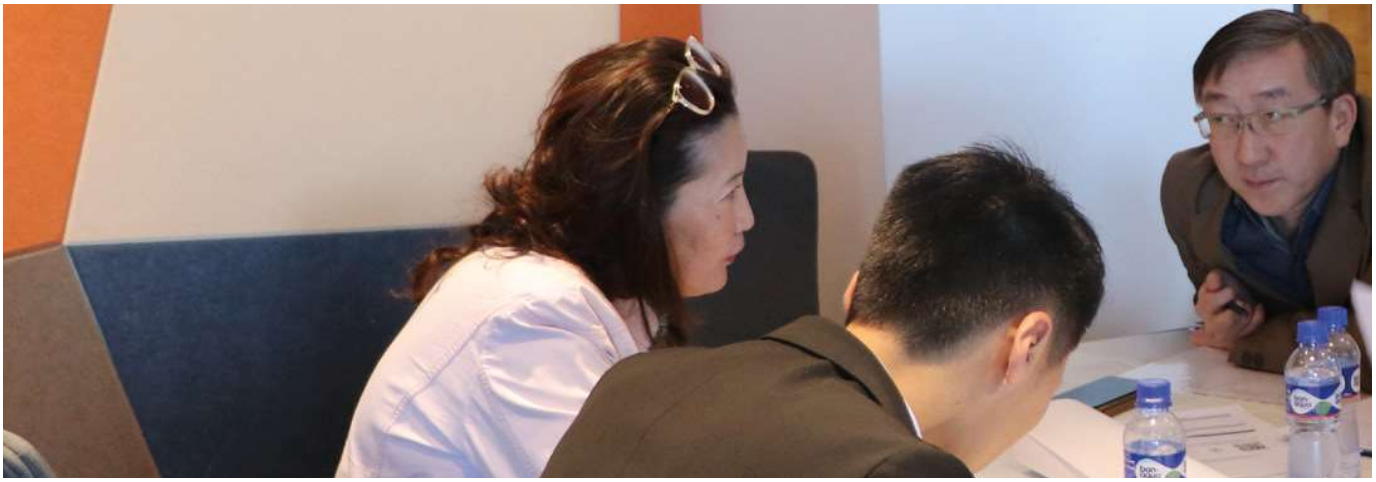
Figure 3. Government efficiencies, business growth, and social and environmental benefits generated through the NSDI Approach. Figures calculated January 2020.

A Collaborative Approach

> The NSDI is only made possible through collaboration and cooperative partnerships with government, private sector, academia and the community of users.

The interrelationships between the relevant implementation bodies and stakeholders is illustrated in Figure 4 and includes the following proposed functions:

- **NSDI Committee** - a high-level body to provide leadership and direction for strengthening geospatial information management, and the implementation and ongoing operation and management of the NSDI for the benefit of all citizens, businesses and Government
- **NSDI Program Office** - coordinates and is accountable for geospatial information management activities set by the NSDI Committee and provides practical implementation support to the NSDI Working Groups.
- **NSDI Working Group** - provides technical and specialist advice and support to the NSDI Program Office and NSDI Committee through specialist sub-working groups.
- **Agencies Leading NSDI Projects** - departments that lead the implementation of NSDI-related projects.
- **Data Providers** - typically, government departments that manage and maintain geospatial data and make this information accessible, and can include private sector, academia and community groups.
- **NSDI Advisory Group** - comprises stakeholders from across the private sector, professional bodies, academia and other interested bodies. The Advisory group is typically presided by the Chair of the NSDI Committee. Meetings are an opportunity for the government to raise awareness of NSDI matters with key stakeholders and, conversely, it is an opportunity for the advisory group to table strategic advice.
- **Agency Responsible for Geoportal** - the NSDI technology is provided centrally on behalf of all government agencies.
- **Stakeholders and End Users** - are part of the broader NSDI consultation process; with two-way communication via the NSDI Program Office.



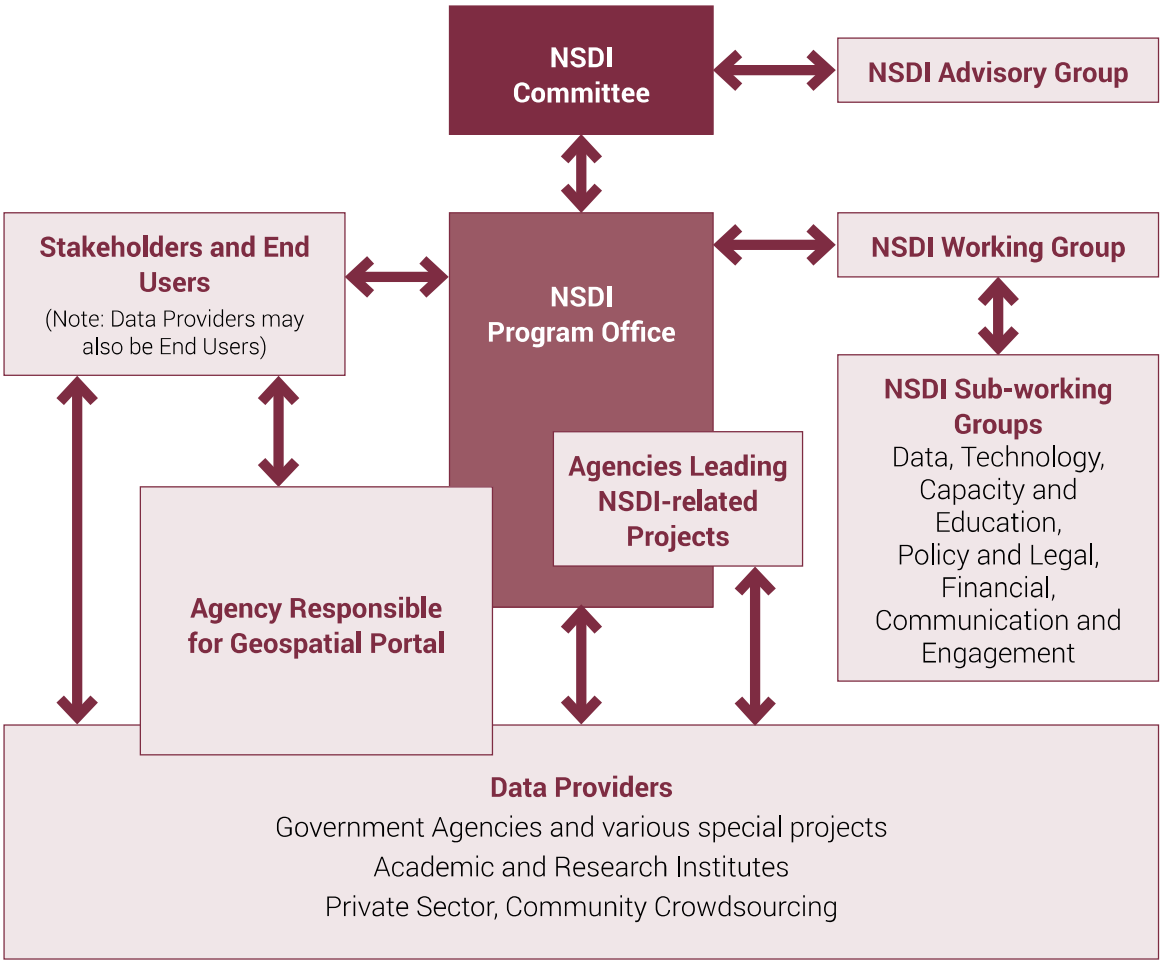


Figure 4. Proposed NSDI Collaboration Model - embracing cooperative institutional arrangements.

Action Plan

> The Action Plan is the "heart" of NSDI implementation. The plan is arranged according to the nine strategic pathways of the United Nations endorsed Integrated Geospatial Information Framework (IGIF) (Figure 5). The pathways consist of - Governance and Institutions, Policy and Legal, Financial, Data, Innovation, Standards, Partnerships, Capacity and Education, and Communication and Engagement

The Action Plan is designed for implementation over a 5-year timeframe and operation for a least a further 7 years. It contains a total of 44 inter-dependent actions that form an integrated roadmap with outlines of costs and timeframes.

The pathway actions are illustrated in Figure 6, and discussed below.

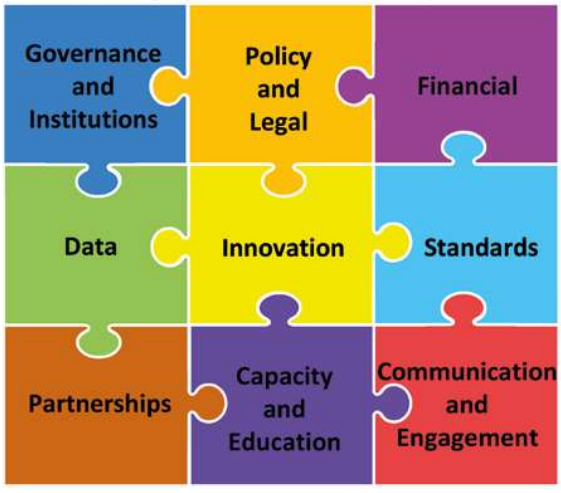


Figure 5 The nine strategic pathways of the IGIF (Available at www.ggim.un.org/IGIF).

1 | Governance and Institutions

- Establish NSDI Committee, Program Office, Working Groups and Advisory Group
- Define the NSDI Governance Model
- Formulate the Geospatial Information Value Proposition
- Develop NSDI Geospatial Strategy
- Implement Monitoring and Evaluation Framework

4 | Data

- Establish Data Framework to organize government data holdings
- Densify the Geodetic Framework
- Complete the Cadastre, and Registration of State Land
- Provide National Access to Satellite Imagery
- Conduct Data Enhancement and Quality Improvements
- Create a single National Street Address Database
- Implement a 3D City Model for High Density City Area of Ulaanbaatar and AIMAG centres
- Integrate Statistical and Geospatial Data
- Update Geographical Names Database
- Ensure secure storage and protection of data and systems
- Identify geospatial datasets for Pandemic Response

7 | Partnerships

- Strengthen and Formalize Partnerships between government agencies and private sector within Mongolia
- Establish twinning arrangements with other countries to share experiences
- Seek International Collaboration

2 | Policy and Legal

- Endorse SDI Law (in progress)
- Establish NSDI Policy and Legal Framework including privacy laws to guide data release and use of geospatial data
- Prepare a Policy and Legal Compliance Strategy

3 | Financial

- Establish NSDI Financial Program Management and Leadership
- Review Best Practice NSDI Investment Programs
- Evaluate Alternate Funding Models
- Develop the Investment Business Case

5 | Innovation

- Develop National Geoportal
- Operationalize National Emergency Management Agency geospatial system
- Design National One Map Database System
- Design and Develop Common APIs for NSDI contributing agencies
- Embed Geospatial in existing Public Sector Innovation Programs
- Develop Centre for Geospatial Excellence

6 | Standards

- Strengthen and formalize cross-government partnerships
- Develop Compliance Mechanisms for Standards
- Build Knowledge and Skills Capacity in application of Standards
- Agree and adopt international standards where appropriate

8 | Capacity and Education

- Develop an NSDI Capacity Building and Education Strategy
- Conduct an NSDI Skills Gap Analysis
- Enhance Capabilities in Tertiary Level Education
- Enhance Teaching and Awareness of Geospatial Information in School Curricula
- Foster Geospatial Entrepreneurship
- Provide training on the use/misuse of data resources to all stakeholders

9 | Communication and Engagement

- Develop an NSDI Communication and Engagement Strategy and Plan
- Create an Outreach Group

Figure 6. The Nine Strategic Pathways and Associated Actions

1 | Governance and Institutions

NSDI governance needs to be formalized early to meet accountability and outcome provisions for strengthening integrated geospatial information management, and to stimulate efficient data sharing and effective collaboration across institutions. This will be achieved through the following pathway actions:

- Establish NSDI Committee, Program Office, Working Groups and Advisory Group
- Define the NSDI Governance Model
- Formulate the Geospatial Information Value Proposition
- Develop NSDI Geospatial Strategy
- Implement Monitoring and Evaluation Framework

These actions define the leadership roles that will drive the implementation of the NSDI, and how organizations work together to deliver and sustain the NSDI in the longer term. It includes a governance model that establishes the NSDI Committee (in progress), NSDI Program Office, NSDI Working Groups, and NSDI Advisory Group – all have well-defined roles and responsibilities.

This pathway also develops the Geospatial Strategy and formulates the value proposition, which are both essential for raising awareness of the need for an NSDI with decision makers, and the benefits and outcomes that can be achieved using integrated geospatial information. A Monitoring and Evaluation Framework is also developed to regularly monitor the progress of the NSDI Action Plan and track achievements.

2 | Policy and Legal

NSDI-related goals and data sharing policies are aligned with many government agendas and polices including the Vision 2050 Long-Term Development Policy of Mongolia, the Government Action Plan 2020-2024, and the Draft Resolution on eGovernment etc. However, there is still a need for a NSDI Policy or Legal Framework that encourages data sharing between government agencies. The introduction of the SDI law, which is currently in draft form, and the following pathway actions will address data sharing issues:

- Endorse the SDI Law (in progress)
- Establish the NSDI Policy and Legal Framework including a legal and regulatory framework on privacy to guide the release and use of geospatial data.
- Prepare a Policy and Legal Compliance Strategy

These actions will stimulate data sharing between government agencies and promote its use for decision-making and policy setting. The SDI Land and NSDI Policy and Legal Framework providing overarching guidance for the collection, management, distribution and use of geospatial information. The Compliance Strategy is there to encourage and assist organizations to comply with policies and laws and in doing so, advance the development of the NSDI.

3 | Financial

A socio-economic analysis undertaken by the World Bank in November 2019, indicates that integrated geospatial information management will generate significant economic growth in addition to social and environmental benefits. The positive impacts will be cross-cutting and realised in many sectors including transportation, agriculture and farming, urban development planning, emergency response and disaster preparedness, health, mining and materials, natural resource monitoring, environmental protection, and land management and property ownership. To achieve this economic growth potential, the actions in this pathway are:

- Establish the NSDI Financial Program Management and leadership
- Review best practice NSDI investment programs
- Evaluate alternate funding models
- Develop the Investment Business Case

In addition, a revised business model to finance the projects needed to realise societal, economic and environmental benefits is required. This business model will be underpinned by the creation of a series of targeted business cases to demonstrate 'return on investment' and consideration of alternative funding options including public-private partnerships and International Financial Institution (IFI) loans, in addition to government financing.

4 | Data

Mongolia has a well-defined National Fundamental Geospatial Data Framework that is based on United Nations endorsed Fundamental Data Themes. Critical geospatial datasets have been collected. However, basemap information is currently out of date, and a finer level of detail is required, particularly at the city level. Some datasets such as land parcel, land use, buildings and street address data are not integrated.

While some geospatial data is accessible online, it is not integrated with data from other government agencies. The following pathway actions will enable data to be analyzed in a meaningful way:

- Establish the Data Framework, including metadata catalog, to organize government data holdings for easy access and use
- Densify the Geodetic Framework
- Complete the cadastre, especially the registration of State Land
- Provide access to satellite imagery, nationally
- Conduct data enhancement and quality improvements
- Create a single national street address database
- Implement a 3D city model for high density city areas of Ulaanbaatar and AIMAG centres
- Integrate statistical (e.g. census) and geospatial data
- Update and enhance the geographical names database
- Ensure secure storage and protection of data and systems
- Identify and prioritize geospatial datasets for a Multi-Source Information and Analysis Platform to enable an integrated response to pandemics.

When combined these actions will promote consistent management, sharing and reuse of geospatial information. This will ultimately deliver high quality fundamental datasets that are relevant to, and a priority for, a broad range of applications for government, private sector and the community.

5 | Innovation

While most government institutions have their own data portals, it is the integration of this data that will be of most value to research and development of new products and services across both the government and private sectors. A single integrated geospatial information portal and One Map application interfaces are required to enable a national geospatial innovation/ research agenda.

The geospatial portal and One Map functionality are the most critical elements of the Mongolian NSDI. It is the availability of suitably formatted and integrated data that will lead to innovation and product development. The portal can be used to operationalize emergency management as well as develop sophisticated applications for disease management and monitoring, such as a dashboard application to monitor the COVID-19 pandemic. The pathways actions that will deliver the public infrastructure necessary for innovation in the longer term are:

- Develop a National Geoportal
- Operationalize the National Emergency Management Agency geospatial system
- Design the National One Map Database System
- Design and develop common APIs for NSDI contributing agencies
- Embed geospatial in existing public sector innovation programs
- Develop a Centre for Geospatial Excellence

These actions will promote access to geospatial information to the broader community, and in doing so, create opportunities for government, businesses and small start-up ventures to develop location-based Apps based on open data.

6 | Standards

There is a need to strengthen and formalize the use of a common standards framework across the government sector. Organizations are responsible for the localization, adoption, publication and compliance monitoring of their own standards. However, in some cases, different data models, such as those used for street addressing, exist and this means government data is not easily integrated. The following pathway actions will deliver a national standards framework:

- Conduct a needs assessment into data and technology standards
- Develop compliance mechanisms for Standards
- Build knowledge and skills capacity in the application of standards
- Agree and adopt international standards, wherever appropriate, for geospatial information and associated platforms

These actions will support wide-spread adoption of data and technology standards so that geospatial data and systems are interoperable and the integrated linkages between datasets will be discoverable.

7 | Partnerships

Strategic partnerships are evolving at the national level to support geospatial information management, mainly with the Department of Technology on Smart Cities for the development of cross portfolio applications. The pathway actions that will create more meaningful engagement and opportunities to increase community participation through crowdsourcing applications are:

- Strengthen and formalize partnerships partnerships, between government agencies and with the private sector
- Establish a twinning arrangement with other countries to share experiences and tools
- Seek International collaboration opportunities

By establishing local and international partnerships it is possible to address a need or gap in a capability and/or pool resources to increase capabilities, particularly in terms of develop financing, capacity building, data and ICT partnerships with private sector and research institutions.

8 | Capacity and Education

Because there is no insight into the status and availability of geospatial skills nationally, there is a need for a Strategy to strengthen geospatial information capacity across the government, education and private sectors. The following pathway actions will lead to a renewed focus and interest in location-based technologies:

- Develop an NSDI Capacity Building and Education Strategy
- Conduct an NSDI Skills Gap Analysis
- Enhance capabilities in the tertiary level education system
- Enhance teaching and awareness of geospatial information in school curricula
- Foster geospatial entrepreneurship
- Provide training on the use/misuse of the data sources to all stakeholders.

These pathway actions, are designed to build a strong foundation for geospatial-related professional workplace training, facilitated workshops, scholarship programs, study tours, professional certification programs, and platforms for technical expertise and advice sharing.

An important element of these actions will be to include geospatial entrepreneur programs to develop the use of geospatial information in the private sector, as well as training in interrelated professions, such as the health sciences and real estate sectors, to increase the uptake of location-based services.

9 | Communication and Engagement

Regular forums and an annual conference are being used successfully to raise awareness about the benefits of geospatial information. However, there is a need to increase the number of stakeholders and users from across the various sectors and levels of government, and encourage greater input from them. This is typically achieved through public events, media coverage and outreach programs. The following pathway actions are critical to the ongoing operation and success of the NSDI:

- Develop an NSDI Communication and Engagement Strategy and Plan
- Create an outreach group

With a Communication and Engagement Strategy and Plan, and outreach programs in place, it is possible to achieve greater collaboration and cooperation when implementing the NSDI.

Business Case

> From a strategic perspective, investing in a National Spatial Data Infrastructure will generate the following positive economic, societal and environmental impacts:

Economic

i) Government

- Increasing revenue from land use fees and taxes by completing the land register.
- Improved property tax revenue collection from a single national street addressing system.
- Support to the National Development Agency with online access to more current and complete geospatial information.
- Reducing the costs of the subsidies systems by identifying potentially fraudulent claims.
- Reduced conflicts between mineral exploration and local protected areas by completion of cadastral registration of state land.

ii) Business

- Increasing crop yields by use of precision agriculture techniques to link satellite imagery to fertiliser distribution.
- Better asset management for utilities - the NSDI program will enhance the availability of current geospatial data enabling digitalization of paper records to be more accurate and converted more quickly.
- Quicker and less costly land and construction survey work from the availability of more CORS geodetic stations.
- The real estate sector enabled to use web technology to provide new and better commercial and residential property services to citizens using location data.

iii) Consumer

- Improved transport data to underpin more intelligent real time transport planning.
- Greater efficiency of transactions between citizens and businesses, especially by having a single national address database augmented with geographical position.
- Tools to allow better coordination of street works, reducing traffic disruption and producing travel time efficiencies and fuel economies.

Societal

Key impacts that are not easily expressed in economic terms, include:

- Integration of land registers providing a more transparent, consistent and up to date database to underpin growth of the land market by increasing the level of mortgages secured on land rights.
- Improved disaster response, making mobilisation faster so reducing loss of life and costs of damage to forests, crops and property.
- Mapping of crime scenes and finding patterns that relate incidents together is facilitated by good topographic mapping data, so helping to reduce crime rates and improving public safety.
- Improved Vision-2050 and Sustainable Development Goals (SDG) reporting through enhanced geo-statistics.

Environmental

There are particular direct impacts upon the environmental protection and response to climate change, such as:

- Heat loss from central heating systems can be pinpointed using thermal imagery.
- Selecting sites for alternative energy schemes, particularly wind and geothermal will be aided by being able to visualise and analyse integrated themes of geospatial data.
- Better range land monitoring to match carrying capacity to quality of pasture, to avoid over grazing and land degradation.
- Enhanced Urban planning and Smart city design through access to 3D “digital twin” information models.

The planned investment amounts to 94 Billion MNT (US$35million) spread over a 5-year period. A cost-benefit analysis over a 12-year period, shows a Net Present Value (NPV) of 186.4 billion MNT (USD 69.3 Million) and a benefit-cost ratio (BCR) of 2.5, indicating the economic viability and attractiveness of the project. Sensitivity analysis demonstrates that the case is robust.

It is important to stress that this assessment is based upon quantification of under 20% of the identified use cases. If data and time were not constrained, it is the expert opinion of the analysts that the calculated Return on Investment would be significantly higher.

Implementation Road Map

The NSDI Implementation Road (Figure 7) illustrates the NSDI Action Plan investment profile, which is aligned with government needs and priorities. The purpose of the Road Map is to aid implementation, monitor progress and support investment planning. More details are available in the NSDI Action Plan.

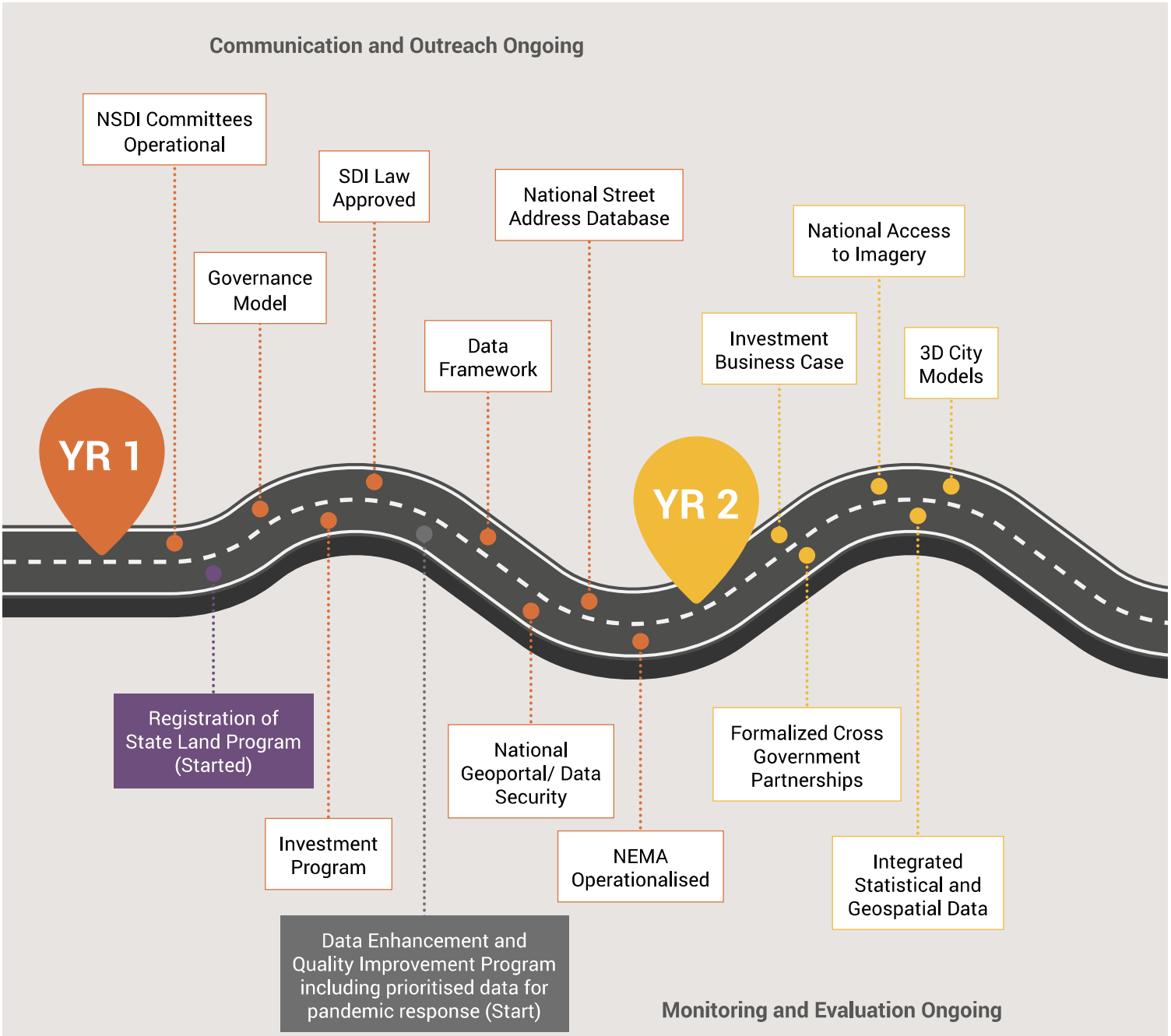
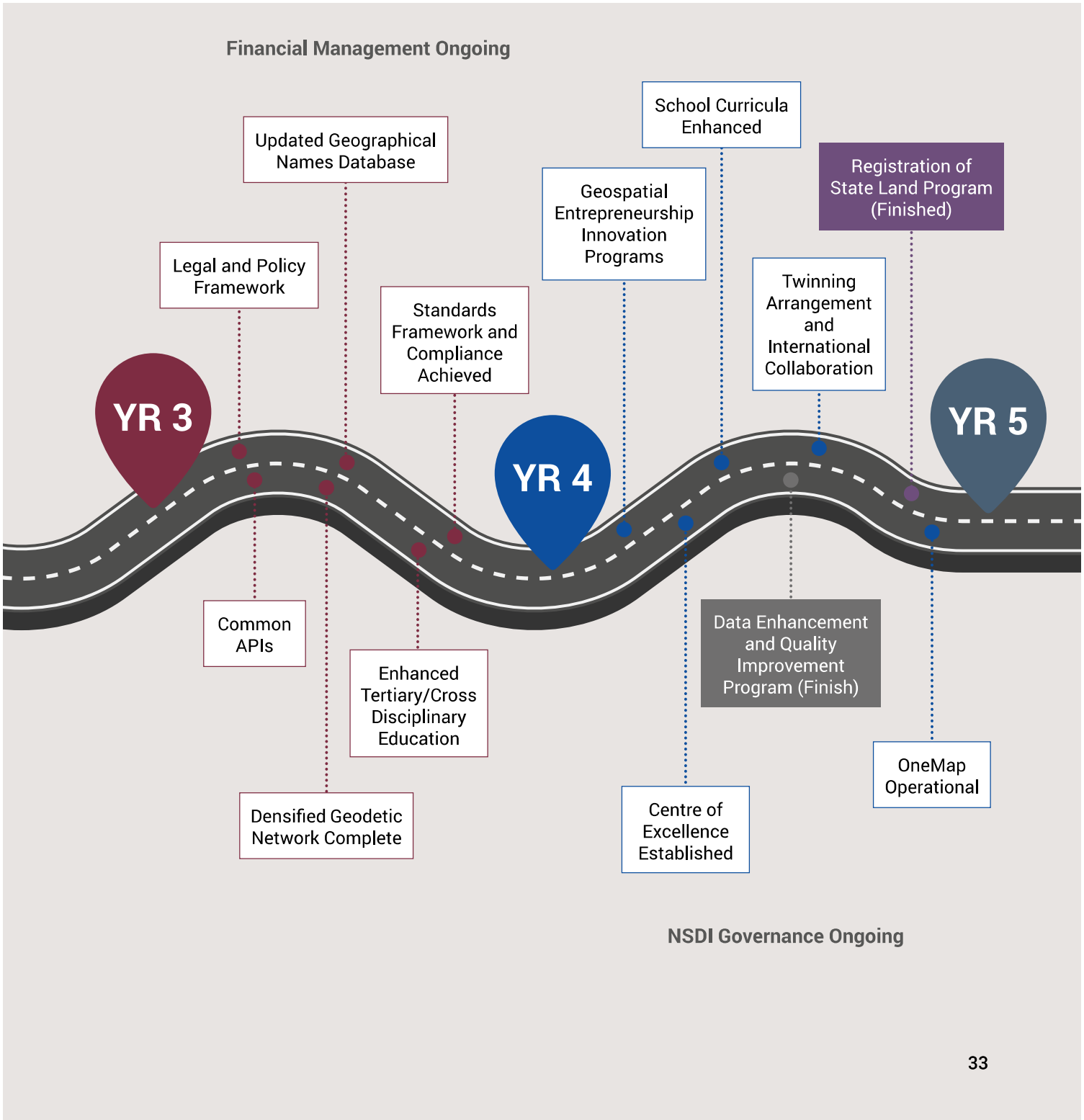


Figure 7: Road Map and related investments


Financial Management Ongoing
School Curricula Enhanced
Updated Geographical Names Database
Registration of State Land Program (Finished)
Geospatial Entrepreneurship Innovation Programs
Legal and Policy Framework
Twinning Arrangement and International Collaboration
Standards Framework and Compliance Achieved
YR 3
YR 4
YR 5
Common APIs
Enhanced Tertiary/Cross Disciplinary Education
Data Enhancement and Quality Improvement Program (Finish)
OneMap Operational
Densified Geodetic Network Complete
Centre of Excellence Established
NSDI Governance Ongoing

Delivering & Monitoring

> Achieving the NSDI vision for Mongolia will require a collective approach across many stakeholders.

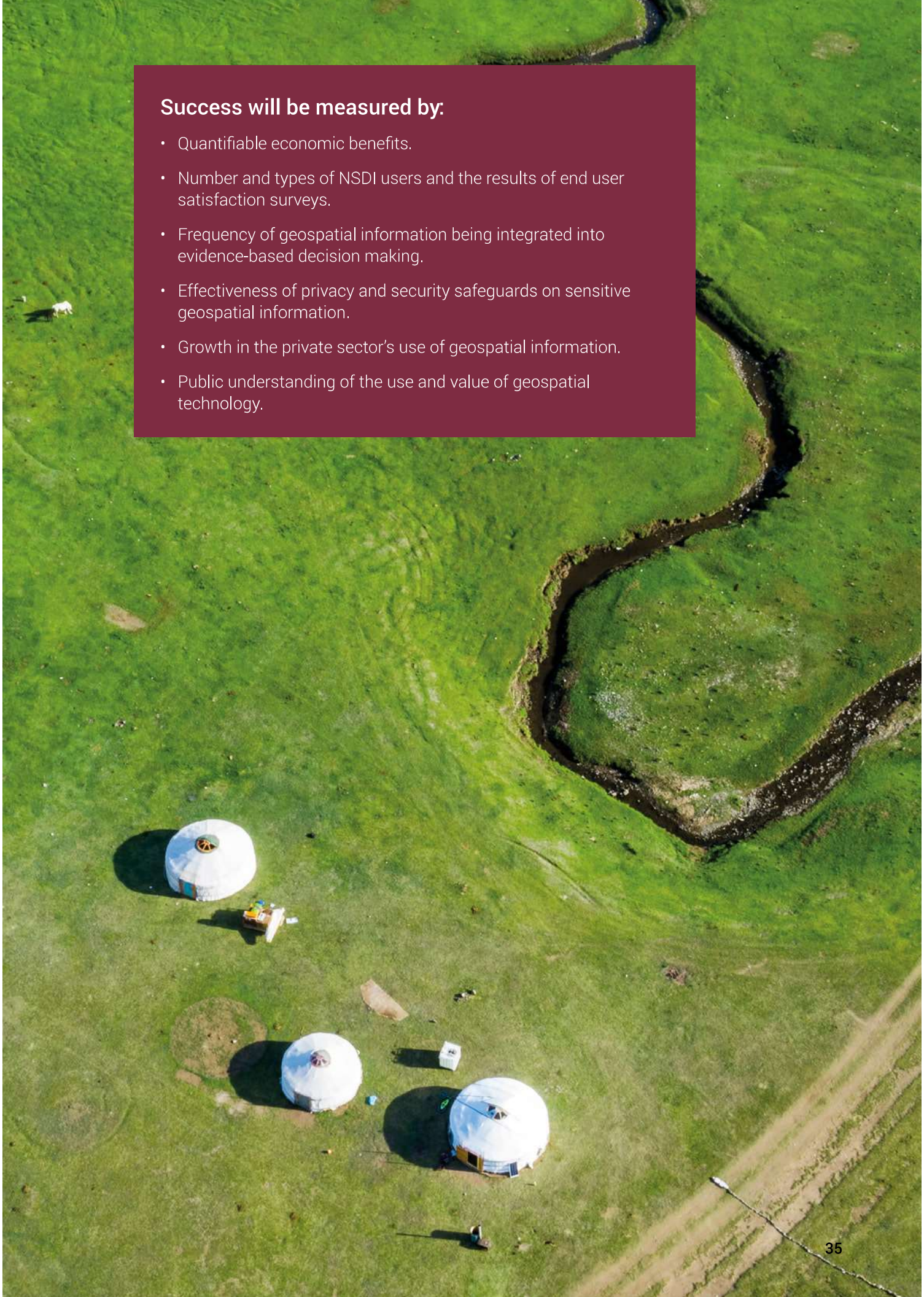
The implementation of the strategy will be:

- **User needs and value driven** – prioritizing action in areas where there is evidence of greatest opportunity.
- **Flexible and reactive to experiences from implementation** – regular monitoring of the impact and feasibility of new ideas and technologies will continually and iteratively improve the success of the NSDI.
- **Beyond technology** – technology alone is not enough; strong leadership, governance arrangements, policy and legal frameworks, partnerships, stakeholder engagement, and capacity development matter too.
- **Collaborative** – coordination and trust will be built across all levels of government, the private sector and society to bring about the necessary collective effort, and to learn from each other, through connecting data, people and systems.

This strategy and associated action plan cover a five-year period. This is not a fixed plan, but will evolve and adapt through experiences, priorities, new ideas, innovation and disruptive technologies as they emerge.

The NSDI Committee will lead this geospatial information initiative and publish annual plans assessing progress and next steps towards implementation. This strategy will be refreshed at a mid-way milestone. The next steps recognize that the NSDI Committee has different levers available to stimulate activity and collaboration across the key stakeholder groups.

- In the public sector, the NSDI Committee will work directly to remove barriers, create trust in sharing information, promote innovation and enable progress through capacity development.
- In UB city and aigmags, the NSDI Committee will collaborate to develop principles, standards and guidance, and promote continuous improvement, while respecting local needs and decisions.
- In the private sector, the NSDI Committee will address market failures, review incentives, remove any barriers to sharing of geospatial information, and use government procurement to influence beneficial outcomes.



Success will be measured by:

- Quantifiable economic benefits.
- Number and types of NSDI users and the results of end user satisfaction surveys.
- Frequency of geospatial information being integrated into evidence-based decision making.
- Effectiveness of privacy and security safeguards on sensitive geospatial information.
- Growth in the private sector's use of geospatial information.
- Public understanding of the use and value of geospatial technology.

Feature

Findable, Accessible, Interoperable and Reusable (FAIR)

The challenge of making geospatial information FAIR is at the heart of this strategy. By reducing restrictions that can impede data use and innovation, this digital transformation to FAIR data will maximize the economic, social and environmental value of geospatial information.

Government departments currently have considerable volumes of geospatial information that can form the basis for the NSDI. However, data quality (accuracy, completeness and currency) is highly variable and keeping information up-to-date it a challenging process. The importance of FAIR data cannot be underestimated:

Findable

Finding geospatial information and knowing its usage limitations is often problematic. To make data findable, metadata (information about data) needs to be available through the geoportal so that users can search and identify geospatial information appropriate for their use.

Accessible

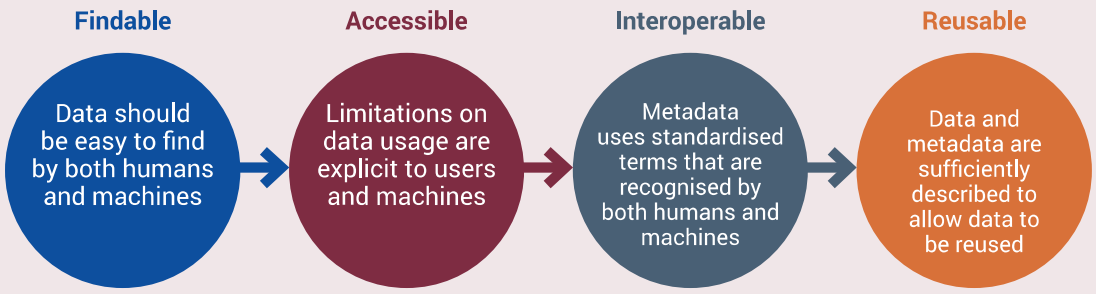
The variety of complex legal and business frameworks associated with geospatial information across stakeholder groups limits accessibility to geospatial information. Users need to be able to navigate their way through a well-defined Policy and Legal Framework to understand licensing, pricing and privacy conditions. An 'open data' policy and, supporting rules and practice is required.

Interoperable

Fundamental to the use and success of an NSDI is the ability to share and reuse information that is interoperable across a common ICT platform. For example, combining information on land and property ownership, land value and land use with environmental constraints and population growth predictions - supports urban planning. Interoperability requires adherence to data and technical standards.

Reusable

The value of geospatial information is increased when it can be re-used by more people and businesses beyond its original purpose. If information is fit for many purposes, additional value and benefits are is realized each time data is reused.



NSDI Fundamental Data Themes

The proposed NSDI Fundamental Data Framework includes 16 fundamental data themes, which are illustrated below. The data themes are used to group similar geospatial datasets so that it is easy for users to locate the information they need. These fundamental datasets are required for a broad range of decision-making applications, and users have a recurring need for them.


Public base topo map


Land use and cover


Land parcels

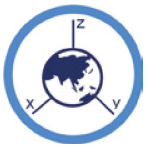

Geographic names


Transportation network

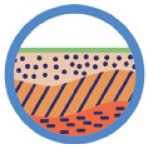

Elevation and depth


Boundary/functional areas


Address



Geodetic reference system


Geology and soil


Buildings and settlements


Orthophotos


Water


Historical, cultural sites


Population


Facility/infrastructure

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More Information

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