Agenţia Relaţii Funciare şi Cadastru a Republicii Moldova

INTEGRATED GEOSPATIAL INFORMATION FRAMEWORK

MOLDOVA

Socio-Economic Impact Assessment

Kartverket

consultingwhere
Maximising the value of location information

AGENTIA RELATII FUNCIARE SI CADASTRU
REPUBLICA MOLDOVA

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ABBREVIATIONS

The table below provides common abbreviations. All other abbreviations are initially included in full text on their first usage, before being abbreviated.

CORS	Continually Operating Reference System
DT	Diagnostic Tool
GAPD	Geospatial Alignment to Policy Drivers
GDP	Gross Domestic Product
GIS	Geographical Information System
GNSS	Global Navigation Satellite System
IGIF	Integrated Geospatial Information Framework
NSDI	National Spatial Data Infrastructure
SDG	Sustainable Development Goal(s)
SDI	Spatial Data Infrastructure
SK	Statens kartverk, Kartverket, Norwegian Mapping Authority
UN-GGIM	United Nations Global Geoinformation Information Management
WB	World Bank

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A full list of the parties engaged in the production of this report is included as Annex B.

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PREFACE

The world is experiencing a fourth industrial revolution built upon the internet and a comprehensive data infrastructure of fundamental datasets1. The term infrastructure is used here in the same sense as the road network is part of the fundamental infrastructure required to support transportation.

To help achieve this transition, many countries are building national data infrastructures. For instance, the Netherlands has been at the forefront of recognizing that integrating authoritative key data registers, such as buildings, addresses and ownership, into a coherent data infrastructure will, not only make Government more cost-effective, but will also make the interaction for citizens and businesses with Government quicker and more efficient2 and allow the private sector to derive benefits from new services.

One of the primary components of a data infrastructure is the location of a nation's assets, including land, natural resources, and the built environment to allow these assets to be managed more effectively in the context of development planning and climate change mitigation, for example. This is because "everything happens somewhere" and without knowledge of location (geospatial position3), decision making on many matters of national importance is significantly impaired.

The term Spatial Data Infrastructure (SDI) has historically focused on the collection of data and the implementation of technologies. The IGIF provides guidance on how to extend the scope of SDI to cover the governance, policy, financial, capacity and engagement processes necessary to collect, maintain, integrate, and share geospatial information, through all levels of government and society.

In August 2020, the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) adopted the Integrated Geospatial Information Framework (IGIF), which provides the strategic guidance that enables sub-national or national-specific Action Plans to be prepared and implemented to strengthen integrated information management.

The IGIF aims to assist countries (including city and regional governments) to move towards e-economies, e-services, and e-commerce. Delivering socio-economic value by improving services to citizens, enhancing evidence-based government decision making processes, creating new job opportunities, facilitating private sector economic growth, and taking practical actions to achieve a digital transformation. Through these means, IGIF will help to bridge the geospatial digital divide between developed and developing countries and to support the 2030 Agenda for Sustainable Development.

IGIF Structure

The IGIF comprises of three (3) parts as separate, but connected, documents:

- **Part 1:** Overarching Strategic Framework presents a forward-looking Framework built on national needs and circumstances, focusing on policy, perspectives, and elements of geospatial information. It sets the context of 'why' geospatial information management is a critical element of national social, economic, and environmental development.

[1] United Nations GGIM Fundamental Geospatial Data Themes: https://ggim.un.org/documents/E-C20-2018-7-Add_1-Global-fundamental-geospatial-data-themes.pdf

[2] https://business.gov.nl/regulation/addresses-and-buildings-key-geo-register/

[3] These terms are used in different geographies and contexts and are regarded here as interchangeable.

Part 2: Implementation Guide is the detailed document that provides the 'what', the specific guidance and actions to be taken in implementing the Framework. The aim is to provide guidance for governments to establish 'nationally' integrated geospatial information frameworks in such a way that transformational, albeit staged, change is enabled, visible and sustainable.

- **Part 3:** Country-level Action Plans will provide templates and guides to operationalize the Framework in a national and sub-national context. Providing the 'how, when and who' approach, this document will assist countries to prepare and implement their own country-level Action Plans taking into consideration national circumstances and priorities.

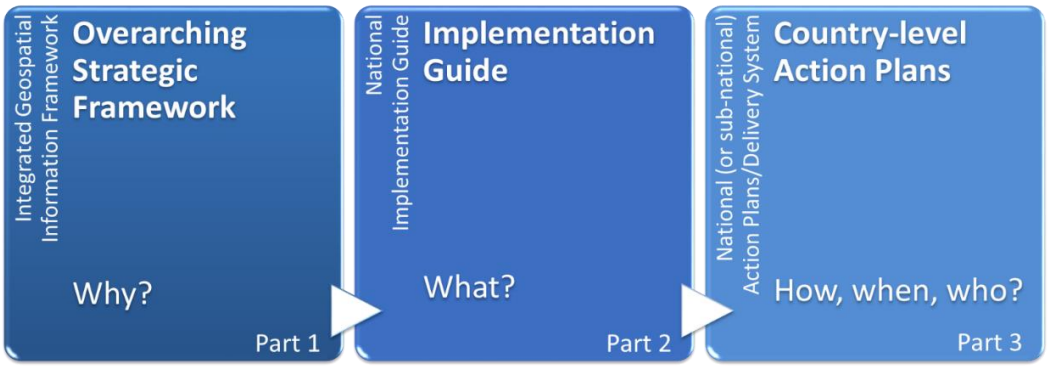


Figure 1: The 3-component documents of the Integrated Geospatial Information Framework

World Bank IGIF Implementation Methodology

The World Bank Group has established an IGIF Implementation Methodology and corresponding analytical toolkit to support the use of the IGIF and incrementally create SDIs customized to specific countries and priorities. The graphic below illustrates the sequence and relationship of these analytical tools used to arrive at the implementation of the SDI. The symbology shows the analytical tools (in orange), key inputs (in blue), the IGIF in purple, outcomes (in green) and uses arrows to different types of information flows.

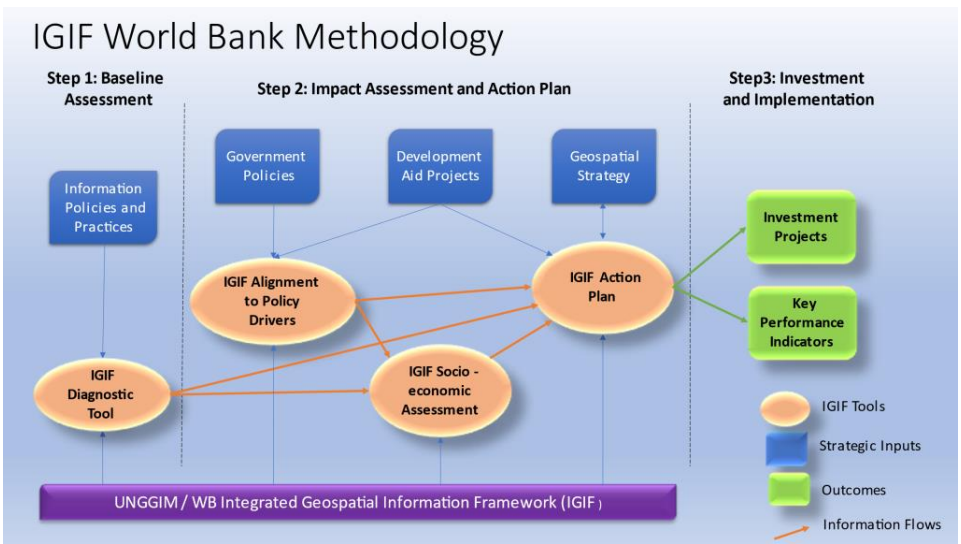


Figure 2: World Bank IGIF Implementation Methodology

In summary, this methodology has been applied as follows:

Step 1: Baseline Assessment

A single integrated tool is used for this purpose:

Analytical Tool 1 – IGIF Baseline Diagnostic Tool (DT): this provides an assessment of the "as is" position of geospatial information management in the country, structured around the nine IGIF pathways, including governance, policy, financial, human capacity, and technical perspectives. The output forms a baseline for the next steps.

Step 2: Impact Assessment and Action Plan

Three tools are used to build a prioritized, cost-justified roadmap for strengthening integrated geospatial information management:

Analytical Tool 2.1 – IGIF Alignment to Government Policy Drivers: this tool is used to align the Government's strategic objectives and international commitments to specific spatial use cases (applications) and then prioritizes them based on how well they support and accelerate achieving these strategic objectives.

Analytical Tool 2.2 – IGIF Socio-Economic Impact Assessment: this tool delivers an assessment of the socio-economic business case for investment in an SDI from both qualitative and quantitative perspectives. It is informed by the outputs from the previous two tools outlined above.

Analytical Tool 2.3 – IGIF Action Plan: this tool builds on the previous deliverables to create or update a high-level geospatial strategy and a corresponding costed plan roadmap for SDI enhancements, presented as a series of interdependent policy interventions and implementation projects.

Step 3: Investment and Implementation

Once the Action Plan has been approved in terms of scope, investment plan and priorities, then work will commence to identify sources of government and international funding. Individual actions may also need to be specified in greater detail to support implementation planning and the definition of Key Performance Indicators (KPIs) to monitor and evaluate implementation.

These steps must be delivered within a recognized project management methodology that provides proper governance and incorporates transparency and accountability for all tasks and outcomes.

CONTENTS

EXECUTIVE SUMMARY

Background

The central purpose of this report is to assess the economic, social and environmental impacts[4] of creating a Spatial Data Infrastructure (SDI)[5] for Moldova and, where possible, quantifying the net benefits. It adopts the World Bank methodology developed under the Global Geospatial project and United Nations guidelines for implementing an Integrated Geospatial Information Framework (IGIF)[6] on which the SDI will be built.

The results of the analysis will feed into an action and investment plan outlining where policy and project interventions will generate the most significant positive social impacts and stimulate economic growth. Unfortunately, there is a shortage of case studies, or agreed methodologies, for quantifying and attributing benefits of the creation of an SDI, particularly for developing countries. In chapter 4, we present a literature review of some of the most relevant existing studies, noting these are small in number. We therefore also borrow from other related disciplines in order to adopt good practice.

Current State

The assessment, using the World Bank diagnostic tool, identified key strengths in governance, innovation, and data. The key weaknesses correlate to finance, education/capacity, and communication/engagement.

Generally, the feedback from the stakeholder community is positive and there is good support from across the stakeholders for the implementation of the National SDI. Most stakeholders are enthusiastic about making a success of the National SDI. The work of ALRC is appreciated and resulted in positive feedback regarding its role and its commitment. However, not all stakeholders are fully aware of the progress being made, this was very evident in terms of Legal and Policy, and Finance. **While significant effort has been made regarding the development of the National SDI, the output from the stakeholder consultations is that many stakeholders are not fully aware or not fully informed of these initiatives, and the progress that has been made, which will have had implications on the assessment**.

Overall, given the limited resources available to them, our observation is that ALRC is providing a valuable service and that the implementation of the National SDI is broadly supported and endorsed. For details refer to document reference 'Moldova IGIF Baseline Diagnostic Report_20210528_v1' available from ALRC.

Alignment of Geospatial Information Priorities to Government Policy Drivers

The overall target outcome for the SDI is to lead to the efficient, equitable and optimal utilization and management of geospatial information applied across all sectors of the economy. To ensure optimal alignment, the study has analyzed a wide range of Government policies and commitments. Based on this analysis, the following sectors are those where, it believes, geospatial information generally and the SDI particularly, can make the most significant and positive impact:

[4] The term impact is adopted throughout this section to acknowledge that there may be dis-benefits from the interventions proposed, so these may be positive as well as negative in financial terms.
[5] National Spatial Data Infrastructure (NSDI) is the policy, capacity building, technical and economic activities necessary to create the required location (spatial) information to underpin social and economic development.
[6] IGIF Overarching Strategic Framework: http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/Part%201-IGIF-Overarching-Strategic-Framework-24July2018.pdf

i. Economic and Urban Planning
ii. Land Management and Administration
iii. e-Government
iv. Transport
v. Disaster Risk Management and Emergency Services
vi. Agriculture, Forestry and Fishing
vii. Health and Social Care
viii. Natural Resources
ix. Water and Hydrology
x. Energy
xi. Environment and Tourism
xii. Local Government
xiii. Commercial
xiv. Multi-sector

This extensive list is illustrative of the wide range of sectors that can benefit from an effective National SDI. A companion report, **'Geospatial Alignment to Policy Drivers'**, contains analysis of key government policy at the time (June 2021) and an inventory of use cases across these sectors.

Investment Profile

The investment required is composed of core data and technology projects with supporting governance, legal, financial management, partnership development and human capacity building measures. It will will ultimately deliver an SDI composed of 32 foundation data themes[7] that are nationally complete, authoritative, up to date and of an appropriate quality to underpin development of the economy of Moldova and facilitate improving the welfare of its people.

However, this will take more than the five-year horizon for investment assessed here. It is worth noting that the Korean NSDI, one of the most advanced in the world, is now going through its sixth five year Action Plan and still sees scope for further development.

The key recommended areas of investments, over the next five years, are:

- Enhancing **human capacity** through closer interaction with schools and tertiary institutions to raise awareness and understanding of the value of geospatial.
- **Upskilling Government Agencies**, including but not limited to ALRC, to be able to provide leadership and coordination more effectively.
- **Growing the geospatial ecosystem** by engaging and communicating more effectively with a wider range of users, particularly in the commercial sector.
- **Raising the profile of NSDI** by focusing messages on its role in digital transformation and positive impacts it brings to many sectors of the economy.
- Complete national coverage of **ortho-rectified imagery, terrain model and topographic basemap** at sufficient scales to support a wide range of use cases and put in place a regime of continuous revision to maintain currency.
- **Completion of the Land Cadastre** for 95% of all parcels and to make it openly available to support the upgrading of valuation processes, and through the process introduce more objective and transparent land and property taxation.

[7] Reference Law 254 of 2016 see https://www.legis.md/cautare/getResults?doc_id=105790&lang=ro

- **Build a scalable National Geoportal** providing **online access to fundamental geospatial data through web viewing and APIs** that will be openly available to citizens, businesses, government, and professionals consistent with cyber-security and commercial constraints such as protecting intellectual property rights.
- Agreement of **Geospatial data sharing** protocols to reduce costly data duplication and improve quality and consistency.
- Roll-out of access to the **National Geocoded Street Address database,** maintained to a high-level currency through effective exchange of updates between local and central government**.**
- Create **3D City Models (digital twins)** for four city centers including Chisinau.
- **Establish a National Earth Observation centre of excellence** facilitating wide access to satellite imagery and associated services.
- **Digitization and quality improvements** for additional fundamental geospatial data themes, particularly focusing on reporting and analysis on the UN SDGs.
- **Maintenance of the geodetic network** including the network of Continuously Operating Reference Stations (CORS).
- Enhancing integration with the **emergency situations** agency to speed up response times to save lives and prevent damage to property and crops.
- Support greater geostatistical capabilities **spatial analysis and visualization capabilities**.
- **Sponsoring innovation** in the development of new applications using the NSDI.
- Define and implement a **sustainable business model** for the infrastructure.

Key to the success of this initiative will be the active participation of a wide range of stakeholders from both public and private sectors to ensure that maximum cross-cutting benefits are realized. It is envisaged that ALRC, as the appointed lead body for geospatial information, will coordinate and manage the program of projects. However, investment will be shared across the stakeholder community.

Selective Benefits Quantification

As is commonly observed across the developing world, there is not necessarily the data, or the understanding of the financial impacts amongst suppliers or users, to build a fully comprehensive justification for investment.

It is also important to note that both the benefits and investments detailed in this report are based on the available data collected in a short timeframe. The absence of specific line item investments or benefits for a ministry does not mean that no action is required, rather it reflects the data we were able to collect and quantify. The team expects that other quantified use cases, and the investments required to realise these benefits, would yield comparable benefit to cost ratios in those use cases detailed below.

To overcome these limitations, the team has sought to quantify a subset of the most significant impacts for a small number of use cases, documented in section 5.3:

1. **Improved address data sharing** – reducing the costs to the collection and maintenance of geospatial information by creation of a single master source that is authoritative, complete and current. The national geocoded address dataset has high potential value in reducing duplication and obviate costs of maintaining multiple separate databases.
2. **Faster amergency despatch** – through availability of fundamental geospatial data, particularly a full national geocoded address database and updated geographical names, including points of interest.
3. **More accurate GNSS-augmented geodetic surveys** – the national CORS network enables accurate surveys that are needed by the construction and utilities sectors. The use of GNSS

equipment reduces costs as it is quicker and requires less staff. There are also benefits for cadastral surveys, but these are not included to avoid double counting benefits with the land value case study.

4. **Digital Mapping Value** – geospatial enabled apps for navigation and other location finding purposes on the web and mobile devices, have been shown globally to have significant value in saving time for consumers. Global benefit estimates have been scaled, based on the size and maturity of the Moldova market.
5. **Local Government efficiency** – currently running projects funded by USAID with support from Kartverket and other aid agencies are assisting local government to make more effective use of geospatial information but there are many functions where the roll-out of applications has not yet started. Using a "benefits transfer" approach a conservative estimate of the positive impact is assessed.
6. **Agricultural Productivity** – the use of data from the EU Copernicus programme has the potential to increase agricultural production by reducing fertilizer use. The experience from recent work in Poland is used to infer the benefits to Moldovan cereal farmers.
7. **Land market growth** – the World Bank Land Registration and Property Valuation Project will complete 95% of registrations. The benefits identified in respect to increased access to credit and lease values of state land are inferred.
8. **New Geospatial products and services** – the availability through the SDI of more comprehensive and open foundation data has been shown globally to contribute to growth of the economy. A conservative assessment of predicted benefits has been made by scaling based on the National GDP and an assessment of the maturity of the Moldovan economy.
9. **Open geospatial data** – the impact on the national economy of free and open access to SDI is assessed by comparison to the observed benefits realized in the EU.

This list covers quantified benefits for about 20% of the total use cases identified, other quantifiable use cases were identified but because of lack of available data or time were not able to be completed.

Investment Plan

During the 5-year investment period the following sums will be required to deliver the benefits anticipated, see table below.

Period	Investment Value (MDL Thousands)	Cumulative Investment Value (MDL Thousands)	Investment Value (USD Thousands)	Cumulative Investment Value (USD Thousands)
Year 0+1	22,710	22,710	1,282	1,282
Year 2	20,323	43,033	1,147	2,429
Year 3	22,664	65,696	1,279	3,708
Year 4	17,348	83,044	979	4,687
Year 5	12,015	95,059	678	5,365
Total	95,059		5,365	

Table 1: Investment Plan

The plan is based on a relatively steady level of investment over a 5-year period from approval. It assumes that investment will drop off during Year 5 as the investment period is completed. The total investment of MDL 95.06 million (USD 5.36 million) is commensurate with what has occurred in other developing countries. It is worth observing that required investment would be much higher had it not been for the input of major donors, particularly over the previous 10 years.

Cost-Benefit Analysis

The financial values for the investment plan and on-going recurrent expenditure have been entered into a discounted cash flow spreadsheet to calculate the likely Return on Investment (RoI) using a standard Cost-Benefit Analysis approach.

The results for the mean case, can be summarized as follows (units are Thousands):

Description	MDL (Thousands)	USD (Thousands)
Sum of discounted benefits	624,630	35,255
Sum of discounted costs	156,578	8,838
Benefit to Cost Ratio	**3.99**	
Cumulative Net Present Value	**468,052**	**26,418**

Table 2: Cost-Benefit Analysis (Mean Case)

The cash flow forecast is shown in the chart below and detailed in section 6 of the report.

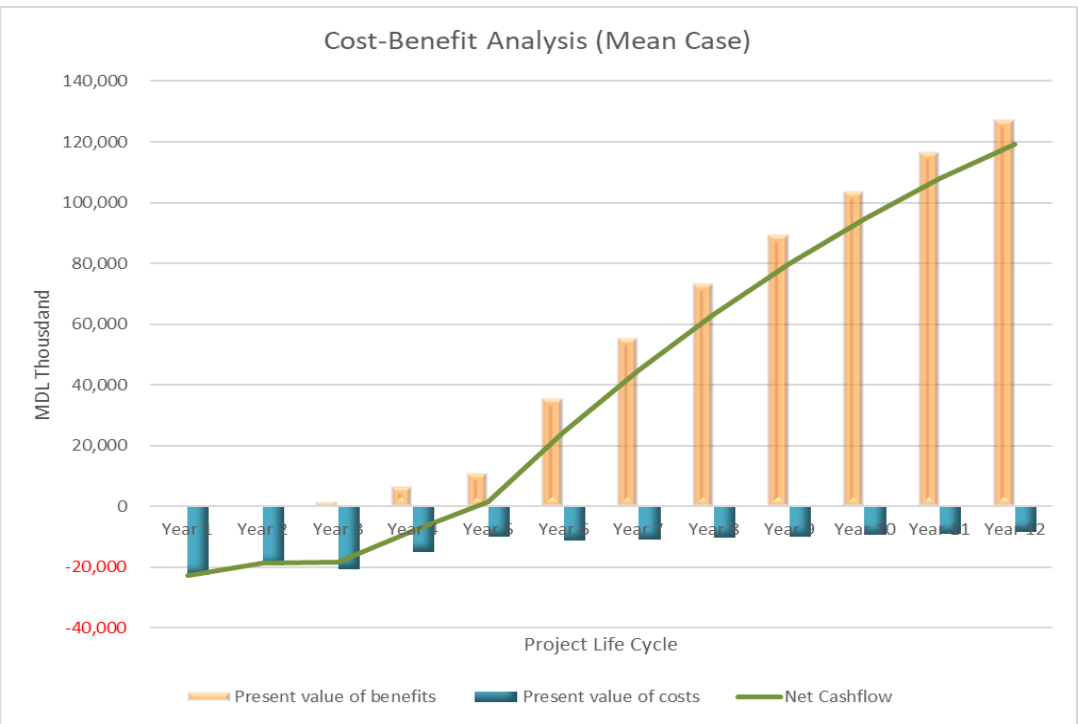


Figure 1 Cost-Benefit Forecast (Mean Case)

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

Sensitivity Analysis

Sensitivity analysis, to assess the robustness of the cost-benefits analysis, was conducted by making the following changes to the mean case outlined above:

Lower Bound

For the most conservative benefit estimate, low bound impacts were used for all those quantified cases where ranges were available, as follows:

Emergency Situations – lower bound estimates

Augmented GNSS – lower bound estimates

Digital Mapping Value – reduced annual growth from 5% to 2.5%

Precision Agriculture – reduced take-up rate from 5% to 2.5%

The impact on the key metrics were:

Benefit to Cost Ratio: 3.17 (reduction from 3.99 for mean case)

Cumulative Net Present Value: MDL 340 million (reduced from mean case MDL 468 million)

Upper Bound

For the upper bound (optimistic case), we have applied the upper bound range of values for the same set of use cases as used in the lower bound, as follows:

Emergency Situations – upper bound estimates

Augmented GNSS – upper bound estimates

Digital Mapping Value – increase annual growth from 5% to 7.5%

Precision Agriculture – increase take-up rate from 5% to 7.5%

The impact on the key metrics were:

Benefit to Cost Ratio: 4.82 (increase from 3.99 for mean case)

Cumulative Net Present Value: MDL 598 million (increase from mean case MDL 468 million)

We would conclude that the policy advice that this is a viable investment would not change even in the lower bound case.

Report Status

Following review and feedback by Kartverket, ALRC, FAO, and WB this version represents the final version of the socio-economic impact assessment work and presents the results of the analysis.

1. INTRODUCTION

Context

To facilitate digital transformation, many countries are building national information infrastructures. One of the primary components of that data infrastructure is the location of a nation's assets including, for example: land; natural resources; the built environment; the results of high impact processes such as climate change and urban planning; and events, such as flooding. This is because "everything happens somewhere" and without knowledge of location (geospatial data) decision making on many matters of national importance is significantly impaired. We use the term Spatial Data Infrastructure (SDI) as a "short-hand" for the policy, capacity building, technical and economic activities necessary to create the required location (spatial) information to underpin social and economic development.

It should be stressed that an SDI does not include all the geospatial data. The United Nations defined a set of 14 foundation data themes[8] for an SDI see Figure 1.

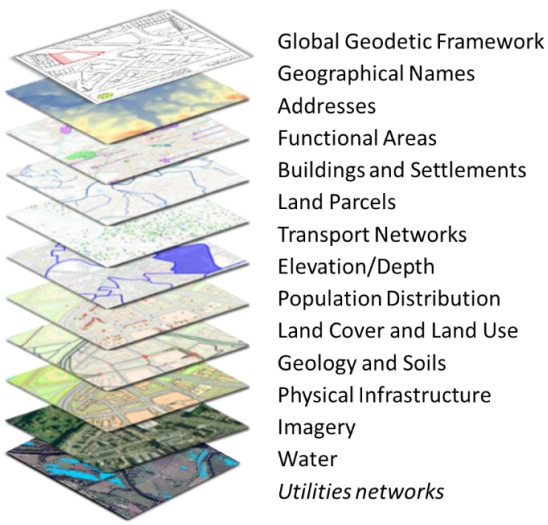


Figure 2 UN GGIM Data Themes

The development of the National SDI in Moldova has progressed over recent years through support from various donors including the United Nations, World Bank, European Union, and the Norwegian Mapping Authority (Kartverket) as outlined in the previous paragraph. A significant milestone for this was the publication of Law 254 of 2016[9] on national spatial data infrastructures. This Law, together with various amendments, Government Decisions and Government Orders, provides the general rules, together with the necessary political endorsement, regarding the establishment of the National SDI. The scope of the Law includes all spatial data sets as specified in the annexes to the Law, data content, data availability, data sharing, metadata, interoperability of the data, data services, data access, data use, together with the relevant responsibilities of the public entities and third parties. The spatial data sets identified in Annex 1, 2, and 3 of the Law are based on the EU Directive Inspire[10] and represents a broader range of data themes than the fundamental datasets covered by IGIF.

[8] UN GGIM Foundation Data Themes http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/E-xC20-2018-7-Add_1-Global-fundamental-geospatial-data-themes.pdf
[9] https://www.legis.md/cautare/getResults?doc_id=105790&lang=ro
[10] https://inspire.ec.europa.eu/Themes/Data-Specifications/2892

In August 2020, the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) endorsed an Integrated Geospatial Information Framework (IGIF), which provides the strategic guidance that enables country specific action plans to be prepared and implemented. Direct benefits will include encapsulating new and innovative approaches to national geospatial information management, implementing integrated evidence based decision-making solutions, and maximizing and leveraging national information systems that are tailored to individual country's situations and circumstances.

The Framework aims to assist countries to move towards e-economies, e-service and e-commerce to improve services to citizens, build capacity for using geospatial technology, enhance informed government decision making processes, facilitate private sector development, take practical actions to achieve a digital transformation, and to bridge the geospatial digital divide in the implementation of national strategic priorities and the 2030 Agenda for Sustainable Development.

This document presents an initial socio-economic impact assessment, based on the IGIF, for development of a Spatial Data Infrastructure (SDI) over a 5-year period. It is a key analysis to guide the development of the Action Plan for Moldova.

Moldova

1.1 Geography

The Republic of Moldova is a land-locked country in Eastern Europe situated between Romania (to the west) and Ukraine (to the east). The country has a total area of approximately 33840 square km[11] (including Transnistria) with a usual resident population in January 2021 of 2.6 million (excluding districts from the left side of the river Nistru and municipality Bender)[12]. The urban population is less than half of the total population, but the literacy rate is very high.

1.2 Administration

The government is a parliamentary republic, and the Executive comprises a Head of State (President), a Head of Government (currently the Acting Prime Minister), and a Cabinet. The territory of the Republic of Moldova is organized administratively in administrative-territorial units: districts, cities and villages. The statute of village (commune), sector, city (municipality) is elaborated based on the framework statute, approved by the Parliament of the Republic of Moldova and it is approved by the local Council. The administrative territorial organization of the Republic of Moldova is made on 2 levels: villages (communes), sectors and cities (municipalities) constitute the first level, districts, Chisinau municipality, Balti municipality constitute the second level[13].

1.3 Climate

Moldova ranks among the most climate-vulnerable countries in the Europe and Central Asia (ECA) region based on a range of social and economic indicators. Climate projections indicate increasing mean annual temperatures (exceeding 2 degrees Celsius by 2050), decreasing (in some regions increasing) precipitation and an increase in extreme weather events, such as droughts and floods, as well as other severe weather events such as hailstorms, torrential rains, late frosts, or heavy winds. The Intended Nationally

[11] https://statbank.statistica.md/PxWeb/pxweb/en/10%20Mediul%20inconjurator/10%20Mediul%20inconjurator__MED050/MED050100.px/

[12] https://statbank.statistica.md/PxWeb/pxweb/en/20%20Populatia%20si%20procesele%20demografice/20%20Populatia%20si%20procesele%20demografice__POPrec__POP010/POP010100rcl.px/table/tableViewLayout1

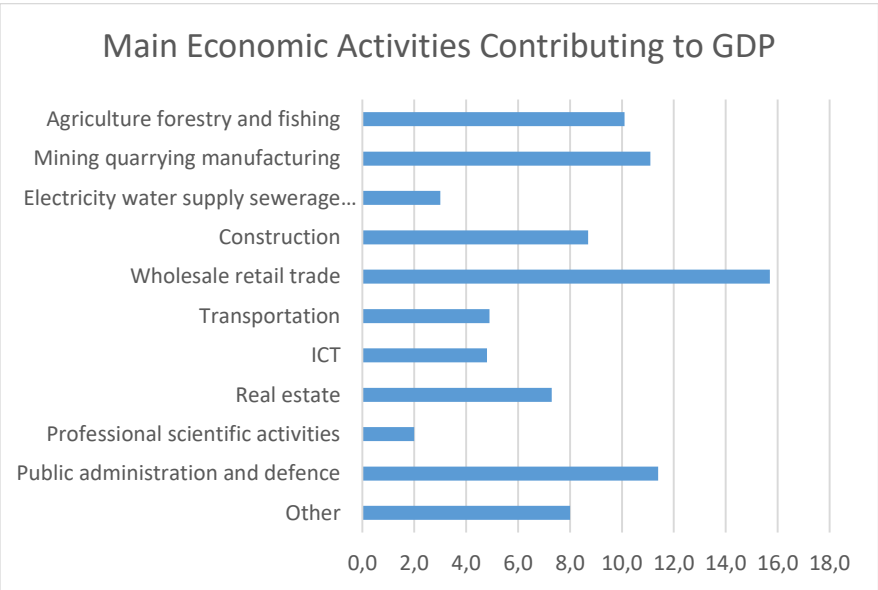
[13] https://moldova.md/en/content/administrative-territorial-organization-moldova

Determined Contribution (INDC) of Moldova specifically requested a developing mechanism for monitoring climate change vulnerabilities, impacts and costs, promoting crop and flood related insurances, and disseminating climate relevant information. Systematic land valuation data prepared before disasters is shown to be essential for estimating the costs of climate disaster damage, cost-benefit analysis of recovery planning and disaster-related compensation and insurance systems. Climate-induced disasters, mainly floods, are also shown to cause significant temporal population displacements and a loss of housing and other property in Moldova.

Economy Breakdown

Moldova is a small, economically, and culturally open, lower middle-income country. Recently, the economy has grown by an average of 5 percent per year, fuelled largely by consumption. Remittances from Moldovans abroad account for a quarter of Moldova's GDP, one of the highest shares in the world.

The economy relies heavily on the agricultural sector but has some natural resources including lignite, phosphorites, gypsum, and limestone. With few natural energy resources, Moldova imports almost all its energy supplies from Russia and Ukraine and has an objective of connecting with the European power grid by 2022. Stronger integration with Europe is a stated goal of the government and this has resulted in some market-oriented progress. Moldova has experienced better than expected economic growth since 2017, largely driven by increased consumption, increased revenue from agricultural exports, and improved tax collection[14]. During 2014 Moldova signed an Association Agreement (AA) and a Free Trade Agreement (DCFTA[15]) with the EU connecting Moldovan products to this market. The EU AA/DCFTA has contributed to significant growth in Moldova's exports to the EU and in recent years the EU purchased over 65% of Moldova's exports[16].



[14] https://www.cia.gov/the-world-factbook/countries/moldova/#economy
[15] Deep and Comprehensive Free Trade Agreement
[16] http://eubam.org/wp-content/uploads/2017/10/Pisar_1-2.pdf

Figure 3 Share of main economic activities in the generation of gross domestic product (excluding net taxes on products)[17]

Agricultural production is dominated by cereal and other plant-based farming, representing approximately 70% of agricultural production. Livestock/animal farming represents approximately 26% of agricultural production.

Manufacturing covers a diverse set of activities including food, beverages, textiles, chemicals and chemical products, basic pharmaceutical products and pharmaceutical preparations, metallurgical industry, motor vehicles and trailers, paper and paper products are some of the many manufacturing activities listed in the National Accounts[18].

In terms of economic outlook, a recent report published by the World Bank[19] has identified that while the economy has gained some momentum following the easing of the restrictions caused by Covid, due to the pandemic and a severe drought, economic activity dropped during 2020 with GDP declining by 7%. Covid impacted trade and industrial production while the drought impacted agriculture (the economy is highly vulnerable to periods of extreme weather). In its report the World Bank forecasts a gradual economic upturn but most of the short-term indicators (retail trade, agricultural trade, industrial production) are forecast to remain in negative territory. In the medium-term, GDP is estimated to rebound to 3.8 percent in 2021, (assuming favorable conditions) and the economy is expected to gain momentum, supported by the recovery in disposable income because of remittances remaining resilient.

Document Structure

The rest of the document is structured as follows:
Section 2 Scope – outlines the objectives of the SDI, target outcomes, priorities and contribution of the economic analysis and its contribution to the Investment and Action Plan.
Section 3 Methodology – sets out the case for cost-benefit analysis and how it has been applied.
Section 4 Literature Review – examines national-scale studies focused on the economic benefits of geospatial information.
Section 5 Analysis – describes the impacts identified during the study and the process used to quantify a subset of the more significant benefits.
Section 6 Economic Impacts – presents the cost-benefit analysis results and sensitivity analysis for potential variations from the expected return on investment
Section 7 Next Steps – summarizes further development that is required to finalize the work

Annex A – outlines the general approach to Socio-Economic Impact Assessment
Annex B – provides a list of stakeholders engaged during this study.
Annex C – details use cases where NSDI benefits were identified but not quantified.

[17] From Statistical Yearbook Moldova 2020 https://statistica.gov.md/pageview.php?l=en&id=2193&idc=263
[18] https://statistica.gov.md/public/files/publicatii_electronice/Anuar_Statistic/2020/13_AS.pdf
[19] https://www.worldbank.org/en/country/moldova/brief/moldova-economic-update

2. SCOPE

2.1. Objectives

The central objective for the study team is to assess the economic, social and environmental benefits of creating an SDI and, where possible, quantifying these benefits. The results of the economic benefits analysis will then feed into a costed action plan outlining where policy and project interventions will generate the most significant positive social impacts and stimulate economic growth.

2.2. Target Outcomes

Based on achieving these objectives, the SDI is expected to lead to the efficient, equitable and optimal utilization and management of resources which, in turn, would have a positive impact on many parts of the economy, including:

- Public administration: supporting an integrated approach to decision-making for planning and development using visualization techniques and the integration of geography and statistics.
- Health and Education: supporting the planning and development of health and education facilities, aligned with population densities and forecasts of population growth.
- Planning and Development: the integration of cadastral data with land use and zoning data will provide more informed development planning; improving the planning and design of urban areas and communities using geospatial data.
- Digital Economy/Digital Transformation: supporting the areas targeted by the digital economy strategy including planning, urban development, rural transformation, transport and infrastructure, and energy efficiency using mapping, imagery, address records, land ownership records, and other public registers. At the national level the use of geospatial information provides a means of consistent integration of public registers into a unified system and coordinated with other policy documents.
- Rural development and the management of natural resources: geospatial information supports the decision-making for agricultural, forestry and rural development purposes using analytics tools and visualization techniques. Moreover, geospatial information also supports the integration of geography and statistics.
- Water supply and sanitation: supporting the management, planning, and development of water and wastewater services with forecasts of population growth, population density, and urban development.
- Energy: supporting the forecasting, planning, development, and maintenance of energy distribution and energy supply infrastructure and contributing to the development of intelligent energy networks; using topographic and climate data to support the identification of suitable locations for sources of renewable energy (e.g., wind, solar).
- Agriculture and the environment: supporting improvements in rural, forestry and agricultural methods to contribute to more sustainable agriculture and providing environmental benefits; contributing to the use of precision farming methods, alongside economic considerations, precision farming also promises substantial environmental benefits and is actively promoted by the EC.

2.3. Economic Status

Moldova's economy relies heavily on its agriculture sector, featuring fruits, vegetables, wine, wheat, and tobacco. It also depends heavily on annual remittances of about USD 1.2 billion – almost 15% of GDP – from the roughly one million Moldovans working in Europe, Israel, Russia, and elsewhere.

With few natural energy resources, Moldova imports almost all its energy supplies from Russia and Ukraine. Moldova's dependence on Russian energy is underscored by a more than USD 6 billion debt to Russian natural gas supplier Gazprom. Moldova is seeking to connect with the European power grid by 2022 to improve its energy security.

The government's stated goal of EU integration has resulted in some market-oriented progress. In 2014, Moldova signed an Association Agreement and a Deep and Comprehensive Free Trade Agreement with the EU (AA/DCFTA), connecting Moldovan products to the world's largest market. The EU AA/DCFTA has contributed to significant growth in Moldova's exports to the EU.

Over the longer term, Moldova's economy remains vulnerable to political uncertainty, weak administrative capacity, vested bureaucratic interests, energy import dependence, Russian political and economic pressure, and heavy dependence on agricultural exports.

2.4. Strategic Investment Priorities

The study has analyzed a series of Government policies which set out its plans for strategic investment. Based on this analysis and aligning with the economic drivers as outlined above, the following sectors are those where geospatial information generally, and the SDI particularly, can potentially make a significant and positive impact:

(a) **Land Administration (including addressing)** – valuation, land and property taxation and land use planning. Completing the Land Registration and Property Valuation project, together with data sharing with other agencies, will allow for more precise valuation and the potential for more efficient assessment of the tax relating to specific land parcels.

(b) **Agriculture/Forestry** – the use of geospatial data can provide for more efficient crop planning and production based on local conditions; having access to satellite data that can be refreshed on a regular basis can provide the ability to monitor vegetation growth patterns and vegetation stress developing at an early stage of the crop cycle. There is also the opportunity for improved development, promotion and implementation of forest policy, and alignment with international trends of socio-economic sustainable development. Of specific importance here REDD+[2021] serves as a framework through which developing countries are rewarded financially for reducing greenhouse gas emissions or increasing the removal of carbon dioxide from the atmosphere through practices on forest land.

(c) **Environment** – environmental monitoring and protection can be more effective with good geospatial data; environmental impact assessments can be more cost-effective using an SDI; visualization and analysis of air pollution leads to better outcomes.

(d) **Economic and Development Planning** – supporting National Development Plans by adopting a holistic approach to balancing economic diversification and social needs across all aspects of the urban and rural built environment whilst also meeting Sustainable Development Goals (SDG). Better and more efficient management of urban migration and rural development will lead to improved decision making on the provision of public infrastructure and services.

(e) **eGovernment (including e-governance)** – to further develop the automation of state registers to make citizen engagement more efficient and reduce the burden on citizens in all interactions with public services.

(f) **Transport** – supporting the National Transport Strategy including creating an environment for the transport and logistics sector to facilitate sustainable economic development; street works

[20] www.un-redd.org

[21] https://redd.unfccc.int

management; road safety and maintenance; and introducing intelligent transport systems that can integrate alternative modes of transport.

(g) **Disaster and Emergency Management** – improving planning and response to all types of incidents. The use of geospatial data to aid preparation, response, and recovery. The monetary benefits accruing from the more effective response to disasters are substantial, as are the social benefits. Geospatial data can also assist in disaster risk reduction in simulation studies.

(h) **Energy and Utilities** – providing access to water, electricity, heating, and telecommunications necessary to the welfare of citizens and development of business; investing in Renewable Energy could help reduce the current dependence on energy imports

(i) **Health** – mapping accessibility of primary health care facilities; development of patient pathways; providing Improved access to primary healthcare and reduction in healthcare inequalities; supporting 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.

2.5. Links to existing Donor Programs

There are multiple existing projects already being advanced by the Government, with support from aid agencies and international financial institutions, that are relevant to the National SDI project. These are summarized below, with a focus on being complementary to the IGIF project.

2.5.1. Norwegian Funded Geospatial Support

The Norwegian Mapping Authority has been supporting the Government of Moldova since 2006 and has successfully implemented several projects including delivering two generations of orthophotos and digital terrain model; setting up a nationwide CORS network; developing a new IT system for property registration and cadastre and building up technical and professional capacity at the Agency for Land Relations and Cadastre ALRC. A new basemap for the whole of Moldova has also recently been completed with Norwegian overseas aid.

Norway has also supported implementation of the National Spatial Data Infrastructure. This has included a substantial project component dedicated to geodata distribution to the users on regional and local level. The IGIF baseline assessment for Moldova was done in May 2019 by ALRC both internally and in collaboration with several stakeholders. The country progress with the implementation of IGIF was reported in a contribution to the World Bank Land and Poverty conference in 2020. It is the sponsor of the current IGIF Action Plan initiative under which this report has been produced.

2.5.2. World Bank Land Registration and Property Valuation Project (LRPVP)

The development objective of the project22 is to improve the quality and transparency of the land administration and property valuation systems. Property Registration will support the first registration of public and private land in Moldova and strengthen the data quality for records already in the land register. This component will also organize mandatory public displays and public awareness campaigns to ensure citizens are engaged and aware of the procedures, activities, and benefits during first property registration. The component consists of three subcomponents: (i) systematic registration of private land—including implementation of public displays, public awareness campaigns and a grievance mechanism; (ii) systematic registration of public land; and (iii) improvement of the quality and reliability of the cadastre data. A second component focuses on property valuation that will support extending mass valuation to incorporate those properties not currently included and to carry out selected revaluation of properties to

[22] Project (P161238) https://projects.worldbank.org/en/projects-operations/project-detail/P161238

help improve the transparency of the property market and keep the property valuation system current and usable.

2.5.3 EU4Moldova

The 'Improving spatial data services in the Republic of Moldova following EU standards' twinning project aims to contribute to further development of National Spatial Data Infrastructure (NSDI) in the Republic of Moldova, based on the EU INSPIRE Directive[23]. It will enable the Agency for Land Relations and Cadastre (ALRC) to assess constraints in managing geospatial data in a more efficient and sustainable way and take corrective measures towards achieving this. As a final goal of this project, the National Spatial Data Infrastructure should be a functional tool for citizens, public institutions, and economic operators to check relevant information regarding properties, infrastructures, and environmental issues on any zone of the country. Furthermore, NSDI will provide reliable tool to the authorities for better planning capabilities in a broad range of sectorial policies, namely transport, environment, and agriculture among others.

2.5.4. CORINE Pilot

This is part of the ENI SEIS II East Description of Action[24] "Pilots on extending CORINE Land Cover (CLC) methodology to areas of the partner countries" designed to facilitate the access to, and use of, geospatial data required for SEIS implementation at national level. This activity also allowed direct links to related initiatives and programs at the European level; namely the completed work to produce the 2018 update of the CLC layers in the EEA39 countries (main parameters summarized in Figure 2), and services provided through the Copernicus Programme[25], a joint European Union and European Space Agency initiative for a long-term sustainable capacity building in Earth Observation from space.

2.5.5. United States Agency for International Development - USAID

USAID is funding a program of upskilling local government organisations. The Local Geographic Information System (GIS-Local) is developed and implemented within the My Community program26. This program will strengthen local government in Moldova to become more effective, transparent, and accountable to citizens. Under this activity USAID will build local government's capacity to meet citizens' needs, achieving four main results: 1) improved quality of and access to municipal services; 2) citizens meaningfully engaged in local governance; 3) decentralization policy reforms advanced; and 4) increased locally generated revenues and improved financial management practices in local governments. The activity will provide comprehensive assistance for up to 100 communities, including towns and villages, primarily targeting local self-government bodies. Local public administrations (LPAs) will engage civic groups and local businesses to develop their communities and improve public services. The activity will also work with central government partners, associations, and civil society groups to advance decentralization policy reform and increase LPAs' financial viability.

2.5.6. GeoBIZ

Co-funded by Erasmus+ programme of the European Union, Moldovan partners are the Technical University of Moldova, Faculty of Construction, Geodesy and Cadastre, Chisinau and Tiraspol State University, Faculty of Geography. The main aim of the GEOBIZ project is strengthening the capacity of

[23] https://eu4moldova.eu/improving-spatial-data-services-in-the-republic-of-moldova-following-eu-standards/
[24] https://eni-seis.eionet.europa.eu/east/governance/project-documents
[25] http://www.copernicus.eu/
[26] https://www.usaid.gov/moldova/governing-justly-and-democratically

academic institutions to better respond to the needs of the emerging geoinformatics industry in Moldova with emphasis on the following aspects: establishing new and innovative forms of business-academia cooperation to support interaction in teaching/learning processes in geoinformatics; establishment of business-academia platform supporting excellence in geoinformatics; developing innovative teacher training programs and practical teaching/learning methodologies and content in technology-based courses in geoinformatics leaned on business-driven needs and experience; and implementing state-of-the art techniques in geoinformatics teaching process.

2.6. Sustainable Development Goals

It is envisaged that the economic analysis will also facilitate the preparation of more informed country action plans to support the 2030 Sustainable Development Goals. The relevance of the fundamental geospatial data themes to the goals are illustrated in the table below, where an asterisk represents a part played in the successful delivery of SDGs by geospatial data.

Data Theme / Sustainable Development Goal (SDG)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
	No poverty	Zero hunger	Good health	Quality education	Gender equality	Clean water & sanitation	Affordable clean energy	Decent work and economic growth	Industry, innovation & infrastructure	Reduced inequalities	Sustainable cities & communities	Responsible consumption & production	Climate action	Life below water	Life on land	Peace, justice & strong institutions	Partnerships for the goals
Addresses				X		X	X		X		X						
Buildings & Settlements	X		X	X		X	X		X		X	X	X				
Elevation & Depth	X	X	X			X	X				X		X	X	X		
Functional Areas	X	X	X	X	X	X	X	X	X	X	X			X			X
Geographical Names	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Geology & Soils		X	X			X	X	X	X		X	X	X	X	X		
Land Cover/Land Use	X	X	X		X	X	X	X	X		X	X	X	X	X		
Land Parcels	X	X						X	X	X	X					X	
Orthoimagery		X				X			X		X			X	X		
Physical Infrastructure			X	X		X	X		X		X						
Population Distribution	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Transport Networks		X	X					X	X		X						
Water		X	X			X	X		X		X	X	X	X	X		
Global Geodetic Reference Framework		X				X	X	X	X	X	X	X	X	X	X	X	

Figure 4: The linkage between the UN GGIM Global Fundamental Geospatial Data Themes and the Vision 2030 sustainable development goals

3. METHODOLOGY

The purpose of undertaking the analysis is to establish the socio-economic justification for the project, guide prioritisation of investments, position the value of SDI in a wider socio-political context, and create an economic baseline against which future progress can be compared.

3.1. Analytical Tools

The study team are following the SDI implementation methodology, developed by the World Bank and United Nations Food and Agriculture Organization (FAO), which is aligned with IGIF. This report covers the Socio-Economic Impact Assessment (SEIA). Annex A outlines the general approach.

3.2. Context

It is challenging to undertake a detailed economic analysis at this early stage of the technical appraisal, when a full description of the interventions to be funded (the country action plan), has yet to be agreed.

Furthermore, there is a lack of case history for quantifying and attributing benefits for either improving institutional structures in land administration or the creation of a Spatial Data Infrastructure (SDI), particularly for developing countries.

For these reasons this economic analysis focuses on the most significant impacts that can be readily associated with directly expected outcomes and quantified. Cost-benefit Analysis (CBA) is the methodology most suited to representing such an analysis in financial terms. Those impacts that were identified, but could not be reliably quantified, are included in narrative form as supporting evidence.

It is envisaged that as the SDI develops, this analysis will be revisited and refined through detailed business cases for components of the Action Plan.

3.3. Approach

In developing countries, there is a lack of comprehensive statistical data concerning “horizontal” components of the economy such as geospatial information and systems. This necessitates the use of a range of techniques to estimate and triangulate the impacts of a program such as creating an SDI.

In this case, interviews with over 30 stakeholders from public and private sectors were undertaken during the period from June – September 2021, the objective being to assemble as much primary evidence as possible in the time available. A mix of traditional methods of building case studies, gathering expert opinion, and benefits transfer have been employed.

4. LITERATURE REVIEW

Two types of studies were reviewed to help leverage best practice. Firstly, in terms of the economic analysis approach, by reviewing recent relevant World Bank material and secondly, national scale economic and financial studies for investment in geospatial information.

4.1. Economic reports

The following are some of the most relevant research reports reviewed in the process of undertaking the analysis. They have been selected for their relevance to the subject matter and approach to economic analysis adopted in this study.

4.1.1. World Bank Doing Business

The Doing Business report looks at domestic small and medium-size companies and measures the regulations applying to them through their life cycle[27]. Doing Business captures several important dimensions of the regulatory environment as it applies to local firms. It provides quantitative indicators on regulation for starting a business, dealing with construction permits, getting electricity, registering property, getting credit, protecting minority investors, paying taxes, trading across borders, enforcing contracts and resolving insolvency, also measures features of employing workers.

Although it does not present rankings of economies on the employing workers indicators or include the topic in the aggregate ease of doing business score or ranking on the ease of doing business, it does present the data for these indicators. By gathering and analyzing comprehensive quantitative data to compare business regulation environments across economies and over time, economies are encouraged to compete towards more efficient regulation. It also offers measurable benchmarks for reform; and serves as a resource for academics, journalists, private sector researchers and others interested in the business climate of each economy.

Moldova scores well in comparison to other developing countries, particularly in relation to factors relevant to this study such as dealing with registering a business and registering property. It is less impressive in relation to construction permits. See Figure 3 below.

Figure 5: Doing Business 2020 Moldova

[27] Doing Business Moldova 2020
https://www.doingbusiness.org/content/dam/doingBusiness/country/m/moldova/MDA.pdf

4.1.2. United Nations Human Development Index

The HDI is used by aid agencies to categorize all countries into high, medium, or low income which determines eligibility for various levels of grant aid and loan interest rates. It was created to emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone. The HDI can also be used to question national policy choices, asking how two countries with the same level of GNI per capita can end up with different human development outcomes.

The HDI is a summary measure for assessing long-term progress in three basic dimensions of human development: a long and healthy life, access to knowledge, and a decent standard of living.

Standard of living is measured by Gross National Income (GNI) per capita expressed in constant 2017 international dollars converted using purchasing power parity (PPP) conversion rates. The HDI simplifies and captures only part of what human development entails. It does not reflect on inequalities, poverty, human security, empowerment, etc.

The Moldova HDI value for 2019 is 0.750 – which put the country in the high human development category – positioning it at 90 out of 189 countries and territories. Between 1990 and 2019, Moldova's HDI value increased from 0.690 to 0.750, an increase of. 8.7 percent[28].

4.2. Economic impact of National Spatial Data Infrastructure

There are relatively few studies of the economic value of SDI. Those that do exist are confined to a few developed countries and because of inconsistency in scope are not directly comparable. For instance, some attempt to cover all impacts of geospatial information for a nation whilst others have a more limited scope in terms of the sectors of the economy assessed. Furthermore, there is no commonly agreed methodology for quantification.

This section summarizes some of those studies that have been undertaken and published in recent years and also includes a recent meta-analysis of return on investment in geospatial data and systems.

4.2.1. Natural Resources Canada (2015)

Commissioned by Natural Resources Canada and published in 2015, the Canadian Geomatics Environmental Scan and Value Study[29] is one of the most comprehensive studies undertaken. The scope is described as providing findings from all lines of enquiry related to the economic and non-economic benefits associated with geomatics technologies and services in Canada. In Canada, geomatics is taken to include all geospatial information activities, rather than the narrower land surveying context used in most other geographies.

The report was based upon a review of the literature and the input received during consultations with Geospatial Information (GI) suppliers in industry and government, users of GI products and services, and providers of GI education and training programs. Selected case studies were also conducted with users of GI.

It considered three groups of socio-economic impacts:

- Geomatics Products and Services: this is the value in the Canadian economy of the provision of geomatics products and services (i.e., supply side).

[28] http://hdr.undp.org/sites/default/files/Country-Profiles/MDA.pdf

[29] Link to study: https://www.nrcan.gc.ca/earth-sciences/geomatics/canadas-spatial-data-infrastructure/cgdi-initiatives/canadian-geomatics

- Economic Productivity: this is the value in the Canadian economy of the use of geomatics products and services (i.e. demand side). The impact that geospatial information has had on the Canadian economy was estimated using a Computable General Equilibrium (CGE)[30] model.
- Social and Environmental Benefits: these are the social and environmental benefits of the use of geomatics products and services that are difficult to quantify in economic terms.

The quantifiable results were estimated for 2013 as:

- A supply-side impact of about 2,450 private sector geomatics firms contributing CAD 2.3 billion to the Canadian economy;
- A demand-side impact from the use of geospatial information of CAD 0.7 billion – or 1.1% of national Gross Domestic Product (GDP);
- Generating approximately 19,000 jobs to the Canadian economy.

4.2.2. Ordnance Survey Ireland (2014)

The study titled 'Assessment of the Economic Value of the Geospatial Information Industry in Ireland'[31] looked at the value added to the Irish economy, the number of jobs generated by the GI industry, and the savings delivered by that industry to the public sector. The project was undertaken by Indecon, an Irish-based economic analysis company. The first section of the report assesses the direct supply-side contribution to the economy, using market survey results and interviews with experts, as follows:

- Revenue from sales of GI related products/services of EUR 117.5 million;
- Total value of exports of GI products/services of EUR 18.9 million;
- Number of Full Time Equivalent (FTE) employees 1,677;
- Expenditure on wages and salaries of EUR 84.4 million;
- Expenditures by suppliers of geospatial information on non-labor inputs of EUR 48.2 million.

The above was used to estimate a gross value added for the sector in Ireland to be EUR 69.3 million.

The second section of the report attempts to quantify the demand-side impacts. It identifies significant or very significant benefits arising from using GI and potential externalities from a market survey, as follows:

- Public and private sector cost savings: estimated public sector cost savings at EUR 82 million per annum;
- Economic value of journey time savings:
  - Private cars: EUR 94.26 million per annum.
  - Commercial vehicles: EUR 185.81 million per annum
- Benefits to consumers of intensifying competition: estimated at EUR 78 million – EUR 130 million per annum;
- Wider impacts on innovation were not quantified

4.2.3. The Economic Impact of Geospatial Services (2017)

A report commissioned by Google[32] clearly demonstrates that the application of geospatial information has significant benefits outside of the traditional geospatial domain. It estimates worldwide and regional

[30] Smart A, Coote, A. Economic and Financial Modelling of the Impact of Geospatial Information - Techniques and Results for land administration in developing Nations. World Bank, Land and Poverty Conference 2017
[31] Link to study: http://www.osi.ie/About-Us/Ireland-GIS-Economic-Report.aspx
[32] The Economic Impact of Geospatial Services, AlphaBeta, September 2017: https://www.valueoftheweb.com/reports/the-economic-impact-of-geospatial-services/

benefits for consumers (commuting and fuel efficiency, personal safety and purchasing efficiency), private industry (new products and services, productivity benefits, sales growth particularly for small businesses and tourism spend) and wider societal benefits (job creation, traffic congestion, urban planning, civic engagement, public health, safety and emergency response, disaster preparation and responsiveness, environment and wildlife preservation, knowledge creation and human capital development).

It is one of the few economic surveys to use a "willingness to pay" survey to calculate value. This is an effective technique particularly when attempting to estimate consumer benefits. The following infographic provides a summary of the major findings.

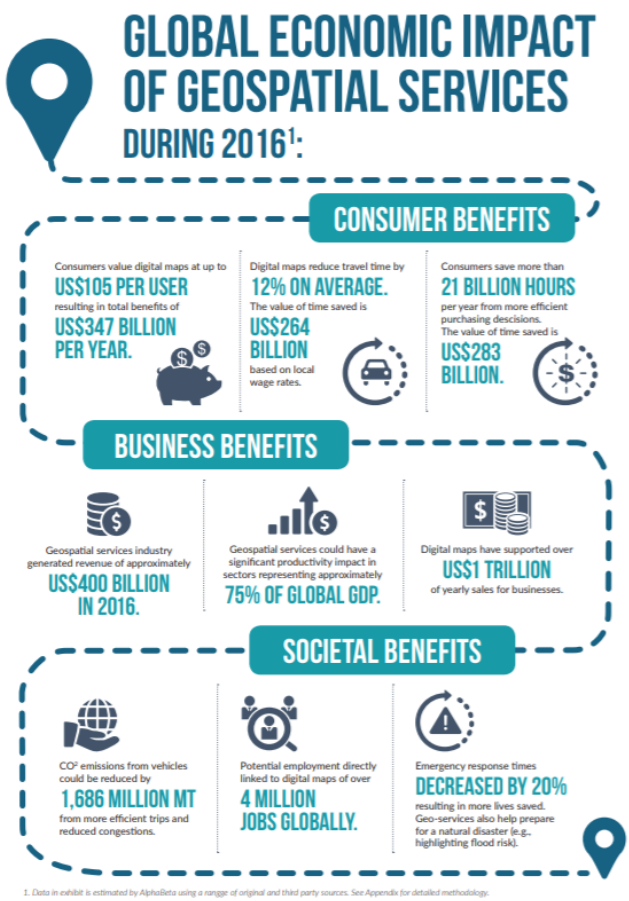


Figure 6: Summary Infographic AlphaBeta Study

4.2.4. Unlocking the Value of Geospatial Data (2018)

The study looks at how key parts of Ordnance Survey's (OSGB) highly detailed OS MasterMap are being made completely open under the Open Government Licence (OGL), with the remaining data being made freely available up to a threshold of transactions. This work will release GBP 130 million per annum of economic value.

Making OS MasterMap available in this way is based on addressing the barriers identified through user research with, in particular, start-ups and small businesses. This research with both current and potential users of OS MasterMap identified four major barriers to its use:

- Price (complexity and cost);

- Licensing (complexity and restrictiveness);
- Ease of use (discoverability, interoperability and mechanism of delivery); and
- Derived data (complexity and restrictiveness).

By addressing these barriers to use, these changes will enable businesses of all sizes to access not only OS's high-quality data, but to also geospatial data more widely to unlock economic value. In particular:

- Significantly more geospatial data will be fully open for businesses and developers to use, free and without restriction;
- Start-ups will be able to deliver new products and services with the data using the free threshold;
- Some businesses will not need to pay at all for their use of OS data because of the use of the free threshold;
- New innovations will be possible in the housing market — for example, this data will make it easier for property developers to identify potential development sites that aren't currently registered;
- New users will be able to understand the pricing structure for the data more easily following the OS changes removing uncertainty around cost of use; and
- An improved errors and omissions tool and reporting process, and publication of data in additional formats will further improve the quality of the data and its ease of use.

4.2.5. Return on Investment Global Meta-analysis (2015)

The study titled 'A Meta-Analysis on the Return on Investment of Geospatial Data and Systems: A Multi-Country Perspective[33]' looks at return on investment based on mainly cost-benefit studies and attempts to explain some variations across 82 cost-benefit assessments undertaken between 1994 and 2013. Multivariate regression methods are used to assess the size, significance and direction of individual effects. The results suggest that regional factors have the largest impact on the profitability of GI. Returns in Australia and New Zealand, for example, are four times larger than in Europe. In addition, small-scale regional investments have a 2.5 times lower return than large-scale international investments. **Overall, the expected benefits of GI investments are approximately 3.2 times larger than the costs.**

The observed increase in return for larger-scale investments is significant in the context of this paper since it indicates that the national approach to SDI is likely to yield a better return than the "project-based" investments that have previously characterized geospatial investment.

4.2.6. Netherlands Geolocation Economy (2021)

The Netherlands Geolocation Economy report has been prepared by Geospatial Media and Communications, in partnership with the Ministry of the Interior and Kingdom Relations of the Netherlands and Geonovum. Geospatial technologies and solutions benefit not just the geospatial product companies but also create indirect benefits for the larger business ecosystem. Using geospatial technologies and solutions, businesses can improve productivity, connect directly with consumers, and ultimately drive business growth. It is estimated that The Netherlands geospatial industry has generated a total revenue of EUR 1.05 billion in 2019, wherein the maximum share of the revenue, that is, approximately EUR 528 billion was generated from geospatial services (inclusive of value-added services and surveying and mapping capabilities). The study shows that the use of geospatial technology and solutions has a strong multiplier effect and could result in a productivity impact on sectors representing 60% of the Netherlands Gross Value Added (GVA). Considering the direct and indirect economic benefits of the Netherlands geospatial industry, the total business impact of the geospatial industry in the country is presently valued at EUR 31 billion.

[33] Trapp, N et al in Transactions in GIS, 2015, 19(2): 169–187

4.2.7. Socio-economic Study of NSDI Impact on the Society in the Republic of Serbia (2021)

The main objective of this Social-Economic Study of NSDI Impact on the Society was to develop and present clear and concise analysis of a socio-economic benefits of the National Spatial Data Infrastructure (NSDI) in the Republic of Serbia. The study assesses the direct and indirect impacts of the NSDI of the Republic of Serbia's social and business environment[34].

The main conclusions of this report are that the socio-economic benefits of the Serbian NSDI are manifold and applicable in multiple thematic policy areas. The main key policy areas refer to environment and spatial development. Several organizational, as well as societal benefits of the current and future Serbian NSDI are identified. Improved data quality, meeting the legal requirements and increased efficiency are considered as the key organizational NSDI benefits, meanwhile cost and time savings are considered as the key societal NSDI benefits. The report presents the benefits in qualitative as well as quantitative terms for selected use cases.

5. ANALYSIS[35]

The results of the assessment are presented as a Cost-Benefit Analysis (CBA). CBA is a well established and widely recognized methodology for appraising large scale investment projects, often involving public spending. The process involves estimating the costs and benefits of a given program to ascertain whether the outcome at the end of the period of investment and operation represents a satisfactory Return on Investment (RoI). The RoI may be compared to other potential investments, facilitating more objective prioritization.

CBA uses a process referred to as *discounting*, which involves accounting for the rate of interest which could have been earned had the funds used for investment been deposited in an interest-bearing account or other investment. The discount rate is applied as a deflator to the estimated gains from a project, because the funds could have earned interest without incurring the same risk.

The rate used for currency conversion in this report is[36]:

1 Moldovan Leu (MDL) is equal to 0.0564 United States Dollar (USD) and 0.0502 Euro (EUR)

5.1. Key Financial Variables

The financial evaluation is based upon the following parameters:

i) Life Cycle – a 12 year period, consisting of 5 years of investment followed by 7 years of use, this is commensurate with the infrastructural nature of the investment but takes into account the increasing pace of technological change which means considering a longer period would introduces an unacceptable level of uncertainty.

ii) Discount rate set at 5% per annum, this is consistent with the World Bank rate used in recent reports for similar infrastructure projects in Moldova.

[34] https://unece.org/sites/default/files/2021-06/Item%202%20Vucetic_Serbia_COVIDrecovery.pdf

[35] The numerical values and associated data illustrated in this section is copied from document ref 'IGIF SEIA CBA Moldova v11 20211130 MEAN CASE' To view the source data contact ALRC

[36] Mid Market Rate accessed from http://xe.com on 23 November 2021

iii) Inflation is assumed to have an equal effect on costs and benefits and neutral in accounting terms, so inflation effects are not considered in the model.

5.2. Investment Plan

The investment required is composed of core data and technology projects with supporting governance, legal, financial management, partnership development and human capacity building measures. It will deliver an SDI composed of the fundamental themes of data that are complete, authoritative, up to date, and of an appropriate quality to underpin the development of the economy and facilitate improving the welfare of citizens. The main components of the investment plan include:

- Enhancing **human capacity** through closer interaction with schools and tertiary institutions to raise awareness and understanding of the value of geospatial.
- **Upskilling Government Agencies**, including but not limited to ALRC, to be able to provide leadership and coordination more effectively.
- **Growing the geospatial ecosystem** by engaging and communicating more effectively with a wider range of users, particularly in the commercial sector.
- **Raising the profile of NSDI** by focusing messages on its role in digital transformation and the positive impacts it brings to many sectors of the economy.
- Complete national coverage of **ortho-rectified imagery, terrain model and topographic basemap** at sufficient scales to support a wide range of use cases and put in place a regime of continuous revision to maintain currency.
- **Completion of the Land Cadastre** for 95% of all parcels and make it openly available to support upgrading of valuation processes and through that introducing more objective and transparent land and property taxation.
- **Build a Scalable National Geoportal** providing **online access to fundamental geospatial data through web viewing and APIs.** To be available openly to citizens, businesses, government, and professionals consistent with cyber-security and commercial constraints such as protecting intellectual property rights.
- Agreement of **Geospatial data sharing** protocols to reduce costly data duplication and improve quality and consistency.
- Roll-out of access to the **National Geocoded Street Address database,** maintained to a high-level currency through effective exchange of updates between local and central government**.**
- Create **3D City Models (digital twins)** for four city centers including Chisinau.
- **Establish a National Earth Observation centre of excellence** facilitating wide access to satellite imagery and associated services.
- **A set of digitization and quality improvements** for additional fundamental geospatial data themes, particularly focusing on reporting and analysis on the UN SDGs.
- **Maintenance of the geodetic network** including the network of Continuously Operating Reference Stations (CORS).
- Enhancing integration with the **emergency situations** agency, to speed up response times saving lives and damage to property and crops.
- Support greater geostatistical capabilities **spatial analysis and visualization capabilities.**
- **Sponsoring innovation** in the development of new applications using the NSDI.
- Define and implement a **sustainable business model** for the infrastructure.

The investment plan is detailed separately in a series of excel spreadsheets packaged with this report and takes the costs of delivering each of these actions into account. It is subject to change as the thinking around the Action plan will develop as the project matures.

It is assumed that investment will be phased over a period of 5 years. The investment profile (non-discounted values) is shown in table 3.

Period	Investment Value (MDL Thousands)	Cumulative Investment Value (MDL Thousands)	Investment Value (USD Thousands)	Cumulative Investment Value (USD Thousands)
Year 0+1	22,710	22,710	1,282	1,282
Year 2	20,323	43,033	1,147	2,429
Year 3	22,664	65,696	1,279	3,708
Year 4	17,348	83,044	979	4,687
Year 5	12,015	95,059	678	5,365
Total	95,059		5,365	

Table 3: Provisional Investment Profile

There will be on-going costs for maintenance of systems, updating of geospatial data, capacity building and other assets created by the investment. **An allowance of 15% of initial capital investment has therefore been made to ensure sustainability during the period of operation**. For recurrent expenditure the full value has also been included.

It is assumed that additional operating costs will be met from within the Business As Usual (BAU) baseline costs of the participating agencies, financed from the positive impacts of the investment. This is detailed in the investment plan, see the cost-benefit spreadsheet supplied with this report.

5.3 Benefits Assessment

The assessment identified many potential impacts of the SDI, some direct and many indirect. These include both market benefits and non-market benefits. A list of 36 separate applications (use cases) were identified during the study, these are summarized in section 5.3.1 below and some of the more significant qualitative use cases are described in more detail in Annex C.

Based on the policy priorities outlined in the report, and assessment of the most significant impacts, the study team has attempted to quantify 9 of the case studies and these are outlined in section 5.3.2.

5.3.1. Socio-economic Benefits

In the following paragraphs, we outline some of the most significant socio-economic benefits. A full description of all use cases identified during the study is included in the **Geospatial Alignment to Policy Drivers (GAPD)** companion report.

From interviews with a variety of staff, representing 19 Stakeholder organisations, including Government Ministries, Agencies, State Enterprises, and private sector companies, the team identified over 40 applications (use cases) where there are demonstrable benefits from the implementation of GIS technology requiring foundation geospatial data[37] that a National SDI would provide. These will have a positive impact on many sectors including:

[37] Foundation Data Themes: http://ggim.un.org/meetings/GGIM-committee/8th-Session/documents/E-C20-2018-7-Add_1-Global-fundamental-geospatial-data-themes.pdf

Economic and Urban Planning:

- Support to the Moldova 2030 Development Strategy by enabling decision makers to see a holistic view of competing initiatives and more easily appreciate location factors.
- Improved urban planning and smart city projects through enhanced visualizations including 3D "digital twin" information models.
- Support to the National Bureau of Statistics (NBS) to undertake more sophisticated statistical analysis through census planning, execution, and analysis.

Land Management and Administration:

- Complete land cadastre and rights registration to enable land to be more easily used as collateral for credit/bank loans.
- More objective property valuation using complete and up to date land use and cadastral data.
- Reduce the number of land related disputes with fewer resulting court cases.
- Increase in revenue from land use fees and taxes.

Geodetic Surveying

- Enhanced access to Continuously Operating Reference Stations (CORS) network providing efficiencies in related surveying and engineering activities.

e-Government

- Integration of national registers through the ability to use geospatial information to aid the synchronization of administrative registers such as land registration and cadastral registers, building and address registers.
- Providing on-line digital services to citizens and business and improving the efficiency of transactions between citizens and businesses using a single national address database.

Transport

- More efficient transport planning using geospatial data to optimize integrated transport links (pedestrian, road, rail, and air).
- Management of 'Street Works' by coordinating requests from utilities, engineering, and local government to dig up roads, to minimize disruption to citizens, reducing traffic disruption, and providing opportunities for travel time efficiencies and fuel economies.
- Reducing costs of feasibility studies and design activities for proposed new road and rail schemes using orthophotos, terrain models and topographic base maps.
- Improved road safety, highway maintenance, and traffic management including spatial analysis for accident 'black spots' enabling more intelligent decision making on safety improvements.

Disaster Risk Management and Emergency Services

- Improved disaster response and management using geospatial data to aid more efficient and informed preparation, response, and recovery.
- More efficient emergency response using integrated address, property, and building data together with address verification and validation services.

Agriculture, Forestry, and Fishing

- Increased crop yields, using precision farming techniques combining satellite imagery of crop development and precise tractor location.

- Agricultural land management (with potential for land consolidation) to provide for more equitable allocation of agricultural subsidies.
- Improved forest management (planning and harvesting) by reducing the requirement for site visits by using satellite imagery.

Health and Social Care

- Improved access to primary healthcare through mapping the accessibility of primary healthcare facilities.
- Facilitate the planning of health facility locations and capacity planning using geocoded patient address information.
- Developing patient pathways and the use of geospatial data to provide improvements in epidemiology, helping to trace patterns in the spread of diseases and supporting control measures.

Natural Resources

- Transition from analogue to digital mapping and use of 3D models for improved groundwater abstraction schemes (important given the risk of drought in Moldova), flood management schemes, and proving input to the regulation of waste disposal.

Water and Hydrology

- Improved water and hydrology management to help meet the requirements of the European Water Framework Directive (WFD).
- Improved management of piped water and sewerage assets.
- Tracking water loss and leak management to manage costs and monitoring water usage.
- Increased revenue by a systematic identification of households/businesses and matching against a register of payments.

Energy

- Reducing the dependency on energy imports by identifying locations for renewable energy facilities, through the integration of meteorological data with the NSDI.

Environment and Tourism

- More cost-effective environmental impact assessments by using geospatial information.
- Visualization and analysis of levels of air pollution and tracing it back to sources.

Local Government

- Developing local government decision making processes through enhanced development governance, management planning, provision of citizen services, and integrated development planning with neighboring administrative areas.

Commercial

- More informed decision making for online banking and other financial transactions by enhancing customer information with location attributes to assist functions such as fraud detection.

Cross-Sector

- Completion and maintenance of the national register of addresses to enable efficiencies in government information management and improved ease of business and citizen interactions.
- Increase in the availability and use of satellite imagery, through agreements with providers, if brokered through the NSDI this will provide the opportunity to reduce costs.
- Modernization of public services through re-engineering and digitization of national registers, improved efficiency through data exchange between public service providers, and diversifying access channels to public services.
- Reductions in the cost of data acquisition and removing the risk of data duplication through a 'collaborative' government data acquisition program including aerial photography, satellite imagery and topographic mapping. Such a program can reduce the costs associated with the capture, storage, and management of geospatial information by procuring once and using many times by many agencies.

In the process of identification of the analysis, a number of those use cases that we were unable to reliably quantify were more fully documented and are included in Annex C to this report.

5.3.2. Quantified Market Impacts

Given the limited time available for the study and the limited availability of economic data, the quantified impacts should be regarded as indicative of an "order of magnitude" return on investment.

Some of the benefits identified are externalities. An externality is an economic term referring to a cost or benefit incurred or received by a third party. However, the third party has no control over the creation of that cost or benefit. An externality can be both positive or negative and can result from either the production or consumption of a good or service[38].

What follows here is an explanation of the case studies and the method of calculation of the impact (benefits and disbenefits[39]) including assumptions and limitations.

The structure is as follows:

i) Context – who is the implementation lead organisation and who are the beneficiaries.

ii) Use Case – this sets out the impact in narrative form.

iii) Quantification Methodology – the data and process of calculation of the net benefits (benefits minus disbenefits). Assumptions and limitations should be stated.

iv) Impact – summary of the calculation, concluding with the values used in the cost-benefit analysis.

5.3.2.1. Local Government Efficiency

Context

In most countries, the contribution of local government to the development of the NSDI is critical and its impact realized from the beginning of its development. Moldova is no exception. In the larger municipalities, such as Chisinau and Orhei, functions including urbanism and transport are already heavy users of fundamental geospatial information. Further, the collaboration between central and local government is well established. However, in smaller raions, there is limited human capacity to operate

[38] Investopedia definition - https://www.investopedia.com/terms/e/externality.asp

[39] A generic example of a disbenefit is that if legal cases are reduced by improved land registration, there are less land law-related cases, so the legal profession earns less fees.

GIS. USAID, Kartverket and the Congress of Local Authorities of Moldova (CALM)[40] are currently working together to provide geospatial training and other resources to the community.

Use Cases

The following examples have been extracted from interviews with municipalities undertaken by the team.

i) Chisinau Transport Department – the key geospatial use cases are in relation to:

- Improving public transport – developing dedicated lanes to improve the speed of buses and measures to encourage citizens to use public transport rather than their own cars.
- Parking solutions – review of available street parking and developing a new strategy to optimize usage and revenue, see the geoportal view of current publicly available on cark parks in Figure 4 below.
- Road rehabilitation – strategic plan for improvements and minimizing disruption to traffic in the process.

Chisinau Municipality has a twinning project with an EU partner (City of Lublin, Poland) financed by the UNDP focused on urban mobility, the project name is 'Moving like Lublin'.

Figure 7: Chisinau Geoportal

ii) Chisinau - General Division of architecture, urbanism, and land relations

The main use cases identified where IGIF fundamental data has a potentially positive impact include:

- Construction process and issuing permits
- Collection of local taxes
- Collection of Rent for social housing
- Privatization – sales of land owned by the municipality
- Land use zoning

iii) Orhei

One of the most advanced users of geospatial information in Moldova, see these key use cases:

[40] The purpose of CALM is to represent all local authorities of Moldova, for more details see: https://platforma-dev.eu/partner/congress-of-local-authorities-from-moldova

Increasing Tax Revenue – this use relates to the gain of tax revenue by detecting companies not paying local taxes. Over the last 5 years, the income of the city has increased from 15 million to 63 million MDL. The GIS and address data it contains has been instrumental in achieving this increase.

Better Waste management – geospatial data is also used for waste management, for example optimum distribution and allocating of waste collection points.

Improved Urban planning – one of the main challenges for the city is the digitalization of the urban plan (zoning map) which indicates areas designated for industrial development, protecting green zones and other categories.

Election management – facilitating voter awareness of where they are registered to vote could increase voter turnout and bring wider social benefits.

Quantification

Unfortunately, although all interviewees in local government were enthusiastic about strengthening geospatial infrastructure, none were able to help quantify the value of these use cases. The use of benefits transfer techniques has however enabled the team to derive a very conservative estimate of the potential value. The approach can be summarized as follows:

a) A report on the value of geospatial information to public service delivery in England and Wales was chosen to be most appropriate to scope and level of development. This study estimates the value in 2010 nationally at GBP 320 million, with predicted annual growth rate being GBP 40 million per annum over a six-year period[41].

b) Comparison of Gross Domestic Product (GDP) was then used to provide a scaling ratio between England and Wales and Moldova, yielding a figure of approximately 0.5%.

c) The estimated increase in value was derived by applying the scaling factor to the England and Wales results.

Impact

The tables below show the calculation of the estimated effect applied from the end of the investment period (year 6 onward). This is a very conservative approach as clearly the benefits are being recognised already as the use case examples illustrate.

1. Annual Value				
Ref	Description	Factor	GBP (Thousand)	Explanation
A	Current State		320,000	
B	6-year Projection	6		
C	Future State		560,000	
D	Annual Increase in Value		40,000	(C-A)/B

[41] The Value of Geospatial Information to the delivery of local public services in England and Wales. Local Government Association: https://www.local.gov.uk/sites/default/files/documents/executive-summary-researc-279.pdf

2: Scale to Moldova				
Ref	Description	Factor	Value	Explanation
E	United Kingdom GDP	USD	2,707,743,777,174	Derived from WB Global GDP (2020)
F	Scale to England and Wales	0.85		
G	England and Wales GDP		2,301,582,210,598	
H	Moldova GDP	USD	11,914,040,905	Derived from WB Global GDP (2020)
J	Scale Factor for Moldova		0.005176457	
3: Value to Moldova Local Government				
	In GBP	GBP	207	D*J
	Convert to MLD (thousand)	MLD	4,911	

Table 4: Local Government Efficiency Estimation

5.3.2.1. Emergency Situations

Context

The use of geospatial information to speed up response to emergency calls, is a common use case in many countries, including an increasing number in developing countries. The emergency situations Service 112 receive calls from the public and distributes them to all relevant entities (ambulance, fire, and police). The responders use geospatial data to find the incident location, then they distribute a call to the required emergency services who dispatch the closest suitable vehicle. GIS is not linked to the GPS system, but 10% of the vehicles have a GPS dispatch tracker. This provides an excellent basis for being able to assess the response with and without geospatial-enabled systems. The agency produces very full and detailed statistics about incident numbers and average response times[42].

Use Cases

The most important NSDI themes for the emergency situations agency are geocoded addresses and other points of interest plus road centerlines for vehicle navigation. Two use cases were evaluated:

- Reduced damage to property by more rapid arrival by fire appliances.
- Reduced deaths results from more rapid arrival of road accidents.

Quantification

The Emergency Situations own statistics and expert opinion of the impact of fundamental geospatial information were used to derive the benefits.

a) Recent and detailed statistics from Emergency Services were used to calculate the impact upon reduced damage to property. The range of values for likely reduction, were not based on a comprehensive survey,

[42] http://dse.md/sites/default/files/statistic_documents/0.Analiza_IS_7_luni_2021.pdf

but based on the sampling of opinion by officers, so the 30% - 40% reported was "written down" to 10% - 20% to ensure a cautious estimation.

Ref	Description	Factor	MDL (Thousand)
D	Average Damage (2020-21)		354,352
E	Lower Bound	10%	35,435
F	Average		53,153
G	Upper Bound	20%	70,870

Table 5: Property Damage Costs

b) For the potential value of lives saved by quicker response, the average number of deaths over the period 2020 to mid-2021, was again derived from the emergency situations statistical reports.

c) A conservative approach was then taken to estimate how many of these deaths might have been saved by a quicker response, based again on the expert opinion of officers but written down to take into account unknown factors such as the nature of the accidents and how often they occurred in places where the quicker response would have been significant.

d) The value of a statistical life (VSL) has recently been researched by Harvard University for the Gates Foundation and value ranges for all developing countries have been produced[43]. The table below shows the results of this calculation.

		Lower Bound	Mean	Upper Bound	Calculation
		USD	USD	USD	
Country	GNI per capita	GNI per capita *100		GNI per capita*160	
Moldova	5,410				
Factor		100		160	
Moldova		541,000	703,300	865,600	P*Q

Table 6: Estimated Value of Lives Saved

Impact

Combining the reduced damage and lives saved gives a total realizable value as shown in the next table.

[43] Harvard Study for Gates Foundation https://cdn2.sph.harvard.edu/wp-content/uploads/sites/94/2017/01/Robinson-Hammitt-OKeeffe-VSL.2018.03.23.pdf (Appendix D: Population-Average VSL Estimates by Country)

Description	Lower Bound	Mean	Upper Bound
	MLD (Thousand)	MLD (Thousand)	MLD (Thousand)
Damage	35,435	53,153	70,870
Lives	541,000	703,300	865,600
Total	576,435	756,453	936,470

Table 7: Total Value

The saving will however not be achieved without the full fleet of emergency vehicles being equipped with tablets and geospatial software, plus on-going budget for staff training. Provision to cover the costs is included in the calculation of net benefits, estimated cumulatively in terms of net present value over the operational period as MDL 119.6 million (USD 6.7 Million).

5.3.2.1. Augmented GNSS: the impact of the Moldova CORS Network

Context

ALRC, with assistance from foreign donors, has established a full network of Continuously Operating Reference Stations (CORS) that provide access to accurate geodetic coordinates derived from Global Navigation Satellite Systems (GNSS)[44]. Access to these data enable surveyors, engineers, mining companies, utilities and transport users to establish the position of control points for multiple purposes.

Use Case

The greatest economic benefits of the use of CORS are derived from:

- Higher levels of accuracy in positioning;
- Faster acquisition of data - tasks that previously took 2-3 hours being reduced to 10s of minutes;
- Less equipment required;
- High reliability where safety is concerned.
- Savings for surveying of between 20% to 40% in labor costs as few staff are required;
- Savings in costs of between 10% and 20% are also reported from applications of machine guidance and automation in mining and construction.

Ensuring consistent operation maintenance of (existing) CORS is also essential for not only quick and cost-effective surveys but also supports monitoring of tectonic and fault movements.

Quantification

A study by ACIL Allen[45] in 2013 in Australia is perhaps the most comprehensive global assessment of the economic benefits of augmenting GNSS. The following table summarizes the main results for the year of the survey and the predicted increase in impacts forward to 2020.

[44] GNSS is the standard generic term for satellite navigation systems that provide autonomous geo-spatial positioning with global coverage. This term includes the GPS (US), GLONASS (Russia), Galileo (European Union), Beidou (China) and other regional systems.

[45] The value of augmented GNSS in Australia
http://www.ignss.org/LinkClick.aspx?fileticket=dKQ6MsXGBAw%3D&tabid=56

	2012	2012	2020	2020
	Low	High	Low	High
Grains	4.800%	8.000%	12.500%	21.000%
Dairy, beef			1.000%	15.000%
Mixed farming	2.000%	2.200%	2.000%	3.000%
Sugar cane (mostly)	0.100%	0.300%	0.200%	15.000%
Mining	0.603%	0.944%	1.863%	2.518%
Construction	0.431%	0.766%	0.583%	1.053%
Utilities	0.081%	0.135%	0.262%	0.411%
Road transport	0.260%	0.327%	0.989%	1.419%
Transport storage and handling	0.156%	0.182%	0.207%	0.309%
Rail transport	0.015%	0.028%	0.086%	0.084%
Aviation	0.000%	0.000%	0.030%	0.071%
Maritime	0.020%	0.050%	0.120%	0.150%

Table 8: Sector Output Impacts from GNSS

The impact for Moldova is calculated using the following logic:

a) The Australian study is used as the basis of benefits transfer. The impacts on output for two sectors most relevant to the growth of the Moldovan economy, construction and utilities (electricity and water) where GNSS can potentially be deployed are evaluated.

b) As a conservative assumption the impacts from 2012 in Australia are used as the basis for calculation of the impact in Moldova.

c) The accuracy of GNSS with CORS correction is only estimated to be required in a proportion of cases (see accuracy required multipler)

d) Sector Added Value is derived from the NBS Statistical Yearbook 2020

e) Implementation of the changes will in practice happen gradually over an assumed period of 10 years.

<u>Impact</u>

f) The results of these calculation are shown in Table 9 below.

Ref	Sector	Sector Added Value (NBS)	Accuracy Required	MDL (Thousands)	Low Case		Mean Case		High Case	
					Impact	MDL (Thou)	Impact	MDL (Thou)	Impact	MDL (Thou)
D	Construction	18,260,108	10%	1,826,011	0.431%	7,870	0.599%	10,929	0.766%	13,987
E	Utilities	6,306,333	50%	3,153,167	0.081%	2,554	0.108%	3,405	0.135%	4,257
G	TOTAL					10,424		14,334		18,244

Table 9: Output Impact in MLD for Relevant Sectors[4647]

5.3.2.1. Digital Mapping Value

Context

Many apps used by citizens rely upon fundamental geospatial information. The economic consultancy Alpha Beta undertook a study for Google in 2017 to quantify the value of geospatial services. The technique used for the study was Willingness to Pay (WTP) where citizens are asked to assess how much they would be willing to pay in order not to lose services, in this case digital mapping.

Use Cases

Some of the primary apps used on Smartphones and Internet browsers that are based on geospatial information include:

- Navigation – what is the quickest route between points if travelling by car.
- Shopping – find my nearest facility including all types of shops, recycling centres.
- Health – fitness apps use geospatial data to assess how far a runner or walker has traveled.
- Environmental – maps showing the carbon footprint of our purchases

Quantification

It is not feasible to undertake a WTP survey for Moldova within the scope of this study. Instead, the WTP results of the global study were scaled based on Smartphone usage and other factors. The following steps were adopted to derive an estimate of the value:

a) The base figure for 2016 for the global WTP per user from the report had been assessed at an average of USD 105 per year. This was factored to 2020 using inflation indices to give a figure of USD 110 per annum.

b) The WTP survey had been largely focused on high income countries, the World Bank GDP per capita statistics were used to scale from the average for such countries and applied to Moldova.

c) A volume of internet app users in Moldova was derived from the International Telecommunication Union (United Nations official agency) statistics and those of the Moldova National Statistical Agency[48] to arrive at a conservative estimate of 250,000.

[46] * Utilities considered as water plus electricity (National Accounts NACE Category D+E)
[47] ** Sector Added Value from Table 13.18 (page 241) of NBS Statistical Year Book 2020
[48] National Bureau of Statistics, statistical report '1-CE' (laura.muntean@statistica.gov.md)

d) Using this volume and the 2020 WTP figure of USD 110 per user, an estimate for the current value of digital mapping was derived, of which a conservative 10% was attributed to the NSDI.

Impact

A conservative assumption was made that no benefits would be realized until the end of the investment period and a slow increase in adoption (5% per annum) would occur over the operational period.

Using this approach, the total realized value over the operational period was estimated as cumulatively circa MDL 35.6 million (USD 1.5 million).

5.3.2.1. Data Sharing – National Address Database

Context

The duplication and inconsistency between datasets are generic problems for developing countries. It results in waste of resources maintaining versions of the same data in different organisations and a lack of trust in the information resulting from what appears to be different versions of the truth. In Moldova, we have identified that this is particularly problematic with geocoded address data, with the National Address Database currently being incomplete and although the data is shared on request it is not in use in many organisations that could benefit from it.

Use Case

The National Address database is maintained by the Agency for Public Service (APS). About 1.5 million addresses are currently registered and by 2023 it is planned to register additionally:

- 250 000 individual homes
- 75 000 orchards
- 100 000 public property buldings
- 70 000 isolated real-estate constructions/buildings

According to government legislation, local authorities have to maintain their own address plans. Many smaller authorities do not have the capacity to maintain such a database and have concluded the agreements to delegate this function to ALRC. However, the database is incomplete since not every local authority has provided data.

APS foresee that in future years the local governments are maintaining their own address database and are fully responsible for all the amendments which are just sent to the single shared database of addresses.

A single addressing system will benefit for Moldova in the following ways:

- a well-developed address system will facilitate the work of the ALRC, and increase the efficiency of carrying out the state policy of the administrative-territorial structure of the country;
- creation of an interoperability framework among the Public Services Agency's systems and external systems that use address data, will reduce duplication;
- web access will reduce the effort required by citizens to use government services;
- data access control and data security will be improved;
- analysis, forecast and research activities in many different organisations will be facilitated;

- emergency services (ambulance, police, firefighters) and the post office will be better able to play their key role in improving the welfare and safety of citizens;
- increased transparency of the electoral process will result in easier assignment of voters to polling stations;
- the address data can also be used by other applications (e.g. for smartphone applications).

Quantification

The costs of maintain multiple address database is clearly a duplication of effort. Although there are many other advantages to having a single master source, the wasted effort of duplication is easy to identify and quantify as follows:

a) With the help of APS, a list was drawn up of organisations that currently need to maintain address databases to support their core operations. This included Ministries, agencies, and large private sector organisations such as banks and retail chains.

b) The estimated annual costs of maintaining the national address database were provided by APS.

c) Making a conservative assumption of an annual 10% increase in adoption rate, from the end of the investment period.

Impact

The number of duplicated national databases currently being maintained and not using the national address database was estimated conservatively at 16. There are also others that current could be more efficiently accessed, for instance through an API but the savings from this process were discounted.

The overall duplication of effort was calculated as shown in the table below:

Description	MDL
Number of Duplicate Address Databases	16
Annual Cost of Maintaining National Address Database	1,675,000
Annual Potential Savings from Removing Duplication	26,800,000

Table 10: Potential Savings from Reduced Address Duplication

Over the seven (7) year period of operation, this is estimated to create potential total savings of MDL 48.5 million (USD 2.7 million) once discount rates are applied.

5.3.2.1. Improved Agricultural Yield using Satellite Imagery

Context

Moldova is largely an agricultural country with agricultural production estimated at 34,597 million Lei at current prices in 2019 according to the National Statistics Yearbook, representing about 10% of total annual GDP. The ability to improve agricultural production is clearly an important potential source of positive impact to the economy.

Use Case

Within the scope of the project, it was not feasible to undertake a national survey. It proved difficult to engage with industry associations however, speaking with individual organisations it was evident that the introduction of precision agriculture techniques would have substantial benefits by increasing crop yields.

Precision agriculture requires precise positioning technology (GNSS) and the use of frequently refreshed satellite imagery. Such techniques have been introduced with good effect in countries such as Denmark and the positive impact on yields examined in detail through socio-economic studies.

These studies tend to focus on cereal production, which represents nearly 74% of land use in Moldova, according to the 2020 National Statistics, see Figure 6 below.

Figure 8: Agricultural Land Use 2020

The study in Denmark was undertaken under contract by the This Green Land economic consultancy for the European Space Agency under the management of the EARSC[49].

Element	Actual today (Euro/ha)	Factor technical capability	Full potential (Euro/ha)
Reduced chemicals	2.6-5.2	20%	13-30
Time savings	0.6-1.5	10%	6-15
Yield Increase	0	0	1
Farm practices	0	0	0
Total	3.2-6.7		20-46
Total Benefits:			
Based on 50,000ha	€160k – €335k		€1m – €2.3m
Based on 1,184,000ha being 80% of the maximum adoption level assumed (1,480,000 ha)	€3,8m – €7,9m		€23.7m – €54.5m

Table 11: Denmark: Total Benefits to Farmers

The main components of the benefits were identified as:

- Reduced cost of fertilizers
- Time Savings for farmers

Although there were also clearly benefits in crop yields these were affected by many external factors such as the weather during the growing season, global and local demand. Improvements to farm practices were also not quantified. The study therefore presents a conservative assessment of the benefits.

Quantification

[49] https://earsc.org/sebs/wp-content/uploads/2019/03/Farm-management-in-Denmark-Full-case.pdf

The approach used the Denmark study results and scaled these to the Moldovan situation.

a) The table below shows the assumptions made, crucially scaling the potential value in Moldova using the current mid-range value for Denmark rather than using the much higher potential values, this approach represents a very conservative estimate.

Ref	Element	Denmark Actual (Eur/Ha)	Current Uptake	Full Potential (Eur/Ha)	Assumed Potential Moldova (Eur/Ha)	Potential (Eur)	Potential (MDL)	Calc
G	Reduced chemicals	2.6-5.2	20%	13-30	3.9	7,183,410	143,141,656	G*L
H	Time savings	0.6-1.5	10%	6-15	1.05	1,933,995	38,538,138	H*L
J	Yield increase	0	0	1	0	0	0	J*L
K	Farm practices	0	0	0	0	0	0	K*L
L	Total Arable Land in Moldova (Area, ha)	1,841,900						D
M	Total Realisable Benefits					9,117,405	181,679,794	G+H

Table 12: Potential Impact Calculation for Moldova

b) The costs to be set against these benefits are calculated based on the case study rate per hectare of EUR 2.68 (MDL 56) per annum. The number of hectares used for arable crop production is derived from the same national statistics source, giving a total annual cost for full implementation of MDL 98 million.

Impact

Using a conservative adoption rate of 5% per annum applied from Year 3 onward gives an estimated cumulative net benefit once discount rates are applied of MDL 125.6 million (USD 7.1 million).

5.3.2.1. Increase in Land Value

Context

Completion of the registration of land based upon cadastral parcel surveys is a fundamental task of Governments in all countries. It enables land to be used as collateral for getting access to credit to allow the land to be improved with positive effects on public welfare and economic growth. However, it has many other positive effects including, when linked to land use records, enhancing the ability of Government to more accurately value land and property.

Moldova has made good progress with the support of funding, particularly from the World Bank. However, the task needs to be completed and a regime for continuous updates put in place to become sustainable.

Use Case

The World Bank Land Registration and Property Valuation Project[50], initiated in 2018, sets out the overall objective as follows "clarifying private and public property land and property rights, the project will contribute towards Maximizing Finance for Development (MFD). Clarification of private land and property rights is linked to greater private sector investment in the economy because constraints such as insecurity of tenure are reduced or entirely removed, giving the private sector greater incentives to use the land and property resources available in the country. The clarification of public land and property rights is linked to improved management of public property assets, which, in turn, can create a crowding-in effect because

[50] https://documents1.worldbank.org/curated/en/491971535859109015/pdf/Moldova-Land-PAD-08132018.pdf

public property assets that are deemed unnecessary for the public-sector portfolio can be sold or leased to the private sector"[51].

The primary beneficiaries of the project would be the general population, particularly members of the public within Moldova, but also foreign investors and overseas Moldovan nationals, who currently own real estate or who will acquire real estate in the future. Special attention would be paid to women and vulnerable members of society to ensure that the benefits are more equally distributed.

Beneficiaries would also include the land market professionals (surveyors, valuers) and organizations associated with mortgaging (commercial banks), who would benefit from more accurate and accessible real estate data and who will be able to provide better services to the public. Further, government institutions and agencies, such as the Ministry of Finance, PSA and the LPAs, would benefit as they will be able to easily access information about real estate for planning and property tax purposes; for providing social and other local government services; and through improvements in the use of the real estate that they manage.

Quantification

a) In justifying the Project Assessment Document (PAD) seeks to quantify the following benefits:

- Increased Access to credit
- Increase in lease value of public land

The table below, extracted directly from the PAD, shows the positive cashflow forecast from evaluating these two use cases.

		Color Key	Assumption	Actual Value	Calculation							
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	**Cumulative**
Private land - Increase in Access to Credit												
Number of private parcels to be registered	#	550,000	550,000	550,000	550,000	550,000	550,000	550,000	550,000	550,000	550,000	550,000
% of parcels registered	%	0%	10%	30%	30%	30%	0%	0%	0%	0%	0%	100%
Number of private parcels registered - new	#	0	55,000	165,000	165,000	165,000	0	0	0	0	0	550,000
Number of private parcels registered - cumulative	%	0	55,000	220,000	385,000	550,000	550,000	550,000	550,000	550,000	550,000	550,000
% of newly registered parcels seeking credit	%	5%	5%	5%	5%	5%	5%	5%	5%	5%	5%	
Number of registered parcels seeking credit	#	0	2,750	11,000	19,250	27,500	27,500	27,500	27,500	27,500	27,500	198,000
Average credit amount per parcel	USD	50	50	50	50	50	50	50	50	50	50	
Total new credit generated in the economy	**USD M**	**0.0**	**0.1**	**0.6**	**1.0**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	**1.4**	9.90
Public Land - Increase in Lease Value												
Number of public parcels to be registered	#	308,750	308,750	308,750	308,750	308,750	308,750	308,750	308,750	308,750	308,750	
% of parcels registered	%	0%	10%	30%	30%	30%	0%	0%	0%	0%	0%	
Number of public parcels registered - new	#	0	30,875	92,625	92,625	92,625	0	0	0	0	0	308,750
Number of public parcels registered - cumulative	#	0	30,875	123,500	216,125	308,750	308,750	308,750	308,750	308,750	308,750	308,750
% of newly registered parcels leased at higher value	%	16.4%	16.4%	16.4%	16.4%	16.4%	16.4%	16.4%	16.4%	16.4%	16.4%	
Number of registered parcels leased at higher value	#	0	5,057	20,230	35,402	50,574	50,574	50,574	50,574	50,574	50,574	364,136
Expected increase in average lease value per parcel	USD	100	100	100	100	100	100	100	100	100	100	
Total increase in lease values	USD M	0.00	0.51	2.02	3.54	5.06	5.06	5.06	5.06	5.06	5.06	36.4
NPV and IRR Calculations		**Year 1**	**Year 2**	**Year 3**	**Year 4**	**Year 5**	**Year 6**	**Year 7**	**Year 8**	**Year 9**	**Year 10**	
Increased access to credit	USD M	0.00	0.14	0.55	0.96	1.38	1.38	1.38	1.38	1.38	1.38	9.90
Increase in lease values	USD M	0.00	0.51	2.02	3.54	5.06	5.06	5.06	5.06	5.06	5.06	36.41
Total economic benefits		**0.00**	**0.64**	**2.57**	**4.50**	**6.43**	**6.43**	**6.43**	**6.43**	**6.43**	**6.43**	**46.31**
Project cost	**USD M**	-2.97	-3.91	-6.09	-7.76	-14.28						**-35.00**
Project cash flow	**USD M**	**-2.97**	**-3.27**	**-3.52**	**-3.25**	**-7.84**	**6.43**	**6.43**	**6.43**	**6.43**	**6.43**	**11.31**
Discount Rate	%	5.0%										

Table 13: WB Economic Analysis

b) The total benefits were extracted as:

[51] The World Bank Land Registration and Property Valuation Project (P161238) Page 11 of 67

Description from PAD	USD	MDL (Thousand)
New Credit (from Table 1)	1,400,000	24,802
Lease values (from Table 1)	5,060,000	89,642
Total	6,460,000	114,445

Table 14: Total Benefits

c) Using data supplied by Public Services Agency (PSA) the assessment of the current position (Autumn 2021) was that with a target to get to 95% registration, the total remaining was just over 404,000 parcels.

d) The cost of registration is fully funded from the World Bank project and so its costs are considered a "sunk costs".

e) The costs of maintaining the system were calculated using data supplied by ALRC and PSA as shown in the following table.

Agency	Activity	Budget (MDL pa)	Comments
ALRC			source: email from ALRC 09/09/2021
	Records of land cadastre	1,400,000	creation of geospatial and textual data on land use
	Error correction	500,000	
	Cadastral Services	100,000	
	Development of Automated Information System Land Registry	1,450,000	This is an mean figure based on the forecasts provided
	C	3,450,000	
PSA			source: email from PSA 16/09/2021
	Registration of rights from rural localities	1,049,440	based on the certificate of inheritance
	Registration of Lands (post PIEF)	353,739	maintaining the real estate register
	Revaluation of real estate	3,500,000	
	D	1,403,179	excludes revaluation item
Ingeocad			source: email from Ingeocad 16/10/2021
	Budget for Cadastre activities	2,815,000	annual salary for cadastral services
	E	2,815,000	
	C+D+E	**7,668,179**	MDL pa
		639,015	MDL pm

Table 15: Maintenance costs

Impact

It is assumed that the benefits of the project will be realized over time at an incremental rate of 10% per annum. The running costs will be incurred annually.

The net benefits over the operational period after the discount factor is applied are estimated using this approach as MDL 170 million (USD 9.6 million).

5.3.2.1. Geospatial Products and Services

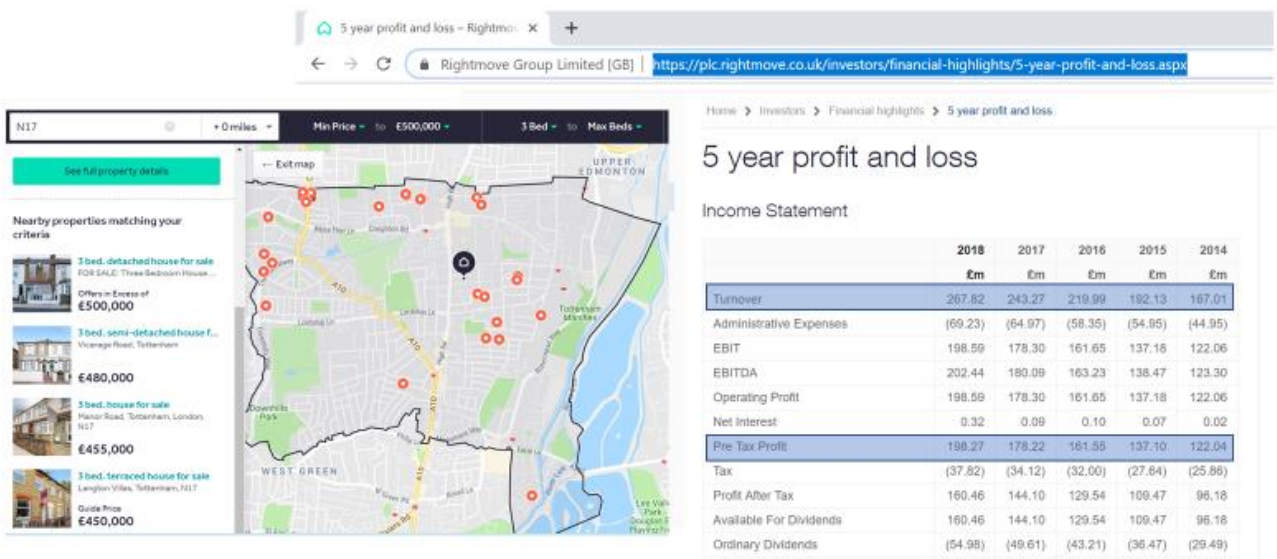
Context

The global study by economists AlphaBeta identified in section 4.2 on the value of geo-services found the growth in new products and services as one of the single biggest positive impacts for the business sector of investment in geospatial systems, such as NSDI.

Use Case

A tangible example of generation of new businesses from such investment and information shared by government with the private sector, is the development of property aggregator websites such as Rightmove, see **Feil! Fant ikke referansekilden.** below. Rightmove is what is referred to in economic circles as a "unicorn" – a business that has grown quickly and very profitably usually on the back of the use of ICT. Other examples are Uber (the ride share company) and Facebook.

Rightmove relies on open geospatial information such as traffic and crime statistics, market prices of property from individual sales transactions and, fundamentally, addresses. The figure below shows its pre-tax profits in 2018 to 73%, which is exceptionally high.



	2018	2017	2016	2015	2014
	£m	£m	£m	£m	£m
Turnover	267.82	243.27	219.99	192.13	167.01
Administrative Expenses	(69.23)	(64.97)	(58.35)	(54.95)	(44.95)
EBIT	198.59	178.30	161.65	137.18	122.06
EBITDA	202.44	180.09	163.23	138.47	123.30
Operating Profit	198.59	178.30	161.65	137.18	122.06
Net Interest	0.32	0.09	0.10	0.07	0.02
Pre Tax Profit	198.27	178.22	161.55	137.10	122.04
Tax	(37.82)	(34.12)	(32.00)	(27.64)	(25.86)
Profit After Tax	160.46	144.10	129.54	109.47	96.18
Available For Dividends	160.46	144.10	129.54	109.47	96.18
Ordinary Dividends	(54.98)	(49.61)	(43.21)	(36.47)	(29.49)

Figure 9: Rightmove Property Aggregator Website

Quantification

The calculation of benefits attributable to this project are estimated as follows:

a) The estimate size of the market almost certainly grew in the period between 2016 and 2020 but has reversed during COVID, so an assumption of zero net growth is a conservative assumption.
b) Global estimates are scaled to the Moldova economy based on GDP (Current prices) tables published by the World Bank for 2020, see the table below:

Ref		USD	MDL (Thousand)	Calculation
A	Overall size Global Geospatial Services	400,000,000,000		
B	Global GDP	84,705,425,882,119		
C	Moldova GDP	11,914,040,905		
D	Scale Factor	0.000140653		
E	Pro-rata Annual Value of Revenue	56,261,052	996,715	A*D

Table 17: Scaling of Potential Market Size Growth

c) Multiplying these factors, gives the estimated total realizable impact in USD, that is then converted to MDL (Row E) above.
d) The actual size of the current geospatial market, which with the aid of expert local opinion, was estimated in the range of USD 1 million and USD 1.5 million per annum. A figure of USD 1.25 million (MDL 22.1 million) was used for the mean case.
e) The rate of growth of the IT market was derived from IDC research which estimated an annual rate of growth through the period 2018 – 2024 of Compound Annual Growth Rate of 7.86%.

	2018	2019	2020	2021	2022	2023	2024	CAGR
Domestic	33.50	38.27	41.35	43.04	44.58	45.84	47.06	4.97%
Outsourcing	120.90	144.19	162.62	176.57	191.48	203.25	215.20	8.59%
Total	**154.40**	**182.46**	**203.97**	**219.61**	**236.06**	**249.09**	**262.26**	**7.86%**

Source: IDC, 2019

Table 18: IDC IT Industry Growth

Impact

It is a reasonable assumption that the average rate of growth of the geospatial market is at least as high as the average for the IT market in Moldova, as global studies indicate geospatial has been outperforming the overall IT market for several years and that COVID has, if anything accentuated that position.

Applying this growth rate to the current size of the market gives an estimated growth in revenues over the period after investment has been completed of MDL 31.5m (USD 1.8m) once discount rates are applied.

5.3.2.1. Open Data

Context

In recent years many countries have adopted an open data policy by which access is made simple and without restriction. In Moldova, this is extended to access being free of charge to all users.

Use Case

There is evidence from studies in Denmark and North America, that there are positive societal benefits from adopting a policy of making Government geospatial information open.

The benefits to Government are efficiency - removing costly mechanisms for cross charging. For business it enables them to incorporate such data in their products, and for citizens it facilitates interaction with Government.

Quantification Methodology

It was not possible with the cost and time constraints of the project to mount a comprehensive market survey in Moldova to evaluate the impacts, so benefits transfer was examined.

The most comprehensive analysis, of which we are aware, was undertaken in Denmark as part of their Basic Data programme[52]. They undertook two analyses of the value of government data, the first before the introduction of open data and a second 4 years later. The scope of the Basic data programme is similar in scope to the fundamental data made open in Moldova. The results of the Danish study are below.

Ref		Euro million	MLD Million	Euro million	MLD Million	Comment
		2012	2012	2016	2016	
	Production of free geodata					
	Private companies	16	319	60	1,196	
	Government authorities	43	857	50	996	
E1	Municipalities		0	185	3,686	Included in regions in 2012
E2	Regions	129	2,571	20	399	Aggregated figure in 2012
	Independent institutions and others		0	26	518	Included in regions in 2012
F	Sub Total (excludes Private sector)	172	3,427	281	5,599	
	Efficiency gains of free geodata					
	Private companies	5	100	98	1,953	
	Utilities	13	259	31	618	
	Government authorities }			3	60	Included in regions in 2012
F1	Municipalities }			2	40	Included in regions in 2012
F2	Regions }	7	139	0	0	Aggregated figure in 2012
	Independent institutions and others }			0	0	Included in regions in 2012
G	Sub Total (excluding private companies)	20	399	36	717	
	Total socioeconomic value of free geodata	**192**	**3,826**	**317**	**6,317**	
	Remove Municipal and Regions		**-2,710**		**-4,125**	Subtract E1+E2+F1+F2 to avoid double counting
H	**Net Socio-economic Value of Free Geodata**		**1,116**		**2,192**	

Table 19: Value of Open Data Denmark

[52] Good Basic data for Everyone: A driver for growth and efficiency: https://en.digst.dk/data-and-it-architecture/basic-data/

Following the same logic for benefits transfer as adopted elsewhere in the study:

a) The value of benefits to regional and municipal government were subtracted to avoid possible double counting with the local government efficiency case study.
b) The realizable benefits are scaled from Denmark to Moldova using comparison of GDP (current prices) as shown in the table below.

Ref	Description	Unit	Value	Factor
B	Denmark	USD	355,184,024,841	
C	Moldova	USD	11,914,040,905	
D	Denmark to Moldova Scale factor (C/B)			3.3543%

Table 20: Scaling by GDP Denmark to Moldova

Impact

The capacity of Moldova to make full use of the benefits of open data will only be achieved over a considerable period of time, so a conservative 15% annual rate of adoption is assumed.

It is further recognized that the effects will not be realized until the NSDI is fully available, so are only included from Year 6, once full implementation is planned.

These elements of the calculation are shown below.

Ref	**Calculation**	EUR (Million)	MDL (million)	Comment
J	Growth over Period (Average per annum)		269	
K	Scaled Total Realizable Impact		9	Calculation J*D

Table 21: Open Data: Realizable Benefits for Moldova

6. QUANTIFIED ECONOMIC IMPACT RESULTS[53]

In this section the main results of the economic analysis are presented in summary form only, the details of the calculations are contained in a separate accompanying spreadsheet illustrating the base (mean) case and worst and best case scenarios.

6.1. Approach

The results of the assessment are presented as a Cost-Benefit Analysis (CBA). CBA is a very mature and widely recognized methodology for appraising large scale investment projects, often involving public spending. The process involves estimating the costs and benefits of a given program to establish whether the outcome at the end of the period of investment and operation represents a satisfactory Return on Investment (RoI). The RoI may be compared to other potential investments, facilitating more objective prioritization.

CBA uses a process referred to as *discounting*, which involves accounting of the rate of interest which could have been earned had the funds used for investment been deposited in an interest-bearing account or other investment. The discount rate must be deducted from the estimated gains from a project, because the funds could have earned interest without incurring the same risk.

6.2. Key Financial Variables

This study has used the following parameters:

i) Life Cycle – a 12 year period, consisting of 5 years of investment followed by 7 years of operational use. This is commensurate with the infrastructural nature of the investment but takes into account the increasing pace of technological change, so reduces the operational period.
ii) Discount rate set at 5% per annum.
iii) Inflation is assumed to have an equal effect on costs and benefits and neutral in accounting terms, so inflation effects are not considered in the model.

6.3. Costs

The investment plan to be implemented over a period of 5 years is summarized in the table below.

Ref	Period	Investment Value MDL (Thousand)	Cumulative Investment Value MDL (Thousand)	Investment Value US$ Thousand	Cumulative Investment Value US$ Thousands
A	Year 0+1	22,710	22,710	1,282	1,282
B	Year 2	20,323	43,033	1,147	2,429
C	Year 3	22,664	65,696	1,279	3,708
D	Year 4	17,348	83,044	979	4,687
E	Year 5	12,015	95,059	678	5,365
	Total	95,059		5,365	

[53] The numerical values and associated data illustrated in this section is copied from document ref 'IGIF SEIA CBA Moldova v11 20211130 MEAN CASE' To view the source data contact ALRC

Table 20: Summary of Investment Costs

The plan is based on a relatively steady level of investment over a 5-year period from approval. It assumes that investment will drop off during Year 5 as the investment period is completed. The total investment of MDL 95.06 million is commensurate with what we have observed in other developing countries. It is worth noting that required investment would be much higher had it not been for the input of major donors, particularly over the previous 10 years.

Provision is also made for on-going financial support during the operational period (Years 6-12) as follows:

Ref	Period	Operational Costs MDL Thousand	Operational Costs (US$ Thousand)	Calculation	Comments
E	Capital Expenditure	89,987			
F	Maintenance Percentage	15%			
G	Annual Maintenance on Capital Items	13,498	762	E*F	Percentage per annum
H	Recurrent Expenditure	5,072			
J	Period of Investment	5			To annualise recurrent expenditure
K	Annual Recurrent Cost	1,014	57	H/J	
L	TOTAL	14,512	819	G+K	

Table 23: Operational Costs

6.4. Summary of Quantified Case Studies

The quantified benefits described in Section 5 are summarized in the next table. The columns represent the following:

Reference – case study numerical reference.

Case Study Title – short description of the investment and expected outcome.

Evidence – summary of types of evidence sources used in calculation of quantified impact.

Methodology – the approach to impact calculation

Benefit recipients – who benefits from the investment – name main recipients - government (name specific department), business (name of sector(s)) or citizens.

Value – total discounted amounts in local and USD currency

The summary represents the mean case. Often described as the “realistic case”, calculated based on average estimate of net benefits where only a range of possible values, can be derived from the available evidence.

Ref	Case Study Title	Evidence	Methodology	Benefit Recipients	Net Discounted Value of Benefits	
					MDL (Thousands)	USD (Thousands)
1	Local Government Efficiency	Interviews with Orhei and Chisinau Municipalities	Benefits Transfer based on England and Wales Study	Local Government, Businesses, Citizens	26,659	1,505
2	Emergency Management	Local expert opinion Applied to reduced Property Damage and Lives saved in traffic accidents	Emergency Situations Statistics Local Expert Opinion	Emergency Service, Citizens	119,559	6,748
3	Impact of Augmented GNSS	Local expert opinion Australian economic study	Local market intelligence, validated by Australian study	Private Surveyors, Government	32,410	1,829
4	Digital Mapping Value	Internet and Mobile phone usage statistics	Scaling from Global Study	Business, Citizens, Government	35,702	2,015
5	Improved Address Data Sharing	Market Survey, Cost estimates from responsible Agencies	Reduction in costs of duplicate data maintenance	Government, Business	48,547	2,740
6	Agriculture: Improved Arable Farm Management	National Agricultural Statistics Expert Interviews	Benefits transfer from Danish Case Study	Farmers	125,577	7,088
7	Increase in Land Value	Expert Interviews World Bank Project Appraisal study	Application of economic analysis from the World Bank	Government, Citizens	170,808	9,641
8	Geospatial Products and Services Growth	Expert IT industry Opinion Global and Local studies of Geospatial and IT industries	Benefits transfer from global geospatial services study	Business	31,530	1,780
9	Open Geospatial Data	Stakeholder Interviews Danish study of geospatial value derived from open data initiative	Benefits transfer from Danish study	Government, Business, Citizens	33,837	1,910
	TOTAL				**624,630**	**35,255**

Table 24: Summary Table of Quantified Benefits

6.5. CBA Values

The financial values for the investment plan and on-going recurrent expenditure have been entered into a discounted cash flow spreadsheet. This has been used to calculate the likely return on Investment using a standard Cost-Benefit Analysis approach.

The results for the mean case, can be summarized as follows (units are Thousands):

Description	MDL	USD
Sum of discounted benefits	624,630	35,255
Sum of discounted costs	156,578	8,838
Benefit to Cost Ratio	3.99	
Cumulative Net Present Value	468,052	26,418

Table 23: C/B Ratio and Cumulative NPV

It is important to stress that this assessment is based upon quantification of around 20% of the identified use cases. If data and time were not constrained, and more case studies had been quantified, it is our expert opinion that the calculated Return on Investment would be significantly higher.

The cash flow forecast is indicated in the chart below.

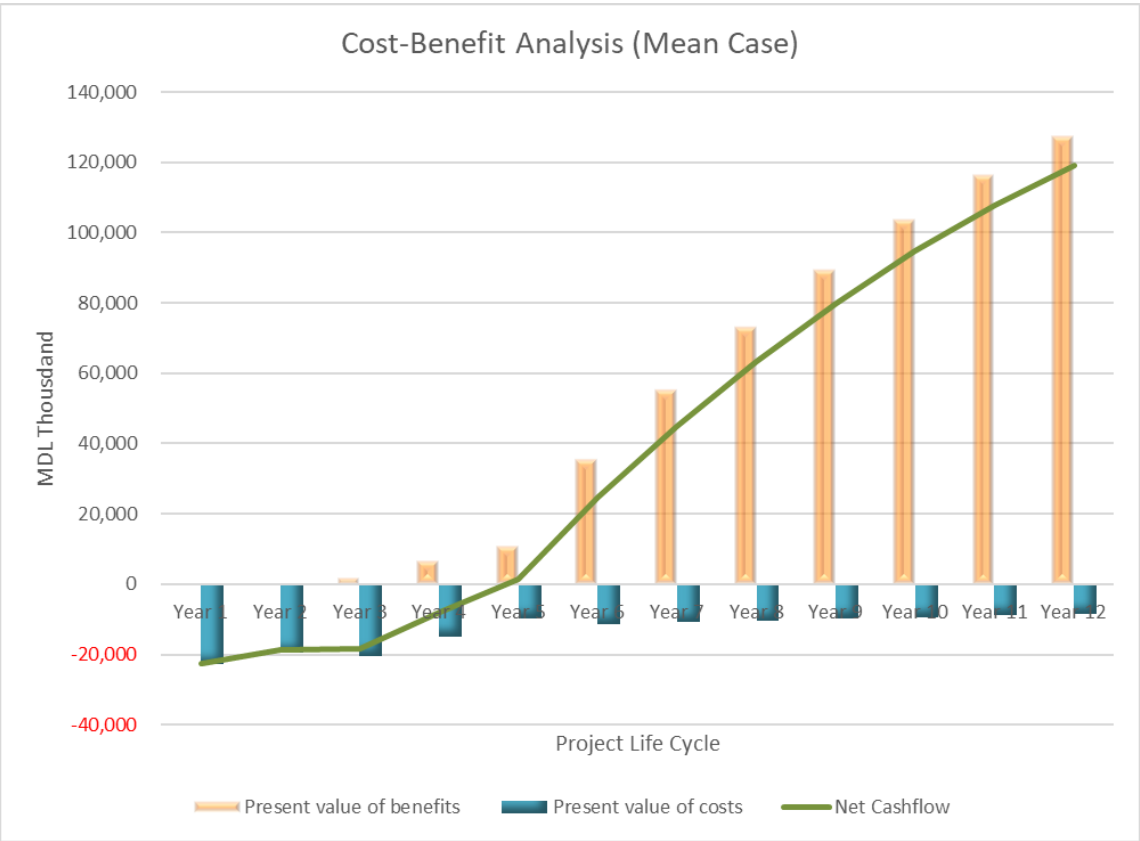


Figure 10: Cost-Benefit Forecast (Mean Case)

We can conclude from the cash flow forecast that the impact of quick wins, where benefits realized before end of investment period, will help to keep the net level of investment required to a manageable level and, on this basis, should be attractive to the government of Moldova. It has been constructed also to be sustainable by including a level of recurrent expenditure within the plan.

6.6. Sensitivity Analysis

Sensitivity analysis, to assess the robustness of the cost-benefits analysis, was conducted by making the following changes to the mean case outlined above:

Lower Bound

For the most conservative benefit estimate, low bound impacts were used for all those quantified cases where ranges were available, as follows:

Emergency Situations – lower bound estimates

Augmented GNSS – lower bound estimates

Digital Mapping Value – reduced annual growth from 5% to 2.5%

Precision Agriculture – reduced take-up rate from 5% to 2.5%

The impact on the key metrics were:

Benefit to Cost Ratio: 3.17 (reduction from 3.99 for mean case)

Cumulative Net Present Value: MDL 340 million (reduced from mean case MDL 468 million)

Upper Bound

For the upper bound (optimistic case), we have applied the upper bound range of values for the same set of use cases as used in the lower bound, as follows:

Emergency Situations – upper bound estimates

Augmented GNSS – upper bound estimates

Digital Mapping Value – increase annual growth from 5% to 7.5%

Precision Agriculture – increase take-up rate from 5% to 7.5%

The impact on the key metrics were:

Benefit to Cost Ratio: 4.82 (increase from 3.99 for mean case)

Cumulative Net Present Value: MDL 598 million (increase from mean case MDL 468 million)

We conclude that the policy advice that this is viable investment would not change even in the lower bound case.

6.7. Risk Management

The overarching message in respect to the proposed investment in NSDI is that information is the key resource that is being created and that technological change is unlikely to negate its value but may well enhance it. Further, the mechanisms proposed for curating and updating data are being designed for sustainability.

The table below, outlines the main risks so far identified and suggest how their effects might be mitigated or managed.

Risk	Impact	Probability	Management
Lack of buy-in by stakeholders	High	Medium	Strong high-level mandate and agreed governance

Expected benefits not realised	High	Low	Tracking of measurable Key Performance Indicators and, if necessary, reallocating investment away from under-performing components
Costs overrun	High	Medium	Detailed costing of investments and strong project management
Incompatible Technologies	High	Low	Adoption of open interoperability standards, detailed technology assessment prior to implementation.
Insufficient human capacity in country to deliver.	Medium	High	Mitigated in short-term by overseas consultancy support, longer term via capacity building programs.

Table 24: Risk Management Strategy

7. NEXT STEPS

7.1. Approval

Following review and feedback by Kartverket and ALRC this version represents the final version of the socio-economic impact assessment work and represents the final results of the analysis.

7.2. Refine the Investment Plan

Given the nature of the investment and limited time and resources for this analysis, it must be re-stressed that it only currently provides an "order of magnitude" indication of the likely benefits.

7.3. Implementation

The results of the socio-economic impact assessment and particularly the investment plan should be refined as the Action Plan evolves. It should be regarded as a living document subject to on-going enhancement.

It is envisaged that the plan would be presented to senior management within ALRC and then to Government Ministers for approval.

The plan includes substantial capacity development tasks whereby additional resources are put in place to manage implementation. These resources clearly need to be put in place from the start of the project.

If it is necessary to "package" the Action Plan into a series of more detailed business cases for presentation to potential sponsors, then it must be considered that unbundling may reduce the return on investment presented here, on the basis that the "whole is greater than the sum of the parts".

7.4. Benefits Realization

It is strongly advised that measuring the benefits throughout the project and adjust investment plans based on performance of each intervention is included in any implementation plan. Key Performance Indicators (KPIs) for each strategic path in the Action Plan suggest suitable KPIs.

More advice on benefits realization is provided in IGIF Strategic Pathway 3 on financial management.

ANNEX A: APPROACH TO SOCIO-ECONOMIC IMPACT ASSESSMENT

Introduction

This document sets out, in an abbreviated and generic form, the process recommended to complete a Socio-Economic Impact Assessment[54] (SEIA) according to the World Bank IGIF methodology.

Although, other techniques can be adopted it is assumed that the result of this work will be a cost-benefit analysis. The World Bank periodically publishes advice concerning recommended best practice on the use of such financial techniques and consultants should ensure they are following the latest advice. However, consultants should also consider current economic conditions and local accepted accounting conventions on key decisions such as discount rates and project life cycle.

The general approach to undertaking SEIA involves the following process:

- Establish scope of use cases to be assessed and the counterfactual[55]
- Identify the impacts over a defined time-period (project life cycle).
- Where impacts can be creditably quantified, develop cash flows of costs and benefits.
- For non-quantified benefits, document in descriptive (qualitative) terms.
- Discount the quantified cash flows of costs and benefits to calculate Net Present Value, Benefit-Cost Ratio, or Internal Rate of Return, as required by local financial practice.
- Test the sensitivity of the result to variations in costs and benefits.
- Document quantifiable and qualitative results.

Six Step Approach

Breaking down the process is helpful to being able to collect and analyze the information necessary to present a coherent, business case[56] for investment:

Step 1: Establish Scope and Priorities

The terms of reference, deliverables, timeframes are discussed and agreed with stakeholders. Strategic inputs to the decisions on scope and priorities include consideration of:

- Results of the analysis of the Baseline (Current State) position in respect to SDI development. Under the World Bank methodology this will have been completed using the Diagnostic Tool (DT) and documented in the Baseline Report. It will help to identify existing investments and their performance in delivering the current SDI.
- Analysis of the Geospatial Alignment to Policy Drivers (GAPD). The GAPD is the second stage in the World Bank Methodology that links geospatial use cases to Government policy objectives this helping to define priorities for future investment.
- National Accounts – a breakdown of the economy to determine which sectors, for example, Agriculture, Manufacturing and Professional Services contribute most to the overall Gross Domestic Product (GDP) of the country. Ideally the contribution of a given sector should be based

[54] The title Socio-economic Impact Assessment, rather than socio-economic benefits assessment, is an acknowledgement that not all impacts will be benefits, there will inevitably be dis-benefits to investment and these need to be included in any assessment.

[55] The counterfactual represents the situation that would arise without the identified project.

[56] A business case provides justification for undertaking a project, programme, or portfolio. It evaluates the benefit, cost and risk of alternative options and provides a rationale for the preferred solution. Association for Project Management.

on its value added to the economy. These are derived from Input/ Output tables where available[57]. This is helpful to evaluate to what extent investment in a sector will have a large impact on economic growth.

- External influences – political, economic, social, technological, legislative, and environmental. Often political pressures will be more important than purely financial outcomes. Understanding these influences will help to draw the optimum balance between competing potential priorities.

The business case approach also needs to be established at this stage and is normally based on how other similar investment projects have been prepared for appraisal by Government decision makers in the country being studied.

Experience indicates that the most viable method of arriving at a justifiable assessment, accepted by economists and decision makers, for this type of project is cost-benefit analysis[58]. A well established and commonly used technique for financial and economic investment appraisal.

Furthermore, it is recognized that the results achievable in what is usually time constrained research where existing statistical data is likely to be scarce, are likely to represent an "order of magnitude" impact. Consequently, the numbers should be caveated as only indicative of the likely return on investment. A conservative estimation ethos should therefore be adopted to ensure that the results are not overly optimistic, but rather represent a minimum level that could be improved if more time and data were available.

Step 2: Develop Engagement Plan

The study team should draw up a list of key organizations to engage with to gather evidence for the SEIA. This should be derived from interviews conducted in the earlier stages of the World Bank methodology based upon the strength of the use cases for SDI identified at that stage.

Organizations on both the supply (data producers) and demand (users) side, including commercial sector bodies, should be involved. The primary objective is to identify the most significant quantifiable impacts, principally related to economic growth, increased productivity, and improved citizen outcomes in the various sectors. However, impacts of a more socio-economic nature that are not so easily quantifiable should also be collected through the process. It is often easier for stakeholders to describe the impacts of SDI in qualitative terms, for example how it will improve services to users, before then selecting those that can potentially be quantified.

Briefing sessions should be undertaken to introduce the objectives of the study and approach. In addition, tutorials for stakeholders should also be held to introduce the concepts of socio-economic appraisal and outline the type of evidence that needs to be collected.

Within the selected organizations, suitable individuals with an understanding of geospatial value may have already been identified. If not, then the initial approach to the organization should clearly set out the attributes of suitable interviewees.

For each engagement, the most appropriate type of interaction needs to be assessed. In most cases for the public sector, this is likely to be by face-to-face interviews based on a small set of pre-circulated

[57] Where input / output tables are not available, a discussion of value-added substitutes can be found in Eurostat Methodologies and Working Papers NACE Rev.2, published by Eurostat.

[58] A cost-benefit analysis is the process of comparing the projected or estimated costs and benefits (or opportunities) associated with a project decision to determine whether it makes sense from a business perspective to make an investment.

questions designed to open up discussion. A similar approach is usually adopted for private sector engagement.

A market survey can be an alternative approach for the private sector market engagement. However, bear in mind that it may prove difficult to obtain statistically significant results if the market in each sector is relatively small.

Successful interviewing to elicit quantifiable socio-economic impacts can be challenging. A separate guide to recognised good practice is part of the package of SEIA support materials.

It should be borne in mind that it is rare for quantifiable economic impact information to be fully gathered on a single engagement. Often it is necessary for such information to be assembled (and/or assessed) from several different departments. An on-going dialogue is often required to gain authorization at a senior level to share financial information and assurances about restrictions on use of such data may need to be documented. The potential for extended duration, due to such causes needs to be factored into project planning.

Step 3: Collate Base Socio-Economic Evidence

Information to underpin the analysis needs to be gathered from various sources, this is often referred to as a literature review:

Existing Geo-economic Studies

An increasing body of evidence of previous socio-economic studies of the value of geospatial infrastructure is available from public sources:

Sector-specific Studies – examining the impact of individual use cases for geospatial information or focusing on a series of use cases across one industry or market sector.

National Studies – although still mostly from developed countries, completed IGIF Action Plans are a growing source of assessments for the developing world. The literature review, in the IGIF good practice guide (Appendix 3.7 Attachment 1) is a useful starting point.

Global Studies – these include reports by economic consultancies commissioned by large corporations and national Governments to assess the total impact of geospatial systems and services. There are also a small number of meta-analyses that look across a range of studies to derive general metrics.

National and Regional Economic Reports

There are many sectoral reports regularly produced for countries and regions by the World Bank, OECD, United Nations Development Program (UNDP) and United Nations Environment Program (UNEP), for example.

To assist in “triangulating” the assessments of value and refining methodological approaches, studies of economic assessments from other disciplines should also be reviewed, particularly from the domains of digital transformation, transport, and environmental management.

Economic Metrics

i) **Size and Structure of the Economy** (national accounts) – often collected from the National Statistics agency. These provided sector level economic activity by NACE[59] codes, the international standard for this type of breakdown.

ii) **Scaling Factors** – which are required if it is necessary to scale benefits that have been assessed in previous studies in other geographies (see benefits transfer description below). These can be derived from the World Bank's database of relevant indicators to allow comparison with other countries. The most commonly used factors include:

- GDP per head of population.
- Human Development Index.
- Population size (rural / urban split).
- Physical characteristics – area, length of coastline, land cover.

Step 4: Analysis

The study team should adopt a standard approach to cost-benefit analysis, as outlined in, amongst other references, the United Kingdom Treasury Green Book[60]. In essence, this involves:

Identification of costs

The cost side of the business case should consider:

a) Investment in the development of governance arrangement, capacity development, infrastructure, data standards, legal and regulatory framework, consulting support and data upgrades required by central and local government, but also by the private sector, communities, and individuals.
b) Investment in the promotion and support of use of the SDI by third parties, who will derive and create additional value to the economy.
c) Operational funding for on-going capacity development, data maintenance, IT maintenance, management and distribution and periodic infrastructure upgrading, amongst other recurrent costs.
d) Parallel running of different systems during the process of upgrade.
e) Opportunity costs of not investing.

Identification of benefits

An initial list of all identified benefits by use case and stakeholder will be assembled. Benefits are separated into quantifiable and qualitative, and we will assess them according to likely size of impact and includes any identified dis-benefits.

Many different types of benefits may be considered, here we mention some of the most common types identified in developing countries:

a) Economic Impacts

New job creation – from innovative software products and services based on geospatial data.

Increased tax revenues – based on more accurate and complete knowledge of property locations and values.

[59] Statistical Classification of Economic Activities http://ec.europa.eu/eurostat/web/products-manuals-and-guidelines/-/KS-RA-07-015 (retrieved 2nd April 2021)
[60] Treasury Green book webpage https://www.gov.uk/government/publications/the-green-book-appraisal-and-evaluation-in-central-governent

Higher agricultural production – resulting from increased crop yields from using precision farming.

Asset value enhancement – an example would be **land market growth** due to ability to secure loans based on official recognition of land use rights, such as ownership.

Lower production costs – decrease in fuel required to transport people and goods, by reducing traffic congestion and route optimization.

Process efficiency – removing the need for data duplication through more effective sharing and system interoperability.

b) Social Impacts

Faster emergency response – by Police, Fire and Ambulance services resulting from more complete and authoritative knowledge linking incident reporting to street addresses and points of interest.

Discouraging crime – using geospatial pattern analysis to increase intelligence for police officers enabling prosecution rates to rise.

Improved water quality – through smarter planning of network extensions to serve more citizens and lowering costs of pipe maintenance.

Reduced numbers of land and property-related court cases – by increasing the accuracy of cadastral parcel and immovable property data.

Helping Public Heath – improving methods of tracking the spread of diseases such as COVID-19.

Supporting decentralization – by developing tools that help better informed and more localized decision making.

c) Environmental Impacts

More sustainable Urban Development Planning – using 3D city models to allow decision makers and public to better visualize the impact of building projects.

Climate Change Adaption – from improved flood prediction using more accurate hydrological modelling.

Preventing Land Degradation – by using satellite imagery to monitor deforestation.

Reducing air pollution – by allowing location-referenced crowd sourced data to pinpoint the causes.

Calculation of Quantifiable Benefits

Two principal methods are used:

- **Primary evidence** – used for those benefits where the evidence is directly derived from interviews during the engagement.
- **Secondary evidence** – **often referred to as benefits transfer,** involves scaling impacts to the national level from case studies in other geographies with strong provenance, based upon metrics such as population, area, and GDP.

Step 5: Construct Financial Model

The model assumptions should cover:

- **Life Cycle** – typically a 12-year period is adopted, consisting of 5 years implementation of the SDI program followed by 7 years of use. This is commensurate with the long-term infrastructural nature of this type of investment.

- **Discount rate** – in the absence of more specific local advice, a "rule of thumb" is to use a figure of 3% above Central Bank base rate. SDI investment is normally considered a relatively low risk endeavor, relying as it does on well-proven GIS technology and leveraging good practice from other geographies, through adopting IGIF guidance.
- **Inflation** – it is normal practice for the effects of inflation to be ignored since they can be expected to affect both costs and benefits equally. However, if there are specific components of either that are established to be more sensitive to such changes, then this should be explicitly justified in the analysis.

From the information detailed above, a discounted cash flow model should be created and populated. The key assessment criteria for the result would be a simple Benefit to Cost Ratio (BCR) or Cumulative Net Present Value (NPV).

In some cases, it may be appropriate to calculate an Internal Rate of Return (IRR). This is the discount rate that equates the present value of benefits with the present value of costs. IRR assumes that all cash surpluses from the project can be invested at the IRR and all project financing can be sourced at the IRR. For high IRRs (say greater than 20 per cent) this is not likely to be the case. In such circumstances the other alternative measures are more meaningful.

To support risk assessment, a sensitivity analysis should be built into the model by varying the value of key factors where the range of potential values, from worst to best case, was largest.

Step 6: Report

The final stage of the process is to create a narrative based upon the information gathering and analysis, together with the results. A recommended structure for the report is as follows:

- Executive Summary
- Introduction – background and overview of country
- Scope – the identified potential "entry points"
- Methodology – options, choice, and assumptions
- Literature Review – relevant economic benefit studies
- Analysis – primary cases and benefits transfer choices
- Results – calculation of costs and benefits
- Conclusions and Next Steps

A range of communication products (Presentations, blogs, social media posts and videos) may also be required to socialize the results with different stakeholder groups from politicians to economists to technical experts and to the public.

ANNEX B: LIST OF STAKEHOLDERS ENGAGED

Key Stakeholder	Abbreviation	Functions	Centralized / Decentralized	Influence
Agency for Land Relations and Cadastre https://www.arfc.gov.md/	ALRC	The functions of ALRC include Geodesy, National Mapping, Geoinformatics, Cadastre, Real Estate Valuation, and Land Reform programs including the implementation of the state policy in the field of land relations and their alignment to European standards; ALRC is the coordinating authority for the National SDI and is responsible for implementing associated government policy.	Centralized	ALRC is the coordinating authority for the National SDI and is responsible for implementing government policy
Public Services Agency http://www.asp.gov.md/	PSA	The functions of PSA include the management and administration of state registers and information systems including population, legal entities, vehicles, drivers, cadastre of real estate, administrative units, and addresses.	Centralised	PSA/Cadastral Department is responsible for the creation and maintenance of the real estate cadastre, execution of cadastral and real estate evaluation works, administration of the real estate cadastre central database, and registration of real estate and ownership rights Cadastre Department is responsible for the Administrative units, Cadastral parcels, Buildings, Addresses A new solution for parcels, property rights and valuation (MoldLIS) was developed with the support of Norway Government…

				http://cadastru.md/ecadastru/
Ministry of Agriculture, Regional Development, and Environment https://www.madrm.gov.md/	MARDE	As the title suggests the functions of MARDE include Agriculture (subsidies, project support, policy, regulatory control); Regional Development (planning, rural development, international collaboration, urban revitalization), and Environment (policy and monitoring, water resource management, waste management, environmental impact assessments).	Centralized	MARDE is responsible for the implementation of the national strategy for agriculture and rural development. MARDE is a central public authority responsible for implementing government policy
Ministry of Economy and Infrastructure https://mei.gov.md/en	MEI	Functions include economic policy, economic forecasting and modelling, energy policy (including energy efficiency and the use of renewable energy resources), transport (including the development of transport strategy.	Centralized	Will have influence in regard to the socio-economic impact assessment and its potential influence on economic policy MEI is a central public authority responsible for implementing government policy.
E-Government Agency www.egov.md	e-Gov	The primary function of e-gov is the implementation of the governments digital transformation strategy including the modernization of public services through their digitization, improving governance through data exchange between agencies and public service institutions (use of MConnect), and improved access channels to public services (through the use of government portals and, offline, through the provision of centres for the provision of public services, this in association with PSA)	Centralized	E-gov will influence strategy for government portals and interoperability . Has limited capacity in GIS applications.
Congress of Local Authorities of Moldova https://www.calm.md/	CALM	The function of CALM is to represent all local authorities, providing a centre for information, training, expertise, experience, and provision	De-centralized	Influence of the individual LPA's in terms of promotion of recognized good practice;

(representing individual Local Public Authorities (LPA's)s including the cities of Chisinau and Orhei)		of other services to support the local public authorities (LPA's)		will influence the implementation of the SDI at the LPA level
Orhei City Hall https://orhei.md/index.php?l=en	Orhei	The functions of Orhei cover all the aspects of local government administration including the provision of public services, urban regeneration, infrastructure maintenance. The economy is represented by three key sectors: industry, transportation, and other public services (telecommunications, electricity and thermal energy, water supply and sanitation, waste management)	Centralized	Orhei is prominent in the use and application of geospatial information and citizen engagement. This experience can help influence other LPA's regarding the potential benefits for SDI for local administrative purposes
Chisinau City Hall	Chisinau	The functions of Chisinau cover all the aspects of local government administration (see also CALM and Orhei)	Centralized	Chisinau as the capital city is also important in the use and application of geospatial information and citizen engagement. This experience can help to influence other LPA's regarding the potential benefits for SDI for local administrative purposes
General Inspectorate for Emergency Situations https://www.mai.gov.md/	GIES	GEIS is part of the Ministry of Internal Affairs, and its functions include all elements of emergency and disaster response (natural and manmade) including epidemics, weather phenomena (floods, droughts, storms, earthquakes) accidents and emergencies, transport accidents, emergency rescue, fire, hazardous waste, and civil protection. The scope of GIES ranges from single one-off events through local, territorial, national, and transboundary	Centralized (coordination function) with de-centralized/regional offices	User of the NSDI GEIS has a WMS-service for data related to Exceptional Accidents and Incidents. The service is used internally only at present
National Bureau of Statistics https://statistica.gov.md/index.php?l=en	NBS	NBS is the central administrative authority with the function of managing and coordinating all	Centralized	NBS influence covers the development, production,

		statistical activities. The bureau is responsible for approving the statistical methods and statistical indicators used and for monitoring alignment with international standards, especially those of the EU		dissemination, and coordination of all official statistics. The use of National statistical data will be a key contributor to the SDI
Energy Efficiency Agency https://www.aee.md/ro	EEA	EEA (part of the Ministry of Economy and Infrastructure) has a primary function of implementing state policy in the field of energy efficiency, energy performance of buildings, capitalization of renewable energy sources, financing projects relating to energy efficiency and renewable energy sources	Centralized	Influential in the areas of environment and climate change
Military Topographic Service[61] https://www.army.md/	MoD	Part of the Ministry of Defence	Centralized	Influential for release of mapping and imagery data to business and citizens.
State Enterprise "Ingeocad" https://www.ingeocad.md/	INGEOCAD	Ingeocad is part of ALRC (one of 4 state enterprises within ALRC) which functions include Institute of Geodesy, Engineering Research and Cadastre (INGEOCAD) and is the leading state enterprise for geodetic, geological, topographic mapping and cartographic production. Ingeocad also provides engineering-geological and surveying/geodetic work for construction sites	Centralized	Key agency for technical development of SDI, including national geoportal

[61] SEIA interview may not be possible for reasons of security

State Enterprise "The State Planning Institute for Land Management" https://ipot.md/en/about-us.html	IPOT	Institute for Land Management is part of ALRC (one of 4 state enterprises within ALRC) and has the primary function of regulating land ownership and monitoring of the land. Functions include land management services (including land consolidation projects; land monitoring, land inventory); cadastral services (including boundary/parcel demarcation, maintaining cadastral plans and records for property transactions); soil surveys; and surveying services (including large scale topographic surveys, engineering surveys for roads, railways, pipelines and other infrastructure		Influential in the field providing public access to specific services/information, providing public access to information on land and property
Ministry of Health, Labour, and Social Protection https://msmps.gov.md/en/	MoHLSP	The function of the MoHLSP is that of the central specialized agency responsible for the implementation of government policies in the fields of health, labour, equal opportunities, social protection, and demography.	Centralized (with local and regional offices)	The National Development Strategy (Moldova 2030) and the CoE Action Plan 2021-2024 both include specific references to SDG's which will fall under the remit of the MoHLP. MoHLSP will be influential in promoting these goals but has a limited capacity for GIS applications.
Ministry of Finance https://www.mf.gov.md/ro	MoF	The functions of the MoF includes budget development and approval, accounting and auditing of the public sector, management of the public finances, management of the public sector debt, and treasury functions such as forecasting and managing the state budget and the preparation and publication of reports on the implementation and performance of the budget.	Centralized	While not a direct user of any of the IGIF data themes MoF will be very influential in terms of contributing to, and promoting, the 'direct use values' which may be outputs from the SEIA analysis and providing substance to the GDP impacts.
Moldsilva http://www.moldsilva.gov.md/?l=en	Moldsilva	The primary function of the Moldsilva agency is the central administration agency for state	De-centralized	Should be influential in the use of the SDI (and

		policy covering forestry (and hunting). The functions include the development, promotion, and implementation of state policy in forestry and hunting, taking into account international trends of socio-economic sustainable development, rural development, rural employment, sustainable forestry, development, forests and wildlife protection, conservation of biodiversity, and forestry research and education.		geospatial information) for the management of the state forests and wildlife management Good capabilities in GIS through ICAS
State Enterprise "Forest Research and Development Institute" (see Moldsilva)	ICAS	ICAS functions include forest management (including disease monitoring), forest research, and forest design. ICAS is responsible for land cover and protected zones (forest fund and State-protected zones of the forest fund) datasets. ICAS is subordinate to Moldsilva	Centralized	Influential and has good capabilities in GIS
Agency for Geology and Mineral Resources http://agrm.gov.md/en/	AGRM	AGRM (part of the Ministry of Agriculture, Regional Development, and Environment) has, as its primary function, the use and protection of the subsoil; the management of mineral resources; regulation and management of mining and quarrying; monitoring of groundwater quality, maintaining a record of mineral reserves (referred to as a cadastre of mineral deposits and reserves), geological exploration, geological research.	Centralized	Influential in the area of Geology and Soils thematic data
S.E. State Road Administration https://www.asd.md/en/	SRA	Responsible for Roads data.	De-centralized	SPA has roads data in digital format and is willing to provide this data to the NSDI via ALRC
SA Apa-Canal Chisinau	ACC	Functions include Water Supply (domestic and industrial) including water capture, water	De-centralized	Influential for utility mapping, asset

https://www.acc.md/		treatment, water pumping, and managing the distribution networks; Public Sewerage including wastewater pumping and treatment; and public services for heating and hot water supply including thermal power plants, production of thermal energy, and electricity production.		management, and customer records

ANNEX C: QUALITATIVE CASE STUDIES

Public Health

Context

The COVID-19 pandemic has forced radical change in most countries. Moldova is no different and while the Ministry of Health is stretched coping with the national response, there has been little opportunity to directly engage with them to assess how geospatial data can benefit public health.

Ironically, the spread and impact of COVID-19 is a geospatial problem, understanding how the virus spreads from a location, its transmission tied to proximity between and among people at a place, and spread over space and time, is paramount. Therefore, appropriately responding to and mitigating the pandemic and its ongoing transmission, is also about location and knowing where the hotspots are, and why.

The COVID-19 pandemic has reinforced the unprecedented need for data, geospatial information, enabling technologies, and insights for governments and citizens across the globe, to not only enable decision-makers to inform policies and planning, but to also minimize the risk to people, especially the most vulnerable population groups[62].

Use Cases

Data collection – the reporting of new cases, Intensive Care Unit (ICU) capacity and many other factors of the information model (see below) have a geospatial component. Most existing tools used for data collection in the health service lack the ability to record location data completely and accurately. A current example is recording of new cases and negative diagnoses in doctors' surgeries. Patient record systems may be paper based, and at best, digitally recorded addresses are in an unstructured form. The level of match of address to location, even in countries such as South Africa with relatively sophisticated geospatial systems is low. Consequently, the location of where a victim caught the disease cannot be ascertained with any certainty, so finding clusters and contact tracing is compromised. GIS can help doctors and patients to pinpoint locations, their home and other places they have visited, on a map or satellite image.

Situational Awareness – the dashboards that have been created by Johns Hopkins University[63] and sites in individual countries and cities are very powerful tools for **visualizing** the status of the disease spread and, when combined with predictive models (see below), what future patterns might look like. These are widely used by politicians and senior company executives to make decisions and to **improve community engagement** by more effectively sharing information with the public.

Predictive Analysis – the reproductive (R) value, that indicates how many other people each corona positive individual might infect, is based on models that are inherently spatial, relying particularly on movement patterns of those individuals and others that they encounter. These models work currently on historical statistical predictions of movement integrating demographic, lifestyle, and geospatial data. Working our way out of lockdown will require near real time spatial data to allow epidemiologists to be able to enhance these models and better inform these decisions.

Demographic Analysis – understanding distribution of population is clearly an important ingredient to planning all components of response. The concentration of vulnerable, elderly, and other "at risk" groups

[62] White Paper COVID-19 Ready to Respond, UN GGIM. https://ggim.un.org/meetings/GGIM-committee/10th-Session/documents/Covid-19_Ready-to-Respond.pdf

[63] Johns Hopkins University Dashboard. https://coronavirus.jhu.edu/map.html

is key to **shielding** measures. Globally, such statistical data is increasingly widely geo-referenced because of global work to enhance census and socio-economic surveys.

Logistics – once demographic analysis has established the need, then meeting the requirement is a job for logistics planning. How we most efficiently deliver food, care workers and Personal Protective Equipment (PPE) to these communities, is a question which can be most effectively answered using road transport data and GIS network analysis algorithms. Improving the response to an emergency call by routing an ambulance to a hospital with capacity to deal with a patient can be literally a matter of life and death at times when the medical system is heavily loaded.

Allocation of Resources – the allocation of critical resources, such as medical staff with particular skills, to hospitals based on travel times is what the GIS community refer to as a location-allocation problem and has developed special tools for doing this type of analysis. Another of this class of problem addressed by geospatial solutions is **site selection** e.g., for field testing centers. Geospatial can answer the question **–** where are the best possible sites, such as large parking lots that could be easily converted for testing and which configuration of these in an area will give the average shortest drive time for the largest number of those needing to be tested.

Nearest Facility – this is the counterpart to the problem above. Once temporary facilities have been set up, how do I direct people to the closest one to their locations. Apps that enable GIS network analysis performed on entry of a current location are readily available from many providers. Often these are enhanced by enabling timed appointments for to be made through the same app.

Test, track, and trace is the term widely used for the techniques currently being considered in different countries for aiding the gradual releasing of lock down conditions. The concept is that you sign-up to an app which you install on your smartphone. If a person tests positive, based usually on answering a series of diagnostic questions within the app, then a series of alerts are cascaded to other persons who have been in your proximity. They will then be asked to self-isolate or follow other instructions from authorities. Work at the Oxford University Big Data Analytics center suggests that the approach helps to reduce the rate of spread, and the time it is necessary to spend in quarantine, even if the take-up of the app is relatively limited[64].

Many of this type of solution already introduced, such as in South Korea, rely on GPS for locating individuals via their smartphone. In Singapore, the Government has now made an open-source app they developed (Trace Together) for this purpose, freely downloadable.

Concerns being discussed with the use of GPS hinge upon **location privacy** and the protections that need to be put in place to prevent long-term storage and subsequent use of the data so collected by Governments or private companies involved in processing and transmitting the data.

GeoStatistics

Context

The National Bureau of Statistics of Moldova (NBS) is the central administrative authority which, as the central statistical body, manages and coordinates the activity in the field of statistics from the country. Moreover, NBS organizes, statistical surveys regarding the situation and economic, social, demographic development of the country, performing the works related to the collection, processing, centralizing,

[64] Oxford University Big Data Institute

storage and dissemination of statistical data[65]. The main current beneficiaries are policy developers at national and local administrations dealing with infrastructure, public health, transportation, education, emergency services and environmental protection and program planning.

Use Cases

In 2014, the National Census was fully executed in paper and little of the information collected on household dwellings and buildings was geo-referenced. The total cost Moldova census 2014 was USD 7,655,902 (USD 2.15 per capita, USD 3.69 per capita (PPP)[66] ((United Nations Economic Commission for Europe, 2014). The next National census is scheduled for 2023. Significant effort is invested to modernize the next census (e.g. usage of tablets, advanced geospatial processing, and analyses). It appears that there is high interest in the data collected by National Bureau of Statistics (e.g. urban planning purposes).

In 2017, the Commission for Censuses was approved. The members of the Commission expressed commitment to support the next 2023 census with tablets. The overall feeling is that the costs of using tablets (as a geospatial mobile technology) will increase the census costs (and so make it more expensive). However, the speed of data collection and resulting data quality are considered to be the main benefits of the tablets usage. Therefore, it is expected that the benefits will be significantly higher in (longer) time. The UN Population Fund (UNFPA) financed the tablets (USD 300 per tablet x 6000 tablets purchased = USD 1,8 million funding) and European Commission funded the underlying system.

Data processing for the 2014 Census was done in 2 shifts of 200 people for 7-8 months to complete the manual entry of the census results (with a cost of 8,000,000 MDL (circa USD 448,000). The data processing was finalized in 2016. In 2023, the tablets will be connected to central datasets, so no manual entry will be required. This change will significantly shorten the data processing time (and data analyses and publication can start much earlier). It is also expected that (geo)digitalization will also significantly shorten the analysis time. Therefore, it is likely that the number of data analysts will be reduced.

It is expected that the number of enumerators will drop from 12,000 (2014) to between 6000 and 7000 (2023) by making use of the tablets. So, the usage of tablets will reduce the number of enumerators by 5000 - 6000. Taking the lower net decrease, will mean a drop of salary costs for enumerators by USD 3,08 million; 5,000 (12,000 – 7000) enumerators x 11,000 MDL/month x 0.056 (currency rate). This reduction in salary costs is also confirmed in Statistica Moldovei (2018). The study also indicates a drop in costs for data processing and dissemination.

The purchase of the tablets will be a one-off cost and it is likely that new tablets will be renewed for follow-up censuses. The National Bureau of Statistics is working on a what to do with the tablets afterwards (e.g., selling them to other government uses (including teachers). However, some tablets will be used to update the census by sampling over the intervening period.

Summary

The socio-economic benefits of geostatistical integration include faster census data collection; lower number of enumerators involved; significant better census data quality, rapid census data processing,

[65] Statistica Moldovei (2018). General overview of 2020 round of the Population and Housing Census in the Republic of Moldova. https://unece.org/fileadmin/DAM/stats/documents/ece/ces/ge.41/2018/Workshop-Geneva-Sept/Republic_of_Moldova_Population_Census_ENG.pdf

[66] A very similar approach was executed in Serbia 2011 (Total costs: USD: 34,131,389 (USD 4.70 per capita, USD 8.85 per capita (PPP)) (United Nations Economic Commission for Europe, 2014).

analysis, and dissemination processes; lower number of census data operators and analysts[67]. Quantification is not possible because of the lack of current strategy on reuse (and therefore cost apportionment) of the tablets required.

Moldavian Air Traffic Services Authority (MoldATSA)

Context

The Moldavian Air Traffic Services Authority (MoldATSA) is the country's air navigation services provider. It is a self-financing, state-owned enterprise subordinated to the Ministry of Transport and Roads Infrastructure. MoldATSA is a member of the International Air Transport Association (IATA) and the International Civil Aviation Organization (ICAO) that impose requirements to implement standards and procedures.

MoldATSA uses many types of geospatial data and rely on authoritative and trusted sources. The cost of data collected and used by the Authority in its daily operations is part of the service costs charged to passengers of air transport services. The data and metadata used by MoldATSA must be traceable, so the Authority uses data from the ALRC where possible. The software they use for data representation and analysis of airports and other objects is specialized and certified by ICAO. However, geospatial information taken from the ALRC is only a small part of the diverse range of data required for the Authority's operations due to bilateral or multilateral international agreements.

Drone use is classified by the Authority as a risk operation, due airspace interference. The regulation for drone operations is under the Government control and is not currently within the MoldATSA remit. The Government has not yet established legislation on drone use. There are however procedures for drone users to apply for authorization but only for use in restricted drone operation areas. To limit the risks associated with drone use there is currently one license of operation for all classes of drones. MoldATSA has been working on new regulations but, due to Covid, this work has been suspended temporarily. Drones can only fly in the controlled zones with permits at low altitude with the permission of the Authority.

MoldATSA covers all the requirements for drone permission. According to the Authority it currently takes more than a month to receive permission for large drone use. The pilot license, insurance as well as information on the scope of use and the quality of drone (specification) is required. Usually the Civil Aviation Authority (CAA) authorization is sent to MoldATSA and then coordinated with the pilot before being issued.

Use Cases

The Authority is undertaking a program of digitalization of Moldova's entire airspace (with all required details) to be completed by 2035. The program is monitored by the Government and the IATA. The digitalization at an operational level is available on MoldATSA' s website.

MoldATSA is part of Aeronautical Information Management (AIM) of Eurocontrol and takes part in various workshops/procedures. The following data is collected to secure safety and is included in radar information:

- all general aviation rules and route of transit, including airports/landing

[67] Amor Laaribi, Linda Peters (2019). GIS and the 2020 Census: Modernizing official Statistics. Esri Press 2019. https://www.esri.com/en-us/esri-press/browse/gis-and-the-2020-census-modernizing-official-statistics

- aeronautical charts for the International Civil Aviation Organization (ICAO)
- additional information
- maintenance of the digital datasets such as points of interest, obstacles, and digital terrain model
- airport mapping data set for all airports (quarterly)
- detailed approach procedures for each airport – departures/arrivals

Data charts are produced on paper and in electronic form. Data is often shared with Ingeocad, the state enterprise part of the ALRC, and then published. Only the terrain model is taken from Ingeocad – the obstacles are produced by the MoldATSA specialists using the orthophoto images. Orthophotos are used for layers as well as the aeronautical data.

Further developments

The Electronic Air Traffic Management (e-ATM) portal is being developed in the EU and there is a road map for each country to implement. All tasks are under the Local Single Implementation Plan (LSIP).

The ATM system is moving from analogue proprietary systems towards an e-ATM, that will be dependent on digital technologies, COTS (commercial off the shelf) products, networks-centric operations with extensive use of the internet, open standards, UAS e-enabled aircraft, cloud services and in the long-term AI (artificial intelligence)[68].

Benefits from SDI

If the datasets (as listed above) were not available from an authoritative source, then MoldATSA would need to create them itself at considerable cost.

Summary

MOLDATSA is heavily reliant upon the NSDI, particularly topographic basemaps and digital terrain models. These are used to produce aeronautical charts necessary for them to be part of the IATA systems for navigation and security. The economic benefits are that if not available they would have to externally contract in resources to create aeronautical charts. Drone regulation is work in progress and they understand the need to balance air safety with the benefits of wider drone use.

Army Topographic Center

Context

The Moldovan National Army Topographic Center[69] specializes in topographic, geodetic, and cartographic operations and is the main supplier of cartographic and geo-spatial data for the National Army. The Center has been involved in the Multinational Geospatial Co-production Program (MGCP) and created the national networks for the WGS 84 coordinate system. The organization also provides Chisinau airport and Balti (Marculesti military airport) with geodetic data.

The Topographic Center is the main user of available geospatial spatial data within the Ministry of Defence (MoD) but also produces specialized geospatial data for other military purposes. Currently there is a small GIS unit within the Center equipped with modern equipment and some GIS software, but it is outdated

[68] See: https://www.icao.int/EURNAT/Documents/Newsletters/EURNAT-NEWS-Vol3-May2018.pdf#search=e%2DATM
[69] https://www.army.md/?lng=2&action=show&cat=122&obj=5007

with limited capabilities. The Center's main requirements include the updating of GIS software and the provision of access to more recent aerial images.

Use Cases

The National Army Topographic Center uses the following data from the ALRC:

- Topographic Map (1:50,000/2014 JICA): the Center does not use an updated version but does update areas of interest that have changed itself.
- Data from the National Geospatial fund (www.geoportal.md) particularly ortho-imagery.
- Coordinates using the National geodetic reference system, but also produces and maintains its own geodetic system
- Satellite imagery (2009/10)
- State boundary dataset
- Land Use data, but also produces and maintains its own land use maps

The Center does not currently use the Digital Terrain Model (DTM) of the ALRC, rather it uses open-source data but would use ALRC data if provided as it is more detailed. In most cases ALRC has more detailed data but it this is not presently used by the Topographic Center. It does not make use of drones (e.g., for mapping the areas near border).

There is currently no coordination between the MoD and local government on land ownership. They do not share information about areas that they control. However, when privatization programs of land parcels are being undertaken, the MoD will be consulted. Consequently, the Center does not use cadastral data to identify the associated land use restriction and interference with their own needs. At the present time the Topographic Center has no interest in addresses.

Benefits from SDI

The MoD and the Topographic Center have expressed the need for the following elements of the NSDI:

- Orthophoto data
- Satellite imagery (24/7)
- GIS software upgrade
- ALRC land use data

For security reasons, most data must be provided on CD although they can access other datasets using WFS/WMS services

Summary

The army topographic centre could make better use of SDI data from ALRC. There are restrictions that make it difficult the share through open APIs. The main restriction is lack of modern software to be process geospatial data.

Forestry

Context

Moldova has relatively low total forest cover, amounting to 11.7% of land area or about 386,000 hectares[70]. About 300,000 hectares is state-administered forests, 25,000 hectares is owned by Local Government and the remainder is in private ownership. The Governmental Agency, Moldsilva, is responsible for Moldova's forest management as well as developing strategy, policy, and research. Most

[70] See World Bank development indicator: https://data.worldbank.org/indicator/AG.LND.FRST.ZS?locations=MD

of Moldova's forests are in the central part of the country, with slightly less in the north and even fewer in the south. Although the forest sector's direct economic contribution was only around 0.27% of Moldovan GDP in 2010[71], forests play a far more important role in the economy, particularly for the inhabitants of rural communities who largely depend on forest resources to meet household needs and supplement their incomes. The World Bank estimates the value of direct forest ecosystems services (e.g., wood and non-timber forest products) to be around USD 28 million per year and that under Business-As-Usual (BAU) predictions, forestry activities may add USD 0.6 million per year to the economy until around 2040[72]. A recent research study titled "Analysis of State Forest Institutions in the Republic of Moldova, using a Causative Model[73]" provides more information.

Use Cases

The Forest Research and Management Institute (FRMI) is a subdivision of Moldsilva. The FRMI's Cartography and Cadastre Unit geospatial database current contains data for about 85% of national forests. This database is used by FRMI for:

- Day-to-day field work for forestry management on 30-40 thousand hectares per annum (including planned cuts and other maintenance and works)
- Business processes including harvesting plans and annual reporting

The database records 60 parameters for each forest compartment including types of soil, diameters of trees, age of trees, types of works, etc.) as well as related infrastructure (such as buildings, roads, lakes, public roads, hydrology, and railway stations). Access Routes are used for logistics purposes and are part of the dataset which is used while transporting lumber and other forest products.

NSDI datasets from authoritative governmental sources are accessed using a Web Map Service (WMS). The following NSDI resources are used by the Institute in their day-to-day work:

- Orthophoto maps
- Topographic Base Maps (referred to locally as line maps) – particularly important are road and water themes
- Digital Terrain Models

Unfortunately, the WMS service cannot be used on-line permanently while in the field due to the lack of internet coverage in a significant part of forest areas. Satellite imagery is also used for reporting on land degradation but not for field work. Since 1994, the published land cadastre does not contain separate information on land use changes.

FRMI's current needs and development plans include:

- Connecting to the Copernicus program for satellite imagery for illegal forest cuts and wildfires monitoring. The institute is in an ongoing discussion with the program and has not reached a sufficient resolution to allow work to start in this area.
- Forest Statistical Inventory program (currently in its initial state of development) – estimated cost is about EUR 1.6 million to EUR 2 million over a 4-year cycle.

Benefits from SDI

[71] Figure from 2010 cited in https://documents1.worldbank.org/curated/en/494321468052757894/pdf/ACS115260REVIS00FOREST0POLICY0NOTE.pdf)

[72] See World Bank above

[73] University of Brasov, Romania: Nicholae Tiapa. https://www.mdpi.com/1999-4907/12/1/105

By implementing modern GIS technology FRMI may reduce up to 3 months of processing work in the office each year. However, they need specialist hardware and digital tools for data collection in the field.

The institute uses the orthophoto and drones (in limited volumes) but they need to calibrate this data in the field. They estimate that up to 20-30% of field work time might be reduced by implementing modern equipment and software.

The estimated savings/benefits are as follows:

a. 3350 man/days – field work valued at MDL 1.3 million per annum

b. 3800 man/days – office work valued at MDL 2 million per annum

TOTAL MDL 3.3 million (USD 187,500) based on average salary of about MDL 8500 per month.

The estimated associated costs of the required equipment and software per engineer is about EUR 10 thousand. There are 20 engineers that would need to be equipped.

Summary

There is clearly value gained from the use of NSDI data within the Forestry sector and there is potential to increase this value with investment in geospatial-enabled equipment. The study team concluded that because including benefits in the assessment would entail including costs of equipment and systems and could not be validated, so it should be included as qualitative write-up.

Agency for Geology and Mineral Resources

Context

The State Agency for Geology and Mineral Resources (AGMR) is under the jurisdiction of the Ministry of Environment. The Agency's main functions are to regulate and coordinate the study, protection, and rational utilization of mineral resources.

Mining and quarrying only represent a small part of the Moldovan economy, in 2019 it amounted to 0.31% of GDP.

There are about 430 mine locations in Moldova. Of these, there are 183 active mines which include 128 surface and 55 underground mines. There are also currently an additional 37 locations being prepared. Annually the AGRM issues 10-15 research permits, and 10-12 extraction permits.

Between 2012-2015 the agency worked with the Japan International Cooperation Agency (JICA) to create an integrated geological information portal. Although the portal was designed it was not executed. It would have included 1:50,000 scale geospatial data as well as mining locations, mineral resources information and landslides. The project would have cost EUR 2 million. It was concluded the current annual costs of circa only EUR 1,000, it was difficult to justify the development. Further, most of the gains would be for the operators rather than the agency.

Use Cases

i) Mining permits – the law states that any economic enterprise should have permission before commencing any mining activities and all permits are issued by the AGMR. Submitted mining proposals must include the permission of the owner or user of the land. In practice this does not always happen, so there are instances of illegal extraction/mining.

ii) Mining surveys – AGMR does not consider GNSS/GPS surveys to be particularly relevant for their activities, but these surveys are important to the operators. The Agency purchased a LiDAR drone last year to verify the volume of potential and actual extraction of mines using 3D models.

iii) Geological mapping – AGMR would like to incorporate vector geospatial data into their operations, but they are only at a very early stage of thinking about how this would add value.

Benefits from SDI

In terms of land use, the Agency does not consider digital access to comprehensive cadastral datasets to be of benefit as again the benefits would flow to mine operators and to citizens. It is not currently within the agency's remit to check for overlaps and other rights.

If the permission procedure were to be online the main benefit to the Agency would be time savings and all parties involved in the granting procedure would be using a single source of information.

Summary

Mining is not a large part of the nation's economy. The level of investment required to re-engineer and automate existing processes to realize such gains is difficult to justify.

Telecoms Operators

Context

The telecoms industry is part of the Information and Communications sector. The GDP contribution of the sector is valued at 5.5% of the economy. The Moldovan telecom market saw several years of solid growth, particularly in the fixed-line and mobile broadband sectors. However, a combination of high unemployment and economic difficulties have led to constraints on consumer spend, resulting in telecom revenue having fallen steadily in recent years. This decline continued into 2020, with a 6.3% in revenue from the important mobile sector alone, year-on-year[74].

Aspirations to join the European Union (EU) have encouraged the government and regulator to adopt a range of measures to bring the country's telecoms sector into line with EU principles and standards. In July 2017 the Electronic Communications Act was amended to accommodate the 2009 European regulatory framework, while further amendments were adopted in December 2017.

Moldova's internet market is developing rapidly, and though the penetration rate is well below the average for many European countries there are many opportunities for further development. A triopoly of operators is dominated by Orange Moldova, while the launch of LTE services has opened up a new revenue growth opportunity centred on mobile broadband. The near comprehensive geographical reach of their mobile networks, market brand recognition and existing customer relationships will make for steady subscriber growth in coming years[75].

Geospatial Use Cases

Network design – including mast siting, particularly for planning 4G and 5G in cities and IoT. Also, network extension in rural areas. The geospatial data required for this use case includes cadastral data to identify land ownership at potential transmitter sites. Digital Terrain Models and detailed topographic maps are used to assess how the transmitter signal will be attenuated by surrounding features, in producing so called clutter maps. For design of trunk optical fiber links, heavier use is made of basemaps to identify routes optimizing use of state land such as roads.

[74] Budde Analysis April 2021 https://www.budde.com.au/Research/Moldova-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses

[75] Business Wire Analysis https://www.businesswire.com/news/home/20190822005602/en/Moldova-Telecoms-Mobile-and-Broadband-Statistics-and-Analyses-2019---ResearchAndMarkets.com

Coverage maps – used by mobile operators in communication with customers, to indicate the availability of various levels of service (2G-5G) using their networks.

Public Health emergencies – integrating mobile telecom data with geospatial has been shown in some countries may be used to increase effectiveness of response to public health challenges, such as the COVID-19 pandemic. In these studies, geocoded mobile call data has been combined with the address registry data, personal data of the citizens, their locations, and nearest facilities.

SDI Benefits

Telecommunications development will be more efficient with the following SDI enhancements:

i) Improved Data

- Administrative boundaries to help determine who the responsible authority is.
- Complete Cadastral maps
- Road network to help plan trunk optical fiber routes.
- Digital Terrain Models - 2-5 meter grids in cities, 20 meter in other areas.

ii) Accessibility: due to restricted and not machine-readable form of access to the cadastral data, telecom companies are under risk of making errors in land property transactions. Also, without such property data on land plots representatives of telecoms spend more time preparing relevant documentation. They must deploy staff for field work to make a correct investigation of the identified place.

Summary

It has not been possible to quantify these potential benefits with the commercial operators. This type of information is highly sensitive, the methods they use for customer prospecting and planning new or improved coverage is part of the competitive advantage. However, better access to National SDI would clearly reduce their costs for information capture and improve their network design work.