Data and Technology Programme

Strategy

DATA AND TECHNOLOGY PROGRAMME

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Design & Layout:

Cover Image: Photo by

(IMAGE OF CDRI MEMBER COUNTRIES)

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ii ABBREVIATIONS AND ACRONYMS

ABAS	Antigua and Barbuda Agenda for SIDS
AI	Artificial Intelligence
AR	Augmented Reality
CDRI	Coalition for Disaster Resilient Infrastructure
CoP	Community of Practice
COP	Conference Of Parties
DRI	Disaster Resilient Infrastructure
EWS	Early Warning Systems
FAIR	Findability Accessibility Interoperability Reusability
GEDSI	Gender Equality, Disability, and Social Inclusion
GFDRR	the Global Facility for Disaster Reduction and Recovery
GIRI	Global Infrastructure Risk Model and Resilience Index
GIS	Geographic Information Systems
HR	Human Resources
ICDRI	International Conference on Disaster Resilient Infrastructure
IRIS	Infrastructure Resilience for Island States
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IT	Information Technology
IRIS	Infrastructure for Resilient Island States
LMICs	Low- and Middle-Income Countries
MDB	Multilateral Development Bank
MHEWS	Multi-Hazard Early Warning System
ML	Machine Learning
MR	Mixed Reality
NDMO	National Disaster Management Organisation
NGO	Non-Governmental Organization
OEDS	Open Exposure Data Standards
OGC	Open Geospatial Consortium
PDNA	Post-Disaster Needs Assessment
PWD	People With Disabilities
R&D	Research and Development
RDLS	Risk Data Library Standards
RFP	Request For Proposal
SDG	Sustainable Development Goal
SFDRR	Sendai Framework for Disaster Risk Reduction
SIDS	Small Island Developing States
SPC	the Pacific Secretariat
SPREP	Secretariat of the Pacific Regional Environment Programme
SWP	Strategic Work Plan
ToC	Theory of Change
ToR	Terms of Reference
UN	United Nations
UNDP	United Nations Development Program
UNDRR	United Nations Office for Disaster Risk Reduction

UNFCCC	United Nations Framework Convention on Climate Change (UNFCC)
UN-IGIF	United Nations Integrated Geospatial Information Framework
VR	Virtual Reality
WB	the World Bank
XR	eXtended Reality

iii EXECUTIVE SUMMARY

This document describes a comprehensive strategic plan for a Data and Technology programme to strengthen the Coalition for Disaster Resilient Infrastructure (CDRI) and its member countries' ability and capacity to collect, access, and use high-quality infrastructure risk and resilience data, tools, and technology resources that help them make risk-informed strategic policy, regulatory, and investment decisions that strengthen the resilience of their existing and future infrastructure systems by leveraging such data and technology as strategic assets.

The most common data and technology challenges for CDRI's Low- and Middle-Income Countries (LMIC) and Small Island Developing States (SIDS) members to implement disaster risk reduction (DRR) are a lack of high-quality geospatial and risk data, an inability to generate, access, store, manage, and govern risk data, a lack of human and institutional technical capacity to conduct, analyse, understand, and act on infrastructure risk and resiliency assessment, and the costs and access to innovative technologies.

The implementation of a cross-cutting CDRI data and technology programme defined by a strategic plan will address these challenges and significantly strengthen CDRI's mission and strategic outcomes, and supplement several other of its key initiatives such as the Global Infrastructure Risk Model and Resilience Index (GIRI) and the Infrastructure Resilence for Island States (IRIS).

The expected outcomes of this strategic plan are:

1. Member countries improve their capacity to generate, collect, analyze, use, and manage high-quality geospatial and infrastructure risk data, tools, and technologies.
2. Member countries develop risk knowledge and analytical capacity to use and deploy models, tools, and technologies to assess infrastructure risk and resilience.
3. Member countries develop and adopt risk-informed policies and regulations.
4. CDRI develops the ability & capacity to use risk data and technologies as strategic assets.

These outcomes will be achieved through the following objectives:

1. Facilitate member countries' timely access to high-quality geospatial and infrastructure risk data, tools, technologies, and knowledge resources.
2. Provide technical assistance, capacity building, and training to member countries to improve their risk awareness and capacity to assess infrastructure risk & improve disaster resilience.
3. Develop CDRI human & technical resources that leverage data and technology to help member countries achieve their DRI objectives.

A rigorous process was followed to identify, select, and prioritize the strategic output activities. This involved extensive internal discussions and external consultations with a

Working Group formulated to guide the strategy and process, CDRI member countries and organisations, as well as other stakeholders involved in disaster risk management and reduction, including academia, non-profits, think tanks, and the private sector.

Three output categories (Technical Assistance, Capacity Building and Training, and Advocacy and Communications) and five themes (Infrastructure asset data, GIRI democratisation, Infrastructure risk and resilience assessments, Infrastructure risk data, tools and innovative technologies, and CDRI internal capacity building) were identified to group strategic activities. The activities were then prioritised based on impact and effort.

A framework for monitoring, evaluation, and learning (MEL) has been created, and monitoring indicators have been identified. Gender Equality, Disability, and Social Inclusion (GEDSI) principles have also been integrated into the strategy.

1 Situational Analysis

1.1 Data and Technology Challenges for CDRI Member Countries

The starting point for integrating resilience in infrastructure development is understanding the risk to infrastructure from climate change and disasters, as evident from the Sendai Framework for Disaster Risk Reduction Priority 1 - Understanding disaster risk. There are many tools, models, and technologies to quantify the risk to infrastructure with varying degrees of sophistication and resolution, and several financial metrics that represent an estimation of such risks. All of these need data in the three dimensions of understanding infrastructure risk: climate and hazard data, infrastructure asset data (exposure), and the degree to which these infrastructure assets could be damaged by disaster events (vulnerability). Data on disaster loss and damage is needed for loss accounting and to advocate for mitigation resources, including disaster risk reduction (DRR) financing.

Additional data is needed to move from risk assessment and loss modeling to resilience levels - the ability of infrastructure assets to absorb/withstand, respond, recover, and adapt to climate change and disasters. This includes data on the physical condition of assets, the age, maintenance records, performance metrics such as effectiveness (delivery/capacity; quality - safety, satisfaction, and availability; service), reliability, and cost (capital, replacement, O&M), and the interconnectedness with other infrastructure systems.

The data and technology gaps and challenges for implementing DRR in Small Island Developing States (SIDS) have been comprehensively documented[1]. The Antigua and Barbuda Agenda for SIDS (ABAS) adopted in May 2024 acknowledges that SIDS face significant challenges in data collection, analysis, technical and institutional capacity that hinders evidence-informed policy making, and emphasises capacity building for stronger data governance that will support SIDS in better data collection, protection, transparency, and sharing. Many Least Developed Countries (LDCs) face similar challenges that have been validated through recent consultations with CDRI member states and organizations. While the priorities and extent of these gaps and challenges vary by country, these can be grouped into three categories as shown in Table 1.

Table 1: Data and technology challenges faced by LDCs and SIDS in implementing DRR

Human Resource Capacity	Data Creation, Access, and Analysis	Access to Technology and Innovation
Less staff to manage and monitor projects, design new initiatives, and consult with stakeholders due to small	**Lack of adequate data**, especially downscaled climate hazard data and projections, and socio-	**Dependency on donors** for technologies, leading to procurement delays and a need for sufficient training

[1] United Nations Department of Economic and Social Affairs (UN DESA) and United Nations Office for Disaster Risk Reduction (UNDRR), 'Gaps, Challenges and Constraints in Means of Implementing the Sendai Framework for Disaster Risk Reduction in Small Island Developing States', 2022.

populations from which to draw expertise	economic data[2], incomplete or insufficient data on critical national infrastructure exposure, and loss and damage data[3]	
Low level of baseline capacity to conduct disaster risk management activities	**Lack of storage and timely access** to data	**High total cost of ownership** - acquisition, maintenance and warranties, upgrade, and depreciation costs
Lack of analytical expertise - lack of trained geospatial and risk analysts with data and risk modeling and analysis skills to perform technical DRR activities	**Lack of digital data** – historical data is often collected and stored in paper format	**Dependency on regional hubs** for data and technology
Challenges in **retaining skilled staff**	**Lack of standardization** for DRR-related data, hampering data sharing and reuse	**Internet availability and connectivity**
Risk knowledge capacity gaps - risk analytics and metrics produced are too complex for decision makers and other stakeholders to understand and act upon	**Disparate pools** of data and institutional data silos due to a project-based culture	

Comentado [GU1]: with appropriate metadata.....AN

Comentado [GU2]: Perhaps find a sentence encouraging working relations with the private sector (eg. telecoms providers) to share data that may be useful to MHEWS.....AN

Comentado [GU3]: Lack of awareness among appropriate users.
Many times the correct agencies are not informed of access to technology and innovation to build upon.....AN

1.2 Data and Technology Needs

Data

ABAS calls for increasing support to improve SIDS' data collection, governance, management, analysis, and assessment on hazards, disaster events, and their impacts, including losses and damages in SIDS, to build their resilience to disasters. Combining this call with the extensive consultations that the CDRI Data and Technology team has had with member countries and organisations (see Table 1), SIDS and LDCs need the following types of data that they are currently lacking:

Comentado [GU4]: Believe this is more than SIDS?

Comentado [AL5R4]: The ABAS agenda is for SIDS

- Downscaled, high-resolution regional and local data:
  - Climate and hydrometeorological hazard data.
  - Infrastructure asset data.
  - Hazard risk mapping data.
  - Vulnerability data.
  - Socio-economic data.

[2] Lindsay, Courtney, Dupar Mairi, Beauchamp, Emilie, 'Mapping the information and learning landscape for adaptation in Small Island Developing States (SIDS)', ODI: Think Change Working Paper, May 2024

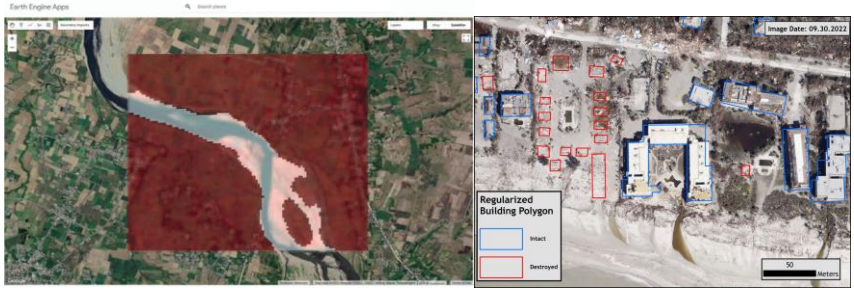
[3] United Nations Office for Disaster Risk Reduction (UNDRR) and United Nations Development Programme (UNDP), 'Data and Digital Maturity for Disaster Risk Reduction - Informing the Next Generation of Disaster Loss and Damage Databases', November 2022.

- Data to make the case for investing in DRR - this includes loss and damage data as well as data to determine the resilience of the asset and the infrastructure system.
- Mitigating environmental threats, including local and lived experiences.

Figure x: Organisations consulted with over the course of the data and technology strategy

Technology

Figure x: Examples of geospatial technologies for disaster mapping; CDRI Fellowships 2023



SIDS in particular need technology, equipment, and systems for:

- Hydrometeorological hazard monitoring, forecasting capabilities, infrastructure, and technologies.
- Expansion of multi-hazard early warning system (MHEWS) and other observing and monitoring networks[4].

[4] United Nations Office for Disaster Risk Reduction (UNDRR) and World Meteorological Organization (WMO), 'Global Status of Multi-Hazard Early Warning Systems', 2024

- Technologies and systems for risk data collection, storage, processing, management, and transmission.
- Technologies and systems for nowcasting to monitor weather and climate hazards such as lightning, thunderstorms, and heavy rainfall.
- Risk analysis to better understand multi-hazard risk to support decision-making.
- Telecommunication systems.

Comentado [GU6]: and how this impacts the vulnerability and exposure of their populations and assets to hazard events

1.3 CDRI Capacity

CDRI needs to enhance its technical and human resource capacities to assist its member countries with the data and technology challenges identified and to achieve its mission of supporting them to take informed decisions leading to disaster risk reduction and climate resilience.

It can serve as a knowledge platform for data access, generation, acquisition, and analysis. This platform will enhance the capacities & practices of its users in data management, and provide resources, including technical expertise, to countries for accessing and utilizing data and technologies for informing infrastructure resilience.

1. For example, CDRI's flagship project, the Global Infrastructure Risk Model and Resilience Index (GIRI), was developed by a consortium of scientific and technical organizations. The data and models are currently hosted by one of the partners. CDRI should build the capacity to host and manage a Data Hub for the data, analytics, and models for subsequent versions of GIRI and other CDRI projects and programs. This Data Hub will be extremely valuable to its member countries in helping them with their problems identified earlier.

Comentado [GU7]: Maybe good to mention an openness to work with other data providers to ensure inter-operability and extended uptake?

Figure x: Clauses to support procurement, collection, and management of geospatial data; Source: Various

Clauses for procuring satellite data

Clauses for collecting geospatial data including formats and standards

Clauses for managing geospatial data

CDRI's contracts and data policies should be reviewed, and an appropriate data governance framework for the organization should be defined to enable CDRI to proactively manage the ownership, access, use, and distribution of data (acquired and produced) from CDRI-funded projects, programs, technical studies, and fellowships.

2 Defining the Objectives of CDRI's Data and Technology Programme

2.1 CDRI Mandate and Value Proposition

The Coalition for Disaster Resilient Infrastructure (CDRI) is a partnership of national governments, UN agencies and programmes, multilateral development banks and financing mechanisms, the private sector, and knowledge institutions that aims to promote the resilience of new and existing infrastructure systems to climate and disaster risks in support of sustainable development.

CDRI has been envisioned and established as a global network to advance the agenda, support coordinated action among stakeholders, and focus on bringing voices from vulnerable geographies and populations to international policy forums[5].

Figure x: CDRI Vision, Mission, and Impact

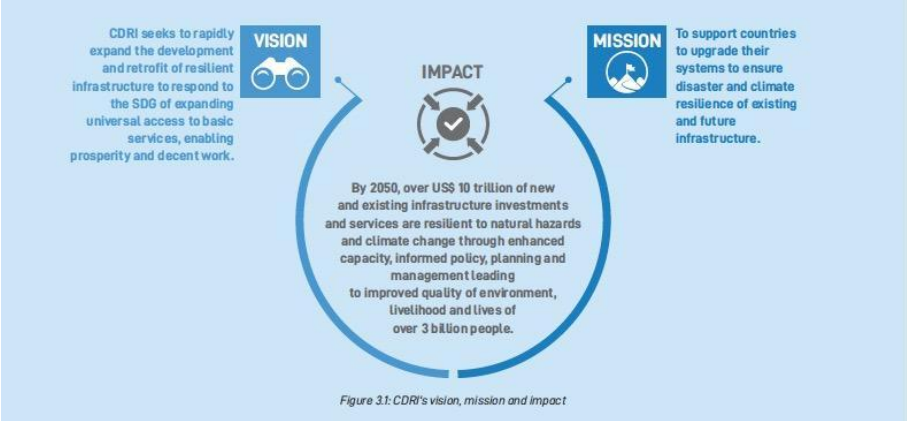


Figure 3.1: CDRI's vision, mission and impact

2.2 CDRI Strategic Outcomes 2026

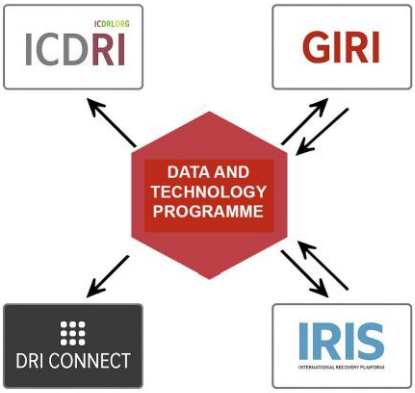
CDRI Secretariat's Strategic Work Plan 2023-26 outlines the planned initiatives in the next four years aligned with CDRI's mandate and Theory of Change. The Work Plan is guided by the three interdependent and mutually reinforcing strategic outcomes shown in Figure x.

Figure x: CDRI Strategic Outcomes - 2026

[5] CDRI Strategic Work Plan 2023-26

2.3 Data and Technology Programme Support to CDRI Strategic Outcomes and Initiatives

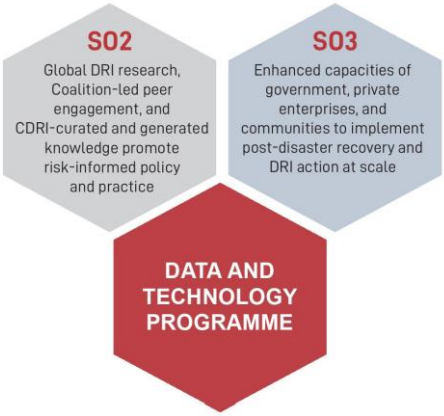
Figure x: Cross-cutting support of the Data and Technology Programme to existing CDRI programs



CDRI's Data and Technology Programme is a cross-cutting enabling initiative that will bolster CDRI's mission, value proposition, and help achieve its strategic outcomes.

The programme will support CDRI's Strategic Outcome 2 (CDRI-curated and generated knowledge promotes risk-informed policy and practice). The programme will also support CDRI's Strategic Outcome 3 (Enhanced capacities of stakeholders to implement post-disaster recovery and DRI action at scale).

Figure x: Cross-cutting support of the Data and Technology Programme to Strategic Outcomes



Two prominent CDRI initiatives support the Strategic outcomes and are very relevant to the Data and Technology programme.

The first is the Global Infrastructure Risk Model and Resilience Index (GIRI), the first publicly available and fully probabilistic risk model to estimate risk to infrastructure assets from most major geological and climate-related hazards. GIRI is a global public good and a fully interactive geospatial open data platform that enables anyone to freely access and use all the geospatial data layers and the risk and resilience metrics produced. CDRI also publishes a Biennial Report on Global Infrastructure Resilience, a comprehensive periodic report on infrastructure resilience, and GIRI is one of the major components of the report.

The second initiative is the Infrastructure for Resilient Island States (IRIS), which is dedicated to achieving sustainable development through a systematic approach to promote resilient, sustainable, and inclusive infrastructure in SIDS. IRIS aims to provide technical support on a variety of infrastructure systems issues in SIDS and promote disaster and climate resilience of infrastructure assets in these countries, as well as strengthen knowledge and partnerships for integrating resilience in SIDS infrastructure.

2.4 Scope of the Programme

The data elements that will be considered in the initial phase (2025-26) of the programme are prioritized based on the risk data required for infrastructure risk assessment and loss modeling, including by CDRI initiatives such as GIRI:

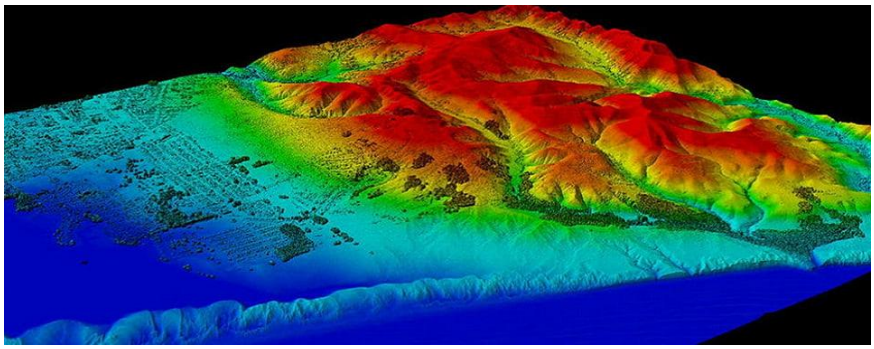
- Earth observation data - climate and weather data from orthoimagery - satellite-based remote sensing, drone, and airborne sensors.

Figure x: Earth Observation Data; Wikimedia Commons

Comentado [グユ8]: I appreciate your recognition of satellite-based remote sensing as a high priority in the initial scope (2025-26). The prioritization reflects an understanding of its effectiveness and critical value in disaster risk assessment and infrastructure resilience planning. Your commitment to leveraging these advanced observation technologies will significantly enhance the quality of geospatial risk data available to member countries. by S. Kawakita from JAXA.

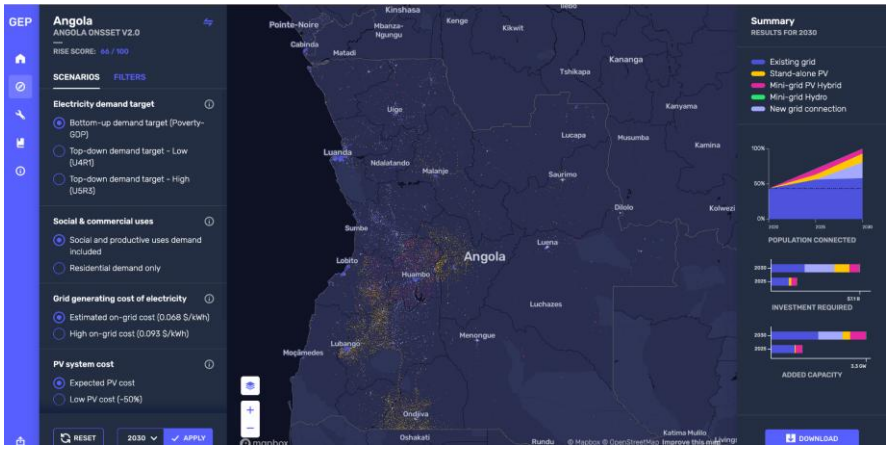
- Geospatial topographic data - digital elevation and surface models, digital line graphs representing features such as functional areas (geographic extents), water, etc., in both vector and raster formats.

Figure x: Topographic data; Wikimedia Commons



- Infrastructure-related risk data:
  - Geo (earthquake, landslide triggered by earthquake, tsunami) and hydrometeorological (flood, tropical cyclone, drought, and landslide triggered by rainfall) hazards.
  - Infrastructure exposure (power, transport including roads, railways, ports and airports, waste and wastewater, telecommunications, oil and gas, education and health facilities, buildings including commercial, residential, and industrial).
  - Infrastructure vulnerability.
  - Infrastructure loss and damage.

Figure x: Electrification data; Energydata.info by ESMAP



In the second phase (2027-2030), the Data and Technology Programme will include infrastructure resilience data elements such as physical condition of the asset, construction quality, maintenance records, performance metrics such as capacity, efficiency, reliability, and redundancy, and the interconnectedness with other infrastructure systems. Other local/regional/country-level data for telecommunications network coverage, macroeconomic and political stability, R&D intensity, and other measures used by the Global Infrastructure Resilience Index (GIRI) methodology may also be added to the scope of the programme at a later stage.

Another later expansion of the programme will need to look at ocean data (bathymetry, ocean temperatures) and ocean hazards (sea level rise, surface wave heights, coastal erosion), given that SIDS and coastal resilience are key focus areas for CDRI programs.

The tools and technologies covered in the initial scope are primary digital software and hardware technologies (AI/ML, IoT, Digital Twins, AR/VR/XR and other visualizations, automatic data collection including remote sensing & drones, robotics, image recognition) applied to the disaster management areas of infrastructure risk assessment and loss modeling, early warning systems (EWS), and post-disaster needs assessment (PDNA).

2.5 Desired Impact

"CDRI member countries make risk-informed strategic policy, regulatory, and investment decisions that strengthen the climate and disaster resilience of their existing and future infrastructure by leveraging geospatial and infrastructure risk data and technologies as strategic assets."

The programme aims to strengthen CDRI and its member countries' ability and capacity to collect, access, and use high-quality earth observation, geospatial, and infrastructure risk data, tools, and technologies that help them develop robust disaster risk reduction strategies, policies, and regulations.

Comentado [グユ9]: The future expansion scope (2027-30) addressing ocean observation is indeed critical, particularly for Pacific Island nations who have expressed high interest in this area. While implementation is scheduled from 2027, I would strongly recommend considering earlier data collection and baseline establishment. Building historical datasets before full implementation would provide valuable trend analysis capabilities and enable more robust assessment of changes over time. This proactive approach would strengthen the eventual implementation and provide immediate value to vulnerable island states. by S. Kawakita from JAXA.

Comentado [AL10R9]: Point well noted.

2.6 Outcomes

1. Member countries improve their capacity to generate, collect, analyse, use, and manage high-quality geospatial and infrastructure risk data and information.
2. Member countries develop their risk knowledge and analytical capacities to use and deploy models, tools, and technologies to assess infrastructure risk and resilience.
3. Member countries develop and adopt risk-informed policies and regulations for infrastructure disaster risk reduction.
4. CDRI transforms into a data-driven organization with the technical and human resource capabilities to use geospatial and risk data and technologies as strategic assets for DRI action.

2.7 Objectives

The Data and Technology Programme will focus on the following objectives for CDRI:

1. Facilitate member countries' timely access to high-quality* geospatial and infrastructure risk and resilience data, as well as tools, technologies, and knowledge resources.
2. Provide technical assistance, capacity building, and training to member countries to help improve their awareness, knowledge, and capacity to use data, models, tools, and technologies to assess infrastructure risk and strengthen disaster resilience.
3. Develop CDRI's human and technical resources that leverage data and technologies to help member countries achieve their DRI objectives.

Figure x: Data and Technology Programme Objectives

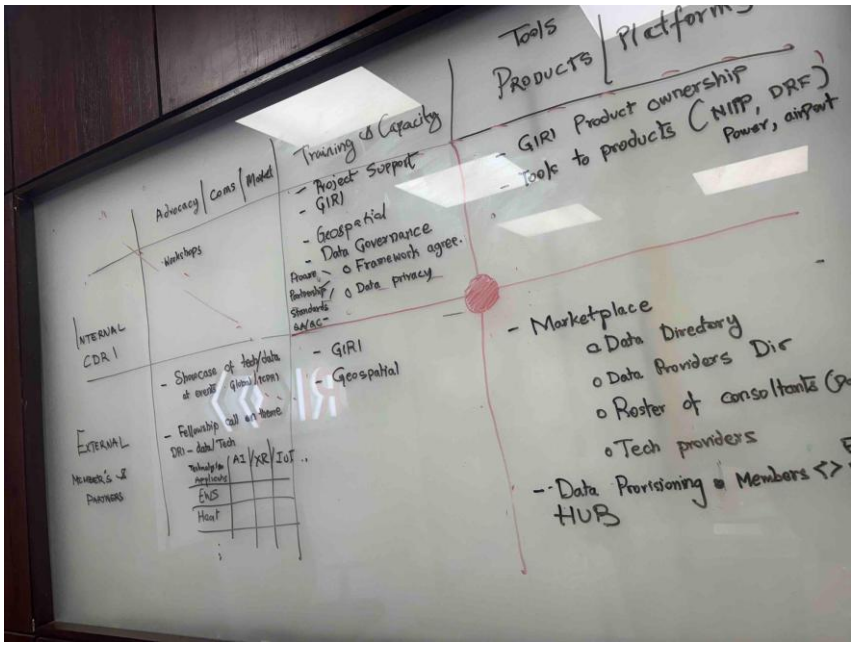
**accurate, timely, relevant, interoperable, and context-specific*

3. Strategy Selection

3.1 Process for Developing the Data and Technology Strategy

The process of developing a data and technology strategy for CDRI was initiated in October 2024. The initial landscape analysis involved a compilation of geospatial and infrastructure risk databases and knowledge platforms, a literature survey of articles, reports, and documented studies of data and technology gaps in LDCs and SIDS, and conversations with the senior leadership team of CDRI to test a set of initial hypotheses for the strategy.

Figure x: Ipshita Karmakar, Dec 2024



An internal Data and Technology workshop was conducted in early December 2025 that involved discussions with teams within CDRI, including the Biennial Report and IRIS teams, to discuss the data and technology challenges that they had observed and faced, and their suggestions were documented.

Comentado [GU11]: Typo? .....AN

The CDRI Charter and CDRI Strategic Work Plan 2023-26 were studied carefully to ensure that the data and technology strategy aligned closely with the vision, mission, and strategic outcomes for the organisation. Various articles, reports, reference guides, and research papers produced by CDRI and organisations working on different aspects of disaster risk and reduction, such as UNDRR, UNDP, and the World Bank, were reviewed. Where available, the data and technology strategies of these organisations were also reviewed. A list of relevant reports is also included in the Bibliography at the end of this document.

Over five months, from December 2024 to April 2025, the CDRI Data and Technology team consulted with external stakeholders, including member organizations, member countries, regional organizations, and individual experts, to validate and modify the hypotheses and options. The list of organizations that were consulted in the process are listed in Annexure A. A word cloud that describes the challenges and key themes from the consultations was generated and is shown in Figure x.

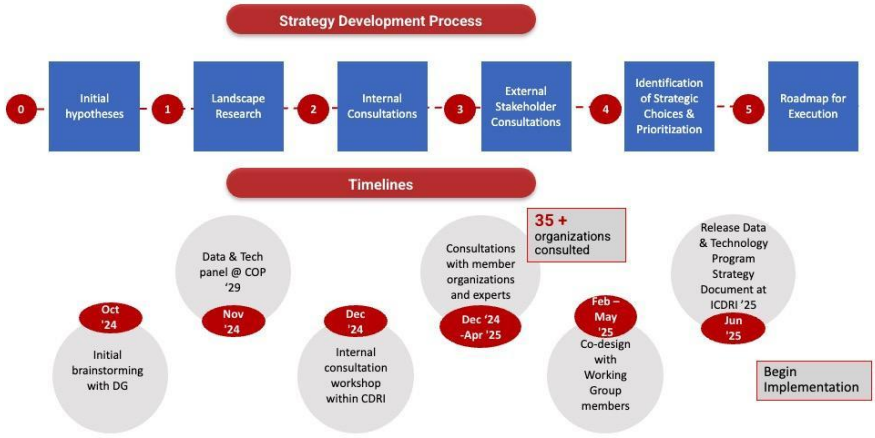
Figure x: Word cloud from CDRI consultations with stakeholders on data and technology challenges

A Data and Technology Strategy Working Group comprising nominated representatives from member organizations and countries was also constituted to guide and approve the strategy. The group met once a month over four months, starting in February 2025, and provided feedback and suggestions to the CDRI Data and Technology team on the candidate strategies and their relative priorities and effort. Annexure B provides the list of member organizations and designations of the nominated members in the Working Group.

Figure X: A snapshot of the Data and Technology Strategy Working group; CDRI, February 2025

The process and timelines are also shown in Figure 14.

Figure x: CDRI Data and Technology Programme strategy development process



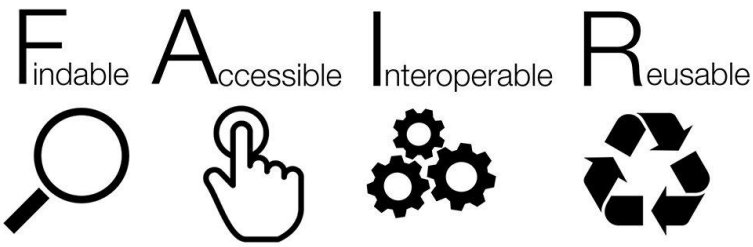
2.8 Core Operating Principles of the Programme Strategy

The Data and Technology Programme strategy has been developed with the following operating principles in mind:

- **Principle 1 - Partnerships:** CDRI is a diverse, engaged, and strong coalition driving collaborative DRI action as a global partnership of national governments, UN agencies, multilateral development banks, the private sector, and knowledge institutions. Partnerships are a key driver of CDRI's value proposition, and the Data and Technology programme will build upon these relationships and networks to work with relevant partners to implement its activities and work.

- **Principle 2 - FAIR Data Principles**: The Data and Technology programme will adopt the FAIR Data principles for long-term care of valuable data, models, algorithms, and other digital knowledge assets used and produced in our work through good data management. The four principles, applicable to both machines and people, are:
  - Findability - data should be easy to find for computers and humans. Machine-readable metadata is essential for the automatic discovery of datasets.
  - Accessibility - data is publicly accessible via trusted repositories in different formats and is understandable to humans and machines.
  - Interoperability - data can be integrated with other data, and operate easily with different applications or workflows for analysis, storage, and processing.
  - Reusability - data has clear usage licenses and can be replicated and/or combined in different settings.

Figure x: Fair Principles for the Social Sciences and Humanities



We will do this by:

- Providing data repository directories to facilitate data discovery.
- Coordinating with member countries, organizations, and implementing partners to identify previously relevant projects and data developed under them.
- Championing and using well-established data formats and metadata standards
- Promoting standard open data protocols.
- Ensuring metadata is always public and exists even where data is private or no longer available.
- Strong advocacy for data governance and data management within CDRI and with its member countries.

- **Principle 3 - Avoid duplication of work and effort:** the programme will aim to avoid, to the best extent possible, duplicating any work that has been done previously through:
  - Coordination and communication with partners, regional organisations, and vendors.
  - Creation of directories that link to existing repositories of risk data, tools, and technologies.
  - Following the FAIR principles and promoting the use of open data and open platforms.

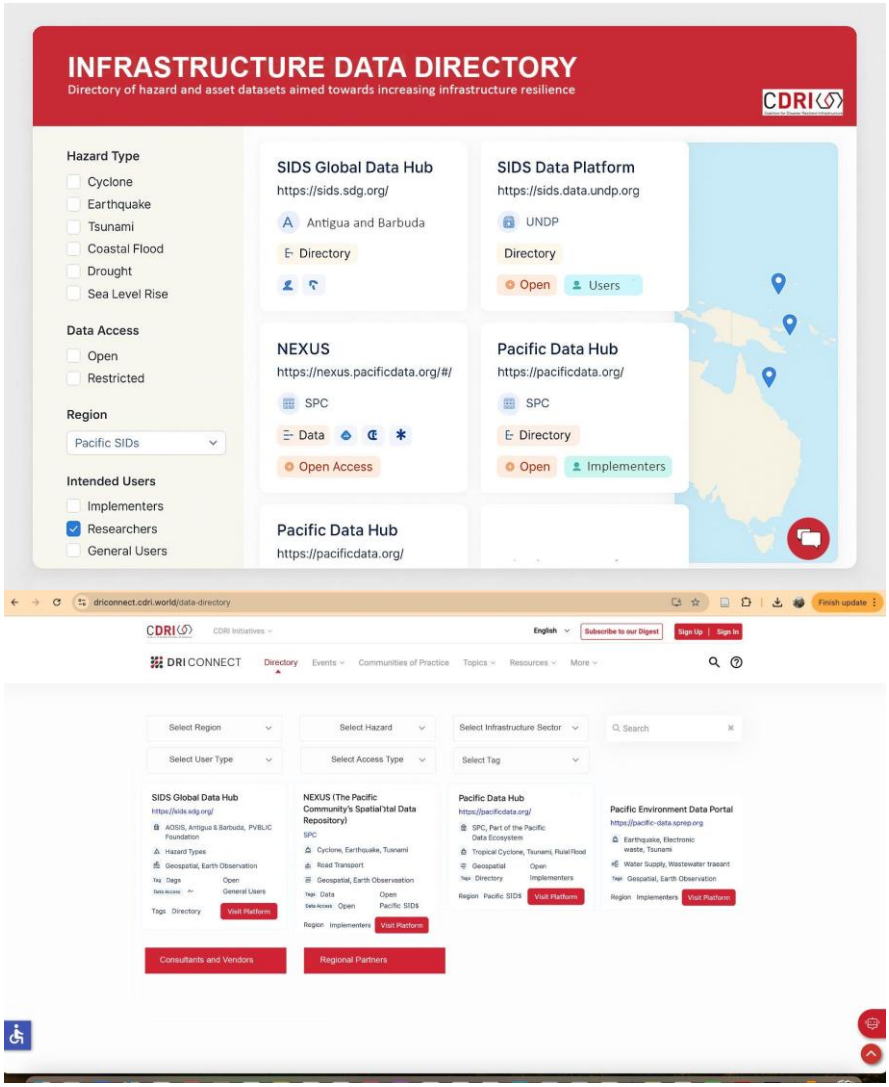
2.9 Activities - Candidate Strategies

The strategic options selected support the objectives and outcomes outlined in the Theory of Change. In alignment with CDRI's offerings, which are grouped by (i) technical assistance, (ii) capacity building, and (iii) global advocacy, the strategic options (activities) evaluated in this plan are similarly grouped in three Output categories through which the strategy will be delivered.

- **Technical assistance** - activities range from the development of infrastructure asset registries and taxonomy standards to democratising GIRI data through additional distribution channels and data services; promoting the discovery of risk data, tools, and technologies through directories of repositories/platforms of risk data, models, and tools, and via a virtual marketplace; advisory services to help governments develop strategies and roadmaps to leverage risk data from national

or regional data hubs and platforms, and models and tools from open model platforms for infrastructure risk reduction and resilience; create tools from CDRI projects (e.g. Resilience Cost-Benefit Analysis tool from the Odisha power sector) and assistance in procuring risk data, tools, geospatial software and related technologies via CDRI initiatives such as IRIS and sectoral projects.

Figure X: Examples of potential data directories by CDRI



- **Capacity building and training in member countries** – focused on improving infrastructure data and risk/resilience knowledge in member countries, targeting

line ministries that are responsible for infrastructure planning and development, disaster/emergency management, climate resilience, but also ministries of finance. Includes training on infrastructure asset data collection and registry creation, risk assessment training workshops and clinics, interpreting risk analytics outputs, training on GIRI usage and GIRI certifications, and infrastructure data governance competencies. Develop Communities of Practice (CoP) around infrastructure risk data, tools, and technologies.

Capacity-building activities would ideally be conducted **in partnership** with organizations such as UNDRR, GFDRR, and/or regional players such as the SDG Data Alliance in the Caribbean and SPC/SPREP in the Pacific.

- **Advocacy and Communications** - facilitating data and risk knowledge and literacy and bridging the communication gap between technical teams and political leaders, ministers and decision makers in various line ministries responsible for infrastructure and also including ministries of finance, on the value of geospatial and risk data and analytics, and their use in disaster management and response; advocating for minimum standards of risk assessment to increase adoption in LMIC and SIDS, developing showcases for innovative tools and technologies via existing centres of excellence in member countries, while also promoting simple and easy-to-use tools.

Table x: Strategic Options/Activities grouped by Output Category

Technical Assistance	**Capacity Building & Training**	**Advocacy and Communications**
Help countries develop and maintain national infrastructure asset registries via regional/national data hubs or platforms	Training on how to develop asset registries and collect asset data	Advocate for the importance of open exposure data standards such as OEDS and RDLS that promote data sharing and interoperability
Democratize GIRI data - new distribution channels, data services, help desk, hackathons	Training workshops on infrastructure risk and resilience - Use of geospatial and risk data - How to create risk maps - Understand and interpret risk analytics output	Facilitate data and risk literacy communication between technical teams and ministries/political leaders in member countries - using GIRI and the Biennial Report
Assist member countries in conducting infrastructure risk and resiliency assessments	GIRI training and GIRI-certified DRI professionals	Advocate for minimum standards for risk assessment to increase understanding
Advisory services - strategies and roadmaps to help governments leverage data and technology from open sources/regional data hubs for DRI	Establish a Community of Practice (CoP) around infrastructure risk data, tools, technologies, and innovations in DRI	Showcase of innovation - via existing regional centres (e.g., PCCCC, A&B CoE) - DRI Connect - ICDRI - Geolab at CDRI

Data and tool discovery - online directories - virtual marketplace		Promote and advocate easy-to-use tools and technologies (e.g., DesInventar)
Participate in the development of data standards		

2.10 Co-creation processes:

The strategic options identified were then distilled into themes, based on our interpretation and synthesis of stakeholder consultations, including the Data and Technology Strategy Working Group.

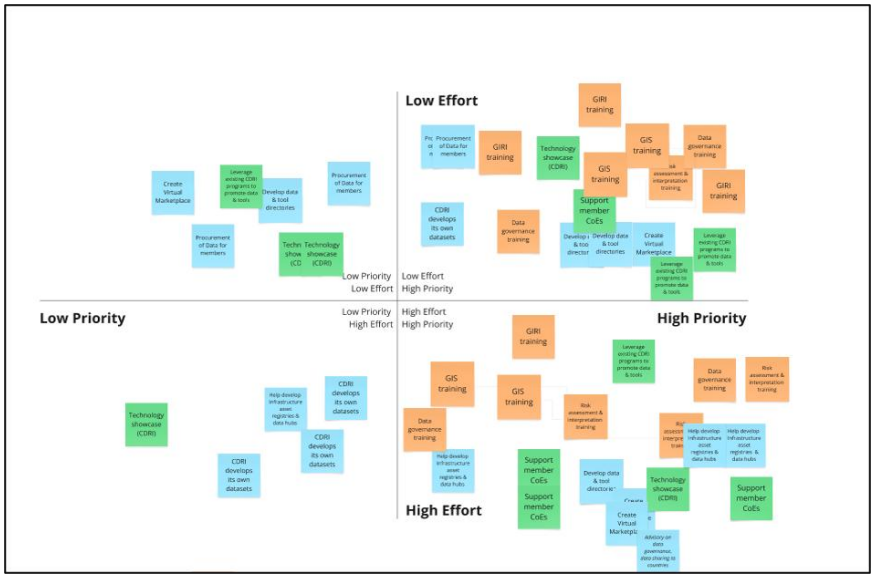
A four-step system of synthesis included:

1. Polling by the Working Group on the priorities of strategic choices

Source:

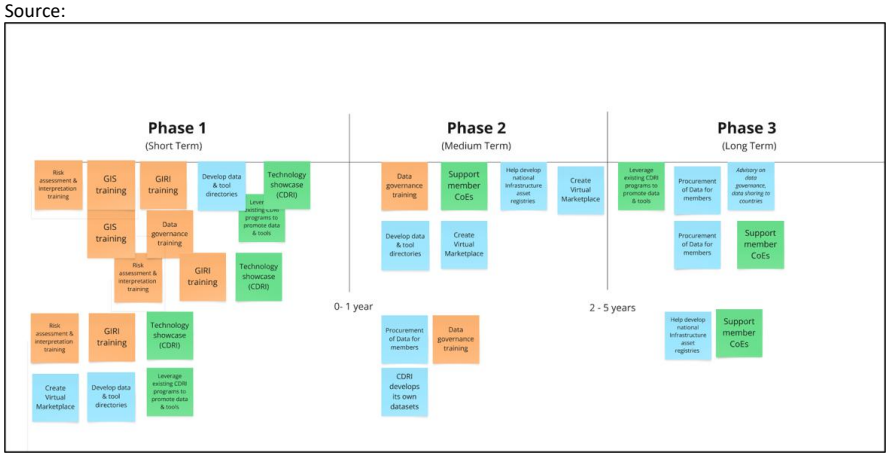
2. Use of a collective Miro board to synthesize strategic options by level of priority and effort, primarily engaging the Working Group.

Source:



3. Use of the Miro board to synthesize strategic options by phase-wise outcomes, primarily engaging the Working Group.

Source:



4. Synthesis of themes from transcripts of recorded technical consultations with stakeholders.

This approach helped the CDRI Data and Technology team parse through the vast information that was generated from the stakeholder consultations and the Working Group, and identify themes to help focus the strategy into outcomes and phases of implementation, as evidenced in the next section of the report.

2.11 Synthesizing Candidate Strategies into Themes

We have defined the following themes around which the strategy will be focused:

1.1.1. Theme 1 - Infrastructure Assets, aka "exposure"

Why this is important

Quality information about a country's infrastructure assets is the starting point for infrastructure risk assessment, risk reduction, and resiliency. The location of infrastructure asset, the replacement cost value of the asset, the structural characteristics of the asset, and the condition of the asset are all required information for assessing risk, measuring resilience, and defining strategies for risk reduction and improved resilience, both at the individual asset level and for the portfolio of assets.

Infrastructure asset information is also needed for effective asset management, operations and maintenance, investment and financing, and insurance.

Objectives of the Programme supported

- Member countries have timely access to high-quality infrastructure risk data (infrastructure exposure) and related knowledge resources; and
- Decision-makers and stakeholders have improved awareness, knowledge, and capacity to use data to assess infrastructure risk and resilience.

Technical Assistance

- Help member countries develop infrastructure asset registries
  - Geospatially referenced asset registries;
  - Information on asset values, structural attributes, and condition; and
  - Support for the mapping of infrastructure assets in regions/countries where it is scarce.
- Participate in shaping and creating infrastructure exposure data taxonomies and metadata standards, via Open Exposure Data Standards (OEDS), and Risk Data Library Standards (RDLS) - this promotes exposure data sharing and compatibility across countries and sectors that helps investors and regulators trying to assess performance of infrastructure as a distinct asset class and integrate it effectively into regulatory frameworks.

Training and Capacity Building

- Training workshops on creating infrastructure asset registries, and the use of simple tools to collect infrastructure exposure, loss and damage data (e.g., DesInventar Sendai);

Advocacy

- Advocate for and promote infrastructure standard taxonomy, data, and metadata standards in various forums, request for asset exposure data in these standard formats in CDRI Requests for Proposals and contracts;

1.1.2. Theme 2 - GIRI Democratisation

Why this is important

GIRI is CDRI's flagship initiative and offers an open-source alternative for probabilistic risk assessment and loss modeling to commercial catastrophe models, which are very expensive and rarely available to governments and infrastructure risk investors.

It is also the key global advocacy tool for CDRI to promulgate its vision and mission on disaster-resilient infrastructure.

Technical Assistance

- Democratize GIRI data:
  - New distribution channels.
  - GIRI data-as-a-service to enable integration with other data repositories
  - Interoperability to support exposure and risk data and metadata formats (e.g., Open Exposure Data Standards, Risk Data Library Standards).
  - Help desk to assist member countries in running GIRI, accessing and using relevant data sets, and interpreting GIRI results.
  - Comprehensive documentation.
  - Hackathons to promote exploration of GIRI data sets and combine with other data for new applications.

Comentado [GU12]: CARIGEO would embrace this idea as there are youth-geared educational awareness plans to integrate geospatial capabilities amongst schools....AN

Training and Capacity Building

- Use GIRI as a key tool in the development of infrastructure risk and resilience training modules that can be included in existing risk assessment and loss modeling training programmes.
- GIRI user training
- Explore online certification - "GIRI-certified" infrastructure risk and resilience professionals.

Advocacy

Facilitate data and risk literacy communication between the technical teams and political leaders & ministers using GIRI outputs and the Biennial report.

1.1.3. Theme 3 - Infrastructure Risk and Resiliency Assessment

Why this is important

Identifying and estimating disaster and climate risk internalized in infrastructure assets is an essential step towards infrastructure resilience, enabling governments and other infrastructure owners to identify and estimate the contingent liabilities they are responsible for in each sector and territory. Financial risk metrics identify funding gaps and clarify the economic case for investing in resilience, and help identify the most effective strategies.

Technical Assistance

- Assist member countries in conducting infrastructure risk and resiliency assessments through the development of hazard and risk maps, vulnerability assessments, and deterministic and probabilistic loss models via initiatives such as IRIS.
- Advisory services - with consulting/delivery partners, provide advisory services that offer strategies and roadmaps for governments to collect, use, and leverage data, models, and technologies for infrastructure risk from national and regional data hubs and open data and model platforms.
- Develop CDRI tools such as the Resilience Cost-Benefit Analysis tool from sectoral CDRI-funded projects, such as the Odisha power sector work.

Training & Capacity Building

- Development of infrastructure risk and resilience training modules that can be included in existing risk assessment and loss modeling training programs - development of risk maps, use of geospatial data and tools, use of risk models, and interpreting model and analytics outputs, communicating output results for decision-making.

Advocacy

- Advocate for minimum standards for risk assessment for different use cases, instead of complex state-of-the-art assessments, to make it easier for states and central governments to begin utilizing the risk assessment results.
- Facilitate data and risk literacy communication between the technical teams and political leaders & ministers.

1.1.4. Theme 4 - Infrastructure Risk Data, Tools, and Innovative Technologies

Why this is important

To pursue its mission of supporting countries to upgrade their systems to ensure disaster and climate resilience of infrastructure, CDRI will enable technological innovation for resilient infrastructure systems.

To deliver Strategic Outcome SO2 (Global DRI research, Coalition-led peer engagement, and CDRI-curated and generated knowledge promote risk-informed policy and practice), CDRI will establish clusters of excellence for aggregating knowledge and facilitating new research, and champion experiential learning by nurturing, incubating, and promoting new and innovative technologies.

CDRI has an ambition to develop as a DRI Centre of Excellence, nurturing, incubating, and promoting new and innovative technologies.

Technical Assistance

Discovery of data, tools, and technologies for its member countries - by providing online directories with links to open data sources, portals, and knowledge resources of infrastructure risk data, as well as through the creation of a Virtual Marketplace. CDRI will pilot these initiatives in a region (e.g., Pacific SIDS).

CDRI will also assist countries with the procurement of data, tools, models, and software via programs such as GIRI, IRIS, Urban, and other CDRI programs. This would include:

- Granular climate and disaster risk data - hazard maps (e.g., urban heat island or urban flood maps), infrastructure exposure data, vulnerability curves, infrastructure loss and damage data.
- Risk analysis tools and models.
- Geospatial and risk software and technologies, including those provided by the private sector, for member countries.

Training & Capacity Building

- Establish a Community of Practice around innovative risk tools and DRI technologies.

Advocacy

- Provide avenues for showcasing DRI innovations:
  - Support existing Centres of Excellence such as the Antigua & Barbuda SIDS CoE and the Pacific Climate Change Centre.
  - Use CDRI's platforms, such as DRI Connect, ICDRI, and programs such as the CDRI Fellowships, to also showcase DRI innovations.
- Promote and advocate for simple, easy-to-use tools for risk data collection and risk analysis - they are likely to see more adoption at the country governments' level.

1.1.5. Theme 5 - Internal CDRI Capacity Building and Training

CDRI needs to increase its technical and human resource capacity to help member countries with their capacity building. We have identified the following areas to be strengthened:

- Ownership and product management of GIRI and other tools (such as the Resilience Cost-Benefit Tool) that CDRI has intellectual property rights to.
- Technical assistance and help desk - custom risk analytics and reports and risk for users, answer technical questions, conduct demos, trainings, and webinars on product usage, infrastructure risk assessment and loss modeling.
- Management of CDRI's spatial data infrastructure - data procurement, data sharing protocols and technologies, storage and server infrastructure, data governance, data visualization.
- Ability to offer advisory services to member countries - guidance and training on data governance, data architecture, and development of infrastructure information management frameworks delivered in collaboration with delivery partners.
- Develop data and technology partnerships with data, technology, and advisory providers from public and private enterprises; and
- Evaluation and introduction of new technologies into CDRI.

Data and Technology Unit at CDRI

We will establish a central Data and Technology unit that can provide the skills and competencies identified above. This will require a new set of people accommodated within the organogram, including product management experts to be hired within CDRI and accommodated within the organogram. Proposed job descriptions for the product owner, geospatial and risk analysts, spatial data infrastructure specialist, and team leader roles in this team have been created and reviewed internally.

Data governance at CDRI

There is also an opportunity for CDRI to strengthen its data governance framework (defined as the cross-functional discipline of managing, improving, monitoring, maintaining, and protecting the organization's data). As a first step, we plan to conduct data governance training for CDRI's procurement, finance, legal, IT, and HR teams, along with CDRI programme leaders. That should lead to the development of a CDRI Data Governance plan, a defined governance framework that describes data policy, key principles, roles and responsibilities, and processes, followed by implementation.

Figure X: Data Governance Workshop at CDRI, Ipshita Karmakar, Dec 2024

CDRI RFPs and Contracts

A review of CDRI's project RFPs and contracts (for GIRI, IRIS and general Vendor Contracts) has also be undertaken, and recommendations have been provided to the CDRI procurement, finance, legal and IT teams, for Terms of Reference Guidelines for procurement of spatial mapping data and risk products and services in the following areas:

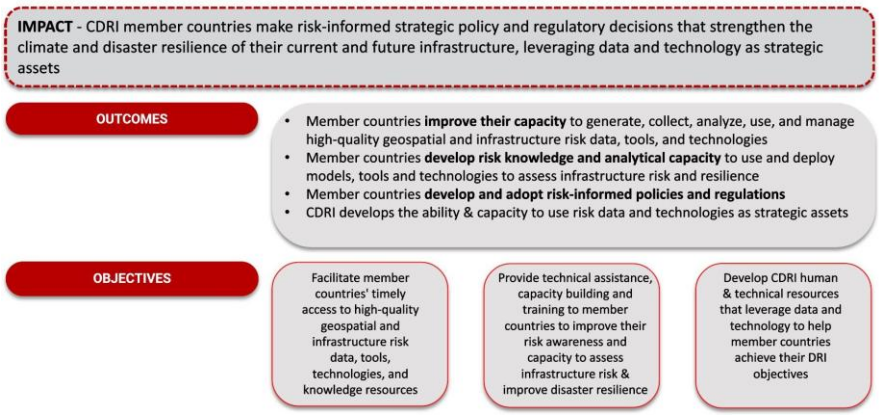
- Requirements for procurement of spatial data products and services:
- Standards for spatial data deliverables
    - Satellite data procurement
    - Data delivery
    - Data Security, Transfer, and Storage/Archival
    - Data Formats
    - Metadata Standards & Documentation
    - Data Confidentiality, Ownership, and Reuse
- Product Support
- Characteristics of a provider of spatial mapping products
    - Fair end-use license agreement
- Characteristics of a provider of spatial mapping services
- Selection Criteria for Providers of Data & Risk Models

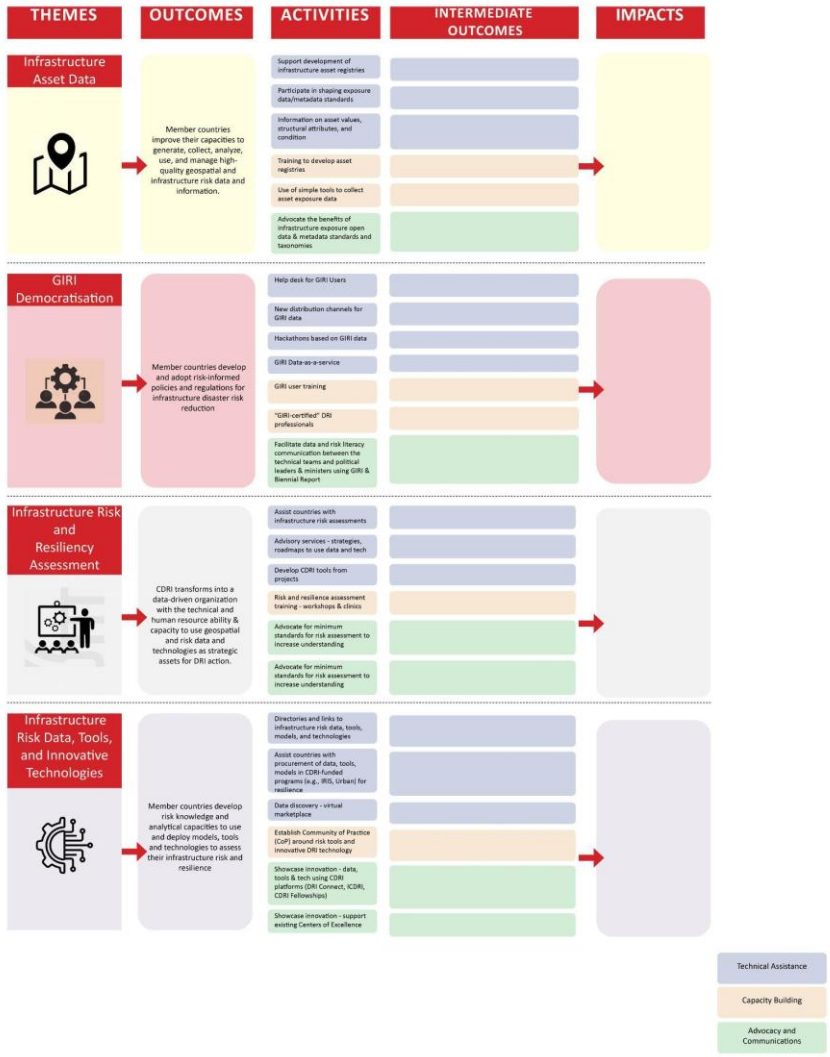
Annexure C lists the detailed recommendations provided.

2.12 Theory of Change

In preparing the strategy, a Theory of Change (ToC) framework was adopted to convey how and why the Data and Technology Programme will achieve its desired outcomes and impact.

Figure x: CDRI Data and Technology Programme Theory of Change





2.13 Linkages to CDRI's Vision, Mission, and Strategic Outcomes

The Data and Technology programme will bolster CDRI's mission to support its member countries in upgrading their systems to ensure disaster and climate resilience of existing and future infrastructure in alignment with the UN SDGs and the Sendai Framework.

The programme will support CDRI's Strategic Outcome 2 (CDRI-curated and generated knowledge promotes risk-informed policy and practice) by:

- Promoting GIRI as an open-access geospatial data platform that enables access to infrastructure data and global risk and resilience metrics.
- Championing experiential learning by nurturing and promoting new & innovative technologies through showcases via centres of excellence, ICDRI, and DRI Connect.
- Leveraging existing CDRI initiatives such as DRI Connect to develop a virtual marketplace that connects data and technology solutions and providers with on-ground demand in member countries.

The programme will also support CDRI's Strategic Outcome 3 (Enhanced capacities of stakeholders to implement post-disaster recovery and DRI action at scale) through:

- Capacity building & training in member countries - focus on geospatial, asset registries, and other risk data collection, understanding outputs of risk analytics models such as GIRI.
- Promote the use of data hubs for member countries, encourage member countries to contribute to existing hubs such as the SIDS Global Data Hub.
- Assistance with the procurement of geospatial and risk data for member countries that is specific to individual country needs
- Assistance in the provisioning of data and technologies for informed planning and decision-making for CDRI programs such as IRIS, Urban Infrastructure Resilience Program, Mountain Region Resilience programs, and sectoral programs across geographies

Comentado [GU13]: PDNA, leaning towards informed planning....

Post Disaster Needs Assessment should be mentioned somewhere as it is helps to pin point risks. Clearly from the assessment, a policy shift can be derived impacting disaster risk reduction.....AN

The programme is linked to two key CDRI initiatives - GIRI and the Biennial Report, and the IRIS program. Increased distribution of GIRI data and its risk and resiliency analytics, using GIRI as a tool to demonstrate key concepts in risk assessment training programs, training more users on the capabilities of GIRI, including GIRI certifications for DRI professionals, and taking ownership of GIRI as a CDRI product are all activities envisaged under the Democratisation of GIRI theme.

And the themes of Infrastructure Asset exposure data and Infrastructure Risk and Resiliency Assessments can be operationalised through the IRIS program as themes in future calls for proposal and/or through specific bilateral projects/programmes.

As per the Sendai Framework for Disaster Risk Reduction (Sendai Framework) Priority 1 and Target 4, CDRI will promote the access as well as the collection, analysis, management, and use of relevant risk data and technologies by its member countries at the global, regional, national, and local levels.

2.14 Prioritization of Themes and Activities

2. Monitoring, Evaluation and Learning Framework

3. GEDSI Integration in the Data and Technology Programme and Strategy

Incorporating Gender Equality, Disability, and Social Inclusion (GEDSI) principles into the Data and Technology strategy and programme is critical to ensure that data and technology focused initiatives to strengthen infrastructure resilience are equitable, accessible, and impactful for all, including women, persons with disabilities, minority groups, and other vulnerable populations. This section outlines how GEDSI will be mainstreamed throughout governance, capacity building, project design, data collection, stakeholder engagement, and recruitment.

2.15 GEDSI Integration in Governance and Stakeholder Engagement

- Integrate GEDSI representation into working groups, steering committees, technical working groups, and consultations with clear mandates to reflect and address diverse needs.
- Develop participatory digital forums such as the Communities of Practice and tools that allow women, persons with disabilities (PWD), minority groups, and other stakeholders to actively engage in decision-making processes.

2.16 GEDSI in the Strategic Output Activities

- Implement training/learning/capacity building platforms and in-person training programs that support women and PWD engineers, planners, and policymakers, ensuring gender balance and disability inclusion in technical domains.
- Support the development and applications of GEDSI-responsive risk and resilience assessments and action plans.
- Foster innovation ecosystems that prioritize the development of resilient, accessible, and affordable solutions tailored to vulnerable populations.

2.17 Inclusive Design and Support Services

- Universal Design Principles will be considered at the design phase for all CDRI tools, products, and platforms.
- Design content and websites with a GEDSI lens that ensures accessibility and inclusivity for all users, regardless of their background or abilities. This involves considering factors like language, visual design, culturally relevant messaging, diverse imagery, and functionality across all content platforms to create a welcoming and usable experience for diverse audiences.
- Disseminate product and project information with a GEDSI lens through diverse formats (digital files, printed materials, audio recordings, videos) and in multiple languages and screen reader compatibility.

2.18 Data Collection, Monitoring, and Analysis

- Partnering with GEDSI-focused organizations for informed data priorities and practices.

- Develop mechanisms to support the collection of sex-, age-, disability-, and diversity-disaggregated data (including but not limited to intersectional vulnerabilities) during all project activities, including surveys and consultations.
- Support the mainstreaming of ethical data collection to avoid exploitation of marginalized communities.
- Create secure, user-friendly online platforms that allow stakeholders to access GEDSI-relevant reports and disaggregated datasets.
- Establish GEDSI-specific monitoring indicators, including participation rates, accessibility, and satisfaction surveys.

2.19 Mainstreaming GEDSI Across the Project Lifecycle

- Conduct systematic GEDSI screenings at the outset of projects to identify key end-users, collect sex- and disability-disaggregated data.
- Embed considerations of gender disparities, disability inclusion, and climate vulnerability into all technology development.
- Incorporate GEDSI criteria in all procurement documents, terms of reference, and contractual obligations to ensure contractors actively support inclusivity.

2.20 Inclusive Recruitment and Workforce Development

- Develop inclusive job postings and outreach efforts targeting underrepresented groups, such as women, PWDs, and marginalized communities, by partnering with advocacy organizations and educational institutions.
- Set diversity targets for the Data and Technology Unit team to track progress regularly and promote a culture of inclusivity.

2.21 Continuous GEDSI Assessment and Adaptation

- Conduct GEDSI assessments at key milestones using both quantitative (e.g., participation rates) and qualitative (e.g., stakeholder interviews) methods.
- Analyze feedback and incorporate actionable suggestions to continuously strengthen GEDSI mainstreaming.

4. Addressing Gaps

The Data and Technology Programme is envisioned as a dynamic and adaptive strategy, designed to evolve with emerging opportunities for collaboration across development partners, the private sector, and other stakeholders. While the programme maintains a strong alignment with its overarching goals, it also envisions an allocation of approximately 20% of its resources to support high-impact, opportunistic initiatives.

While initially centered on hazard and risk-related data, the programme will expand its scope in the second phase (2027 onwards) to include resilience-oriented data indicators. This includes growing engagement with metrics such as resilience indices, loss and damage data, and post-disaster assessments from countries in the aftermath of events.

Comentado [GU14]: This enforces my previous point in section 2, subsection 1.17.....AN

Looking ahead, the programme aims to systematically integrate these time- and place-specific indicators to better inform infrastructure resilience planning and policy formulation.

Additionally, as the programme evolves, greater emphasis will be placed on sector-specific hazard data—particularly in priority areas such as oceanic monitoring, sea level rise, and extreme heat. These thematic sectors will be explored in greater depth to support the existing programme strategy.

3 Conclusion

Comentado [GU15]: Will of course be good to see these thanks

45 Annexure A - List of organizations consulted in the strategy development process

CDRI Member Organisations

Asian Development Bank
- ADB Pacific Disaster Resilience Program
- Climate Change, Resilience and Environment Cluster

The World Bank Group
- Global Facility for Disaster Reduction and Recovery (GFDRR)
- Geospatial Operations Support Team (GOST)
- Sustainable Development Practice

United Nations Development Program (UNDP)

United Nations Disaster Reduction Reduction (UNDRR)

arise - the Private Sector Alliance for Disaster Resilient Societies

CDRI Member Countries

Bhutan
- Department of Survey and Mapping, National Land Commission Secretariat
- Dept. of Disaster Management (DDM), Ministry of Home and Cultural Affairs

Ghana
- Accra Metropolitan Authority

Other Multilateral Development Banks (MDBs) and International Government Organisations (INGOs)

Inter American Development Bank (IADB)

United Nations Global Geospatial Information Management (UN-GGIM)

United Nations Department of Economic and Social Affairs (UNDESA)

Regional Organisations in the Pacific

Pacific Catastrophe Risk Insurance Company (PCRIC)

Pacific Islands Forum Secretariat (PIFS)

Pacific Regional Disaster and Emergency Managers Meeting, April 2025

Pacific Regional Infrastructure Facility (PRIF)

The Pacific Secretariat (SPC)

The Secretariat of the Pacific Regional Environmental Program (SPREP)

The Working Group for resilient housing and resilient infrastructure meeting, March 2025

International Research Organisations

International Water Management Institute (IWMI)

World Resources Institute (WRI)

Academia

Oxford University - Oxford Program for Sustainable Infrastructure Systems

Private Sector

~~4.1.1~~5.1.1 Consulting and Engineering Firms

Arup

NACO, Royal HaskoningDHV

WSP

~~4.1.2~~5.1.2 Industry Networks

Insurance Development Forum (IDF)

~~4.1.3~~5.1.3 Technology and Venture Capital

Google

Tailwind

Non-Profits

Artha Global

Council on Energy, Environment and Water (CEEW)

Climate Resilience For All (CR4A)

IPE Global and Triple Line Consulting

PVBLIC Foundation

~~5~~6 Annexure B - Composition of the Data and Technology Strategy Working Group

S. No.	Constituency	Designation of the Member
1	World Bank	Global Lead, Disruptive Technologies, World Bank
2	Dominican Republic	Advisor for the Implementation of the System for Climate Adaptation, National Council for Climate Change and Clean Development Mechanisms, Dominican Republic
3	Japan	Programme Manager, Space-based Disaster Management Programme, Satellite Applications and Operations Center (SAOC), Japan Aerospace Exploration Agency (JAXA), Japan
4	Antigua & Barbuda	Chief Surveyor, Antigua & Barbuda
5	Tonga	Assistant Secretary, GIS Officer, Tonga
6	Madagascar	Interim Executive Secretary, Cellule de Prévention et d'appui à la Gestion des Urgences (Prevention & Emergency Management Support Unit), PMO, Madagascar
7	Expert	Lead author of CDRI Biennial Report 2025, Former Regional Director, Africa, Sustainable Development Practice Group, World Bank
8	UN	Head of Global Risk Analysis and Reporting, UNDRR

~~6~~7 Annexure C - Terms of Reference (ToRs) Guidelines for the procurement of spatial and risk mapping products & services by CDRI

Best practices for procurement of spatial (geospatial and risk) data mapping products and services

~~6.1.1~~7.1.1 Requirements

The requirements definition should include, at a minimum:

- Consideration of technical requirements
- Schedule and method of delivery
- Acceptable warranty and/or licensing restrictions,
- Documentation expected to be provided by the consultant, including specifications, instruction manuals, and metadata
- Availability of support/maintenance

~~6.1.2~~7.1.2 Standards for Spatial (geospatial and risk) Data Deliverables

~~6.1.2.1~~7.1.2.1 Satellite Data Procurement and Acquisition - sample clauses

*The Vendor should provide a **statement of work** detailing their satellite imagery offerings, including:*

- *Cost of data acquisition (price per km²).*
- *Spatial resolution of the imagery (in meters or scale ratio).*
- *Radiometric and spectral resolution, including the number of bands and sensitivity levels.*
- *Temporal resolution, specifying the revisit frequency of image capture.*
- *Speed of data delivery, including the number of days from order placement to receipt.*
- *Quality and applicability of derived products for disaster risk assessment.*
- *Access methods, including options for data retrieval via FTP, API, or an online platform.*

Standard Product Description Requirements:

*The Vendor should submit a **detailed description of standard satellite products** using the following structure:*

Product Name	**Product Description**	**Resolution** (where applicable)				**Delivery**	**Access Method**
Name of Product	*(geographic coverage, required production time, method or approach used to create the layer)*	*Spatial (meters or scale ratio)*	*Temporal (revisit)*	*Radio metric*	*Spectral (bands)*	*# of days from order to arrival*	*API/Online platform/others*

Comentado [グユ16]: While the provision of satellite data is valuable, I recommend also including simplified analysis and information products tailored to end-users' specific needs. Many stakeholders may lack the capacity to extract meaningful insights from raw data alone. By offering basic interpreted information alongside the data, you would significantly increase adoption and practical application across varying technical capacities in member countries. This approach aligns with your stated objective of democratizing access to risk information and would enhance the overall impact of your program. by S. Kawakita from JAXA.

~~6.1.2.2~~7.1.2.2 Data Delivery - sample clauses

Data delivered includes raw datasets as well as cleaned and validated datasets collected or procured under the ToRs, and used in producing final deliverable outputs such as reports, tables, and visualizations. In the case of surveys, raw datasets should include actual microdata from respondents. Raw data must be delivered at regular intervals (e.g., weekly or monthly) to identify data quality and address issues in real time.

Datasets should be provided in electronic form, or in machine-readable files.

~~6.1.2.3~~7.1.2.3 Data Security, Transfer & Storage/Archival - sample clauses

Appropriate security and encryption protocols such as SSL/TLS to be followed in the transmission of datasets to ensure data confidentiality. The Vendor should store and transfer data using a cloud-based secure storage solution to the designated data repository ____(e.g. CDRI's secure data portal https:cdri.world/XXX).

The Vendor is responsible for ensuring that all data generated under the ToRs is deposited at the designated data repository.

Access to sensitive data must be restricted to authorized personnel only, with appropriate governance mechanisms. If transferred to CDRI's data repository, CDRI would be responsible for ensuring that only authorized collaborators in the Vendor's organization and at CDRI are given access to the data repository.

~~6.1.2.4~~7.1.2.4 Data Formats - sample clauses

- *Survey datasets should be provided in open formats such as **STATA, SPSS, CSV, Excel, ASCII** or other suitable open data formats.*
- *Geospatial datasets should be provided in open format shape files (Vector) or other available formats such as CSV, XLSX or other suitable open geospatial data formats. Preferred formats are shape files (for vector) and GeoTiff (for raster) for compatibility with GIS applications.*
- *CDRI recommends that the Vendor provide geospatial datasets using encoding standards for specific geospatial data types*
    - ***Hydrology:** WaterML (https://www.opengeospatial.org/standards/waterml)*
    - ***Geology:** GeoSciML (https://www.opengeospatial.org/standards/geosciml)*
    - ***Internet of Things (IoT):** SensorThings API (https://www.opengeospatial.org/standards/sensorthings)*
    - ***Sensor Data:** O&M and SWECommon (https://www.opengeospatial.org/standards/om)*
    - ***Transit Data:** GML and GTS (https://www.opengeospatial.org/standards/gml)*
    - ***Open Street Map (OSM):** GML and OSM (https://wiki.openstreetmap.org/wiki/OSM_XML)*

  See http://www.opengeospatial.org/standards for a list of acceptable formats.

- ***FAIR Data Principles** to ensure data is Findable, Accessible, Interoperable, and Reusable (https://www.go-fair.org/fair-principles/)*

~~6.1.2.5~~7.1.2.5 Metadata Standards and Documentation - sample clauses

Definition of Metadata*: For the purposes of the ToR, Metadata refers to data that provides information about other data that is intended to help understand how the data have been created, what they are measuring, and in the case of spatial data , the geographic locations, including but not limited to the geographic area of interest, coordinate systems, data quality, and abstraction methods.*

Metadata Standards*: The Vendor shall ensure that all spatial data delivered under the ToRs complies with the applicable spatial metadata standards. CDRI recommends:*

- *the use of ISO 19115-1:2014 (https://www.iso.org/standard/53798.html) and ISO 19115-2:2019 (https://www.iso.org/standard/67039.html) for geospatial and earth observation/imagery data.*
- *the use of the Risk Data Library Standard (https://docs.riskdatalibrary.org/), an open metadata standard developed by the Global Facility for Disaster Reduction and Recovery, The World Bank for risk data.*
- *the use of the Data Documentation Initiative (DDI) (Codebook version) and the Dublin Core standards for survey datasets that should be documented in compliance with these standards.*

Metadata Documentation:
For spatial data - the Vendor should provide comprehensive metadata documentation for all spatial (geospatial and risk) datasets produced or utilized in the execution of these ToRs. This documentation should include:

- *Title (name of the geospatial data set).*
- *Description - brief summary of what the data represents.*
- *Source - from where was this data created.*
- *Theme - common use word(s) or phrase(s) to describe the subject of the data set.*
- *Format - vector or raster formats used to represent the data including specific standard file formats used.*
- *Projection system - spatial reference system.*
- *Bounding Coordinates - geographic extent.*
- *Data collection date/range.*
- *Data Quality - a summary of data quality such as completeness, accuracy, etc.*
- *Access and use constraints.*
- *Responsible organization or contact information.*

For survey data - the following list of metadata documents:

- *Survey questionnaire in English and local languages which includes any/all*
- *changes from piloting;*
- *Questionnaire design;*
- *Interviewer manual;*
- *Completed household/community questionnaires for all households/villages interviewed;*
- *Concise, but complete description of the sample design;*
- *Sampling weights to be used in data analysis;*
- *Description of the basic field procedures and quality control techniques;*
- *Guidelines for using the data, including, but not limited to:*
    - *Uniquely identifying observations, including the identification variable to be used,*
    - *how to link the various parts of the survey,*
    - *codes for any items not pre-coded in the questionnaire, and*
    - *problems encountered in the data and the solutions taken;*

- *Documentation of constructed data sets that will be available in the public use files; e.g. price indices, and aggregates of household consumption or income;*
- *Descriptions of the files, including contents and names of the data files mapped to the corresponding sections in the questionnaire; and,*
- *System of variable names and labels, data descriptions and dictionaries.*

***Delivery Format**: All spatial metadata should be delivered in a machine-readable format compatible with existing data management systems as specified by CDRI.*

***Review and Acceptance**: CDRI reserves the right to review and accept or reject the provided spatial metadata documentation prior to final acceptance of any deliverables.*

***Updates and Maintenance**: The Vendor shall maintain and update the spatial metadata as necessary throughout the duration of the contract to reflect any changes in the underlying geospatial data.*

~~6.1.3~~7.1.3 Data Confidentiality, Ownership and Reuse

Data confidentiality, Data ownership and Data reuse are important aspects of the data collection activities and should be explicitly stated in the ToRs.

~~6.1.3.1~~7.1.3.1 Sample clause

All data collected under these ToRs as well as the project outputs including all plans, drawings, specifications, designs, reports, data, software and models, and documentation, are confidential and are the property of XXX. The Vendor executing this Contract, must protect the confidentiality of responding establishments and individuals participating in the data collection at all stages. The Vendor must ensure that data or the project output referred to above, collected or compiled under these ToRs, are not distributed for commercial or non-commercial purposes to third parties, nor will they be used by the Vendor, their staff and/or consultants, or their sub-contractors for purposes other than those expressly stated in these ToRs, without the written approval of XXX prior to, during, or after completion of the Contract.

~~6.1.4~~7.1.4 Product Support

~~6.1.4.1~~7.1.4.1 Sample clause

In order to fulfill warranties as defined within the user license, Vendor may offer CDRI product support. Product support can also be offered to the public under similar terms and conditions or sold competitively in substantial quantities based on established catalog or market prices. For the purpose of these ToRs product support consists of:

- *Installation – The act of installing the required Product into a CDRI test and/or production environment. Customer service and help desk are also covered.*
- *Data Reformatting – The process of changing the delivery format so that it may be optimally used in CDRI's system(s). May also include changing file formats of data delivery and orders of occurrence of data to match customer needs for automated use of the Product.*
- *Maintenance – That which may be required to fulfill the product warranty as defined within the user license.*
- *Training - The transfer of knowledge, skills, and competencies that relate to the use of the Product*

Characteristics of a provider of spatial mapping products

Vendor must demonstrate a majority of the following attributes:

- Represent a level of standardization as defined by the Vendor
- Have the ability to meet a published specification or a stated industry standard
- Provide CDRI with a non-exclusive end user license* or other form of shared ownership
- License includes clearly defined terms and conditions including authorized and unauthorized uses
- Provide CDRI with an end-user warranty
- Pricing has been established through a published product catalog
- The Vendor defines the spatial product specifications and as such, the final product is not subject to change by the Vendor for CDRI end-use.

*Sample clause for fair end user license agreement

CDRI requests proposals that establish a End User License Agreement that allows CDRI to:

- *share the data freely within CDRI*
- *share data with partners, consultants and contractors for the use in a specific development project*
- *provide client country government entities a copy of the data for non-profit, public policy, and related non-redistribution uses*
- *operate without risk of being held liable or otherwise responsible if third parties misuse the data, provided CDRI required recipients read and formally agree (via signature) to honor the data's license and terms, which specifically prohibit the resale or public distribution of the data.*

Characteristics of a provider of spatial mapping services

Vendor must demonstrate a majority of the following attributes:

- Exercise professional judgment in developing an appropriate level of standardization needed to meet CDRI's project-specific requirements and expectations
- Have the ability to meet specifications established by CDRI and defined in the contract document
- CDRI owns the contractual project deliverables; Vendor may retain ownership of resulting work documents and records relate to the development of the contracted project deliverables
- License includes clearly defined terms and conditions including authorized and unauthorized uses
- Provide CDRI with an end-user warranty
- Pricing has been established through a published catalog
- The Vendor defines the spatial product specifications and as such, the final product is not subject to change by the Vendor for a specific agency/customer end use.

Selection Criteria for Providers of Data and Risk Model Solutions

The Global Risk Modelling Alliance Programme (GRMA) has developed a useful template that documents the selection criteria for providers of data and risk model solutions. It can be accessed here.

~~8~~9 Bibliography

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