**R&D Directorate, NIGST**

**Proposal**

# 1. Introduction

The **Research & Development (R&D) Directorate** has been established under **NIGST** to address organizational and national needs in the field of geospatial science. It serves as the driving force for innovation, applied research, and technology transfer within Survey of India and among other stakeholders.

The Directorate will play a pivotal role in:

* **Driving Innovation** – Fostering the development of new ideas, emerging technologies, and solutions for geospatial challenges.
* **Supporting Strategic goals with Priority** – Aligning research and innovation with NIGST’s mandate, organizational objectives, and national geospatial policies.
* **Solving Complex Challenges** – Providing science- and data-driven approaches for critical problems in mapping, resource management, disaster preparedness, and infrastructure planning.
* **Delivering Economic & Social Value** – Creating intellectual property, strengthening national geospatial capability, supporting industry, and contributing to employment and skills development.
* **Strengthening Collaboration** – Building collaborations across government, academia, research institutions, and private sector stakeholders.
* **Ensuring long -term Sustainability & Promoting Self-Reliance** – Reducing reliance on external technologies and ensuring long-term sustainability of India’s geospatial ecosystem.

Through these efforts, the R&D Directorate will position NIGST as  **hub of geospatial innovation and capacity building**, while ensuring alignment with the country’s strategic priorities.

# 2. Objectives of the Directorate

1. **Promote Research Excellence**

* Undertake cutting-edge geospatial research to strengthen national mapping and geospatial capabilities.
* Establish and promote standards, methodologies, and best practices for surveying, mapping, and geospatial data management.

1. **Foster Innovation & Technology Development**

* Initiate pilot projects to test, evaluate, and adopt emerging technologies relevant to national mapping needs.
* Encourage indigenous development of geospatial tools, applications, and AI/ML models tailored to Indian datasets.

1. **Enhance Collaboration & Capacity Building**

* Build partnerships with universities, research institutions, and international organizations for joint R&D projects, internships, capacity building.
* Engage with private sector technology providers for co-development of innovative solutions in mapping and geospatial analytics.

1. **Translate Research into Practical Applications**

* Convert R&D outputs into operational tools, services, and workflows for national surveying, mapping.
* Support policy-making through geospatial analytics and decision-support systems.

# 3. Organizational Structure

* **Research Division** - Focuses on foundational geospatial science, surveying methodologies, and data accuracy enhancement.
* **Applied Research Division** - Works on the development of operational tools, applications, and solutions for project specific implementation.
* **Innovation & Technology Transfer Division** - Identifies, tests, and facilitates adoption of emerging surveying technologies such as GPR, Digital Twins, BIM, AI- cartography.

# 4. Short term Research Priorities -

As a priority **Applied Research Division** will work on Operational tools to support following tasks …

* **NAKSHA & AMRUTH -**
  + Process Development
  + Data Management
  + QA/QC Automation
* **ORI & DEM –**
  + Applied Case studies to showcase the utility of data products generated from various projects. Ex: Pluvial Floods

Innovation & Technology Transfer Division will carry out following task as per the requirement -

* **Manuals and SOPs –** 
  + Creation of SOPs and Methodology flowcharts of emerging technologies

# 5. Long-Term Objectives

1. **Spatio-temporal Analysis of Indian Topography:**
   * Carry out **time-series analysis and change detection** using aerial photographs (Old Scanned Aerial Negatives), historical topographic maps, Bhuvan data, and archived satellite imagery to build a comprehensive record of landform evolution and land-use/land-cover (LULC) change.
2. **Nationwide DTM Generation using SAR and Satellite Photogrammetry:**
   * Utilize SAR imagery, LiDAR, and advanced photogrammetric techniques to generate high-resolution Digital Terrain Models (DTMs) covering the entire country, in order to meet the requirements of the **Elevation** **and Depth Data Theme** under the 14 identified National Fundamental Geospatial Data Themes as per NGP 2022.
3. **3D Mapping and Digital Twin Development:**
   * Create 3D city models and digital twins of critical regions for urban planning, smart city initiatives, and disaster preparedness using inputs from Projects like **Naksha.**
4. **Development of Indigenous AI/Deep Learning Models & Automation tools in collaboration/consultation with geospatial industry:**
   * Train and fine-tune **Deep Learning** and **computer vision** models on Indian geospatial datasets to automate feature extraction, object detection, and classification tasks relevant to national geospatial needs.

* Automation tools in Photogrammetric Applications

1. **R & D in PNT Services in collaboration/consultation with geospatial industry:**

* Development of Android based applications for SoI NRTK Services
* Development of Post Processed Kinematic & Geotagging applications
* Development of algorithms for consuming IRNSS Satellite signals & GAGAN based corrections

1. **Geospatial Data Services and Integration:**

* Deliver processed datasets and derived products as interoperable services through the Survey of India (SoI) geoportal, ensuring accessibility, scalability, and integration with national geospatial frameworks.

# 6. Resources & Infrastructure -

## a) Lab Rooms - 02

## b) Manpower Resources

**Departmental Staff:**

* Officer Surveyors – 02
* Surveyors – 02

**Hiring:**

* Senior research fellows – 2
* Junior research Fellows – 4
* Programmer -2
* Content writer -1

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| **Fellowship** | **Eligibility Criteria** | **Stipend (approx.)** | **Duration/Progression** |
| **JRF** | * Post Graduation * CSIR-UGC NET or equivalent | ₹31,000–37,000/month + ₹20,000 p.a. contingency | Tenable for 2 years; assessed at end of term |
| **SRF** | * JRF qualification * 2 years of research and satisfactory review * Possible PhD registration | ₹35,000–42,000/month | Upgraded post-review; extended for further years |
| **Programmer** | * B. Tech/B. E in computer Science * Working experience in Python, C++ * Kotlin/Java developer |  |  |

## c) Hardware Infrastructure

1. High-Performance Computing (HPC) Workstations - 4
2. Midlevel Workstations – 6
3. Laptops – 2
4. Server – 1
5. Office Printer (A4/A3 Size) – 2
6. Flat Bed Scanner – 1
7. Interactive Flat Panel Display (IFPD) or Smart LED Board – 2
8. **Internet:** Dedicated 1 Gbps leased line with static IP, secured through Sophos Firewall XG.

**Specifications:**

1. **High-Performance Computing (HPC) Workstations - 4** 
   * + 1. CPU: Multi-core processors (minimum 32 cores) – Ryzen Thread ripper 7970X (32C/64T 4-channel DDR5, ECC support) or Intel Xeon W-3495X Processors
       2. GPU: High-end GPUs (NVIDIA RTX 6000 Ada / A6000 or AMD Radeon Pro W7900
       3. RAM: 512 GB RAM (DDR5) or higher for AI/deep learning
       4. Storage: 2 TB NVMe (OS) + 4 TB NVMe (Scratch) + 12–18 TB HDD
       5. Board: WRX90/TRX50, ECC, PCIe 5.0, multi-M.2, 10 GbE (or NIC)
       6. PSU: 1000–1600 W 80+ Platinum, robust cooling (360 mm AIO)
       7. NIC: 10 GbE
       8. Monitor: 27–32″ 4K IPS
       9. OS: Windows 11 Pro
       10. Warranty: 3–5 yr on-site/NBD

1. **Mid-Level Workstations – 6**
2. CPU: Ryzen 9 7950X: 16C / 32T *or* Core i9-14900K (24C / 32T)
3. GPU: RTX 4070 Ti SUPER 16 GB *or* RTX 4080 16 GB
4. RAM: 128 GB DDR5
5. Storage: 1–2 TB NVMe (OS) + 2 TB NVMe (Scratch) + 8–12 TB HDD
6. Board: AM5 or Z790, multi-M.2, 2.5 GbE
7. PSU: 850–1000 W 80+ Gold/Platinum, strong cooling
8. Monitor: 27″ 4K IPS
9. OS: Windows 11 Pro
10. Warranty: 3 yr
11. **Laptops – 2**
12. CPU (Central Processing Unit): At least 8 cores (ideally 13th Gen Intel Core i7/i9 or AMD Ryzen 7/9 (7000 series or newer), with high base clock (≥3.2 GHz) and large cache (12 MB+))
13. RAM (Memory): Minimum: 32 GB (Ideal: 64–128 GB)
14. GPU (Graphics Processing Unit)

* Minimum: NVIDIA RTX 3060 (6 GB VRAM)
* Preferred: RTX 4070, 4080, or 4090 (8–24 GB+ VRAM)

1. Storage:Fast NVMe SSD; minimum: 2–4 TB
2. Display & Build Quality: 15.6″ Full HD (1920×1080), with QHD or 4K
3. **Server – 1**

Central Storage Data Storage Management & Servers:

* Network Attached Storage (NAS) / Cloud-ready storage with capacity starting at 1 Petabyte (PB), scalable
* Backup servers with disaster recovery systems
* High-speed data transfer network (10–40 Gbps)
* Centralized Geospatial Data Repository with controlled access
* Regular backup and disaster recovery system
* Data cataloging and metadata standards
* Integration with SoI Geoportal for serving datasets

1. **Office Printer**

* Multifunction Color Laser Printer (A4/A3) like HP Color LaserJet Pro MFP series, Canon imageRUNNER Advance series etc.

1. **Flat Bed Scanner**

* 48-bit color input / 24-bit output (to capture subtle tones of old imagery)
* 16-bit grayscale support
* At least **600 dpi** High-resolution

1. **Interactive Flat Panel Display (IFPD) or Smart LED Board**

* 75–86 inches
* 4K UHD (3840 × 2160)
* Multi-touch support (≥ 20 touch points).
* Whiteboard mode
* Screen recording and wireless casting (can share from laptops/phones).
* Inbuilt operating system (Android/Windows dual system).
* Inbuilt high-quality speakers (20W+)
* 4K wide-angle camera (In-built or external)
* 6–8 array far-field microphone (In-built or external)
* HDMI, USB, LAN, Wi-Fi, Bluetooth Connectivity

## b) Software

## ArcGIS Pro - 10

## ENVI (With Extensions – SARscape, Deep Learning) – 4

## Agisoft Metashape - 4

## Terrasolid - 4

## ERDAS IMAGINE Photogrammetry (formerly LPS) – 2

## City Engine - 2

## FME – 2

## Hexagon Apollo Software – 1 *(to be procured in a subsequent phase, as it will be required for enterprise geospatial data management and dissemination).*

## Server OS Requirement: Windows Server 2022 (Standard/Datacenter Edition) *for centralized user management, secure file and application hosting, and geospatial data services.*

# 7. Conclusion & Way Forward

Strengthening of R&D Directorate under NIGST will be a fruitful toward India’s geospatial capacity. By investing in advanced hardware, specialized software, skilled manpower, and robust data infrastructure, the Directorate will:

* Accelerate the execution of projects of national importance.
* Drive innovation through indigenous research and development.
* Provide science-based solutions to complex national challenges.
* Support policy-making, capacity building, and long-term sustainability.

With the right support and approval, the R&D Directorate can evolve into a **national hub for geospatial innovation and self-reliance**, directly contributing to India’s vision of Atmanirbhar Bharat in the geospatial domain.