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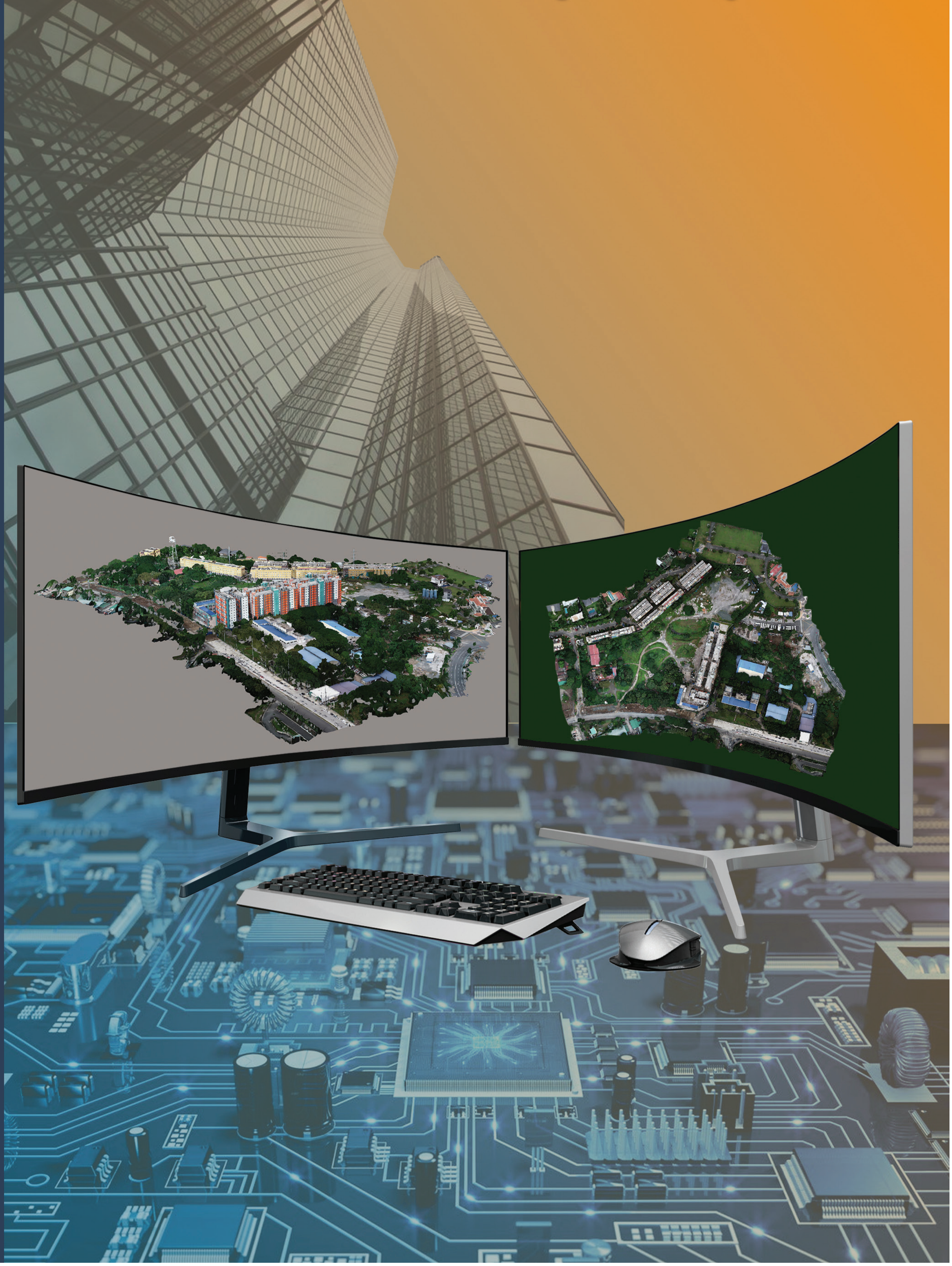
NAMRIA:

Advancing Geospatial Information Management through Innovation



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FOREWORD

Geospatial information is a powerful tool, as most decisions are based on location. This inspired our agency, the National Mapping and Resource Information Authority (NAMRIA), to be at the forefront of geospatial information management.

For over 37 years, NAMRIA has taken pride in fulfilling its mandate of mapping the land and charting the seas. We established the national geodetic network, managed various resource information related to land cover, coastal, and marine resources, and provided safety in navigation. The Geoportal Philippines, a tool for sharing and accessing geospatial information across the country, was developed as a result of our leadership in the establishment of the National Spatial Data Infrastructure. Our membership in local and international organizations strengthened our ties with our stakeholders and built a community of practice for geospatial technology.

It is our unwavering commitment to provide the public with better products and services. From manual to computer-aided to digital and now AI-assisted mapping, we understand the importance of innovation in our endeavors. It is important for the public to know why something happened, is happening, and might happen WHERE. Geo-literacy is now a core competency, and this is why accurate, updated, and sufficient geospatial information is required for effective spatial planning, analysis, and decision-making.

NAMRIA is proud to present this edition of Infomapper, themed "Advancing Geospatial Information Management Through Innovation." It showcases how the agency's innovations in geospatial information management and people strategy affect and improve our operations and technical processes on topographic production, resource assessment, and hydrographic surveys.

We hope you find inspiration in this edition of Infomapper, as I do. We have come a long way but still have a long way to go. Let's bridge the geospatial digital divide and envision together an inclusive and geospatially empowered nation.

Usec. PETER N. TIANGCO, PhD, *CESO I*
Administrator, NAMRIA

TABLE OF CONTENTS

Geospatial Insights: Innovations in Geospatial Information Management

Francisco, RJ., Samarista, LAH., Sontillanosa, RD.

In recent years, the development and enhancement of geospatial information (GI) around the globe have become a vital tool in different sectors, which include environmental planning, urban development, disaster risk reduction, food security, and national security.

In the Philippines, the National Mapping and Resource Information Authority (NAMRIA), serving as the central mapping agency of the government, plays a critical role in managing GI and distributing accurate and up-to-date geospatial data to the GI community. This is in support of the country's sustainable development and national progress.

Innovation, as defined by the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM), emphasizes the transformation of ideas into new or improved products, processes, or services that create value. This concept of innovation highlights the need for adaptability and technological advancement to enhance efficiency, accuracy, and service delivery. NAMRIA exemplifies this definition through its strategic initiatives aimed at modernizing its operation, and continuous innovation to ensure that the Philippines remains at the forefront of technological advancements.

NAMRIA's Key Functions in Geospatial Information Management

NAMRIA was established in 1987 through Executive Order No. 192, which reorganized the country's four mapping and environmental and natural resources offices: Bureau of Coast and Geodetic Survey (BCGS), Natural Resources Management Center (NRMC), National Cartography Authority (NCA), and the Land Classification Teams then based at the then Bureau of Forest Development. The agency was tasked with providing the DENR and the government with map-making services, maintaining and updating topographic maps and nautical charts, and creating other thematic maps.

One of NAMRIA's key functions is to produce topographic maps. These maps are essential for urban planning, infrastructure development, and environmental conservation. By providing detailed and reliable geospatial data, NAMRIA helps planners and policymakers make informed decisions that impact the nation's growth and sustainability.

On the other hand, hydrographic surveys involve surveying and charting the country's coastal and marine areas. An accurate and updated nautical chart is crucial for maritime navigation, ensuring the safety of vessels and protecting marine resources. NAMRIA's hydrographic services, among others, support the shipping industry, fishing activities, and disaster response efforts.

Figure 1. *PAGeNet site selection in Butuan City*

...continued on next page

Geospatial Insights... *from page 5*

NAMRIA's mandate includes the development and maintenance of the National Spatial Data Infrastructure (NSDI) and the Philippine Active Geodetic Network (PAGeNet).

Over the years, the agency has evolved from a traditional mapping agency into a modern organization that uses cutting-edge technology to meet the growing demands for GI.

One of its significant achievements is the establishment of the Geoportal Philippines (GP). This online platform provides access to various geospatial datasets, making it easier for government agencies, businesses, and the public to access and use these information. The GP enhances transparency and fosters collaboration across different sectors, enabling more effective and coordinated efforts in addressing national challenges.

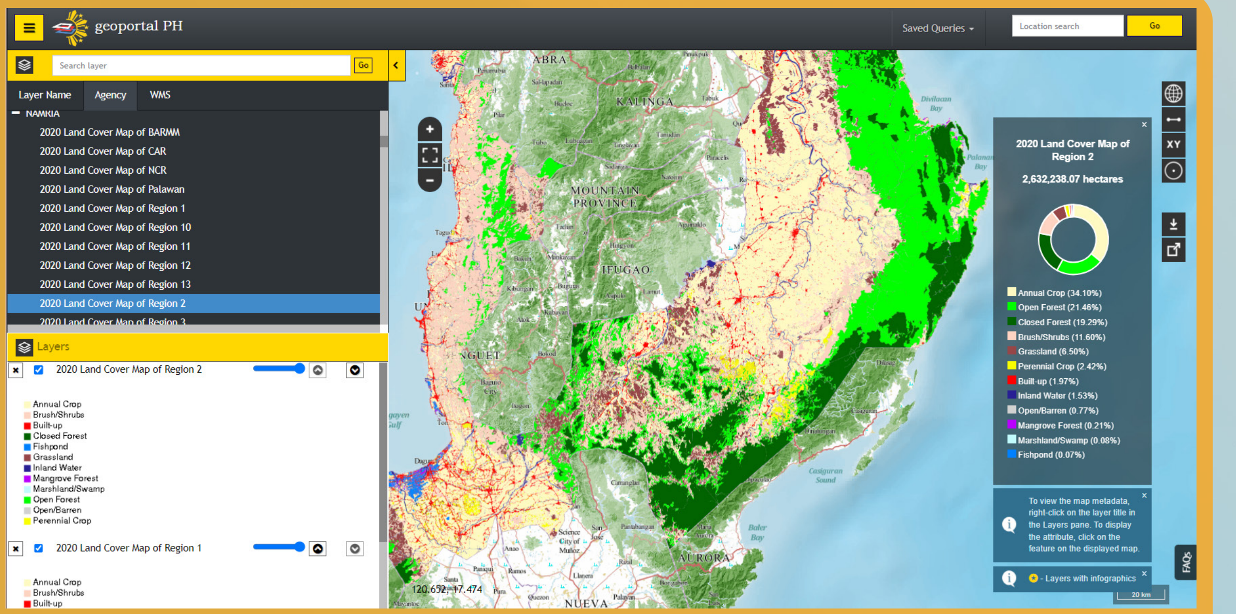

Figure 2. *Geoportal Philippines*

NAMRIA's Strategic Plan

NAMRIA's commitment to innovation aligns with the United Nations Integrated Geospatial Information Framework (UN-IGIF), particularly its focus on improving geospatial infrastructure and capabilities. The Implementation Guide of the IGIF, was agreed on by the Committee of Experts on Global Geospatial Information Management during its tenth session for the national geospatial information management of Member States and in support of the Sustainable Development Goals.

The UN-IGIF Strategic Pathway 5 focuses on driving innovation in geospatial information management. It highlights the importance of adopting new technologies and methodologies to enhance geospatial data's efficiency, accuracy, and usability. This pathway guides countries and organizations in leveraging cutting-edge tools and practices to improve data collection, analysis, and dissemination. By fostering innovation, Strategic Pathway 5 aims to support sustainable development and informed decision-making, ensuring that geospatial data serves its purpose across various sectors.

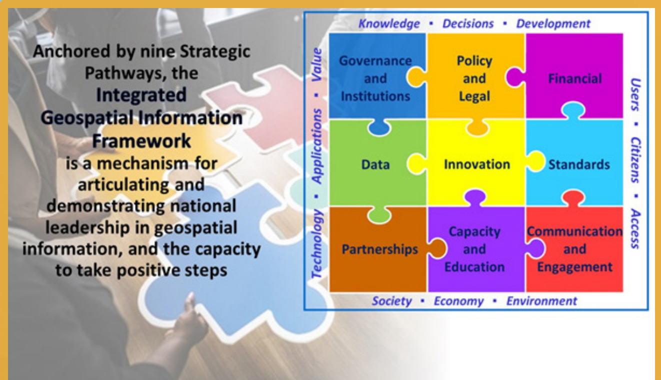

Figure 3. *Integrated Geospatial Information Framework*

Strategic Pathway 5 promotes the development of innovative data dissemination methods. Interactive online platforms and mobile applications (mobile apps) have revolutionized how GI is shared and used. These tools empower users to visualize data intuitively, making complex GI understandable for decision-makers and the public.

NAMRIA's strategic plan is rooted in the vision of becoming a world-class provider of GI for sustainable development, creating a geospatially-enabled Philippines. This vision aligns with the UN-GGIM's broader objectives of advancing geospatial information for social, economic, and environmental benefits. The strategic plan outlines several key areas of focus, each of which reflects NAMRIA's commitment to innovation as defined by UN-GGIM.

1. Modernization of Geospatial Data Infrastructure

At the core of NAMRIA's innovation strategy is the modernization of its geospatial data infrastructure. This initiative involves the adoption of cutting-edge technologies such as remote sensing (RS), geographic information system (GIS), and global navigational satellite system (GNSS). These technological advancements enable NAMRIA to provide more precise and timely GI.

NAMRIA utilizes Earth Observation to create high-resolution maps that are essential for urban planning, disaster management, natural resource, and infrastructure monitoring. The agency operates a fleet of survey vessels equipped with state-of-the-art hydrographic equipment, enabling it to conduct comprehensive hydrographic surveys of the country's vast maritime territories.

In addition, the development of mobile app like PH Tide by the Physical Oceanography Division of the NAMRIA Hydrography Branch provides the time and heights of tides in a certain area. This mobile app will benefit the local fisher folk by making tide information accessible and letting them know the right time to fish to improve their yield.

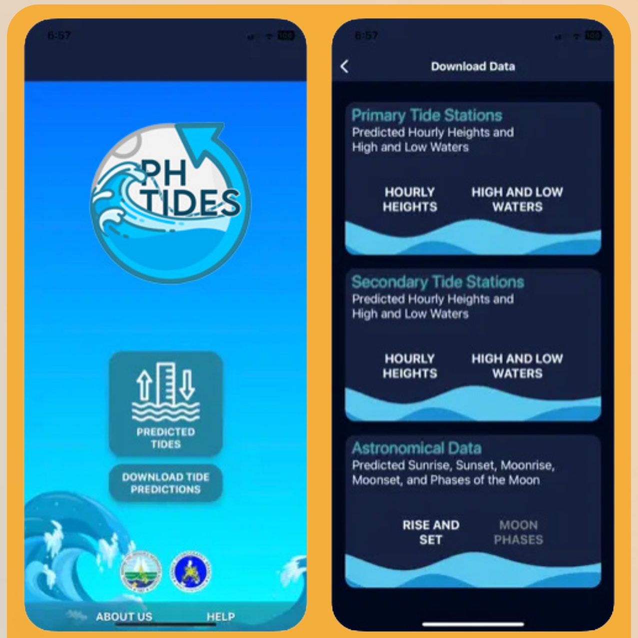

Figure 4. *PH Tides mobile app*

On the other hand, the Mapping and Geodesy Branch, specifically, the Geodesy Division, developed NAMRIA *Mojon* Finder PH. The geodetic control point (GCP) data is sourced from the Geodetic Network Information System (GNIS), NAMRIA's internal database that handles survey records of GCPs. The app is designed to help users locate GCPs in the field, in aid of survey activities.

Figure 5. *NAMRIA Mojon Finder PH*

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Geospatial Insights... *from page 7*

Several map apps are available in the GP to provide an easy way to understand and visualize the geospatial layers uploaded in it. To name a few: Lot Plotter, GP in 3D, Navigational Warning, Road Net, CLUP, COVID-19, and Map Composer. The map apps were developed by the Geospatial System Development Division of the Geospatial Information System Management Branch.

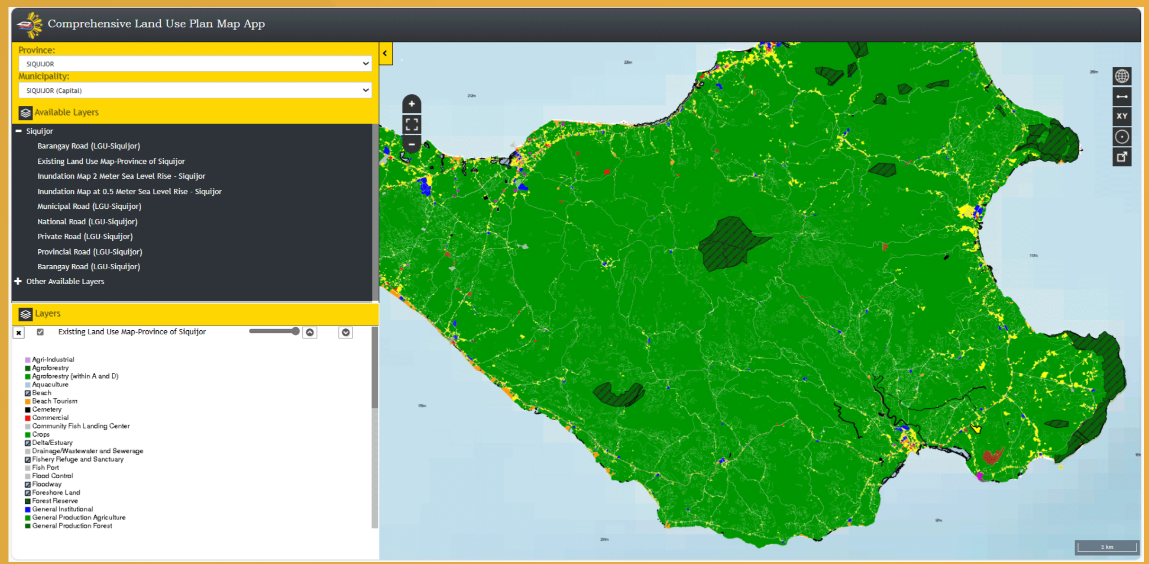

Figure 6. *CLUP Map App*

By integrating these technologies into its operations, NAMRIA has significantly enhanced its ability to collect, process, and analyze geospatial data with unprecedented accuracy and efficiency. This modernization aligns with the UN-GGIM's emphasis on improving the quality and availability of geospatial information, thereby creating value for a wide range of stakeholders, including government agencies, businesses, and the public.

2. Promoting Open Data and Data Accessibility

NAMRIA's strategic plan prioritizes the promotion of open data policy by making its geospatial datasets accessible through its online platform, the GP. NAMRIA fosters transparency and encourages the use of its data for various applications, including disaster risk reduction, urban planning, and environmental management. It improves the availability, accessibility, and timely provision of geospatial information and services to the public through strengthened coordination and cooperation, use of advanced geospatial and related technologies, and enhanced data sharing among the units of NAMRIA. This commitment to open data is a key innovation that resonates with UN-GGIM's principles of data accessibility and inclusivity. By promoting easy access to GI, NAMRIA is enabling a broader audience to understand and use this data for decision-making and development purposes.

Innovation in NAMRIA is evident in its contributions to disaster risk management and resilience-building efforts in the Philippines. The location of the country makes it highly vulnerable to natural disasters such as typhoons, earthquakes, and volcanic eruptions. NAMRIA's geospatial data are indispensable for early warning systems, emergency response planning, and post-disaster recovery efforts. For instance, the agency entered into a Data Sharing Agreement (DSA) with the Office of Civil Defense (OCD) and the University of Hawaii (UH), the managing partner of the Pacific Disaster Center (PDC). The purpose of the DSA is to formalize the collaborative data-sharing relationship between NAMRIA and OCD, and UH/PDC. It aims to promote general disaster risk reduction (DRR) collaboration, emphasizing data and information exchange between the three offices. In addition, the DSA was entered into to support the implementation of the joint OCD-PDC PhilAWARE and National Disaster Preparedness Baseline Assessment Philippine project.

Figure 7. *NGTC offers both online and hybrid GIS training to cater to more learners.*

This proactive approach to disaster risk management reflects UN-GGIM's call for the use of GI in addressing global GI challenges and building resilient communities; and promoting international cooperation to address shared challenges and achieve sustainable development.

3. Strengthening Partnership and International Cooperation

NAMRIA's strategic plan recognizes the importance of partnerships and international collaboration in fostering innovation. By engaging with regional and global geospatial organizations like UN-GGIM, Regional Committee of United Nations Global Geospatial Information Management for Asia and the Pacific (UN-GGIM-AP), and Association of Southeast Asian Nations (ASEAN) Geospatial Agencies (AGA), NAMRIA can exchange knowledge, adopt best practices, and participate in initiatives that advance the field of geospatial information management.

Since 2021, NAMRIA has partnered with the Singapore Land Authority (SLA) to conduct national-level competitions and select the Philippine representatives for the ASEAN Geospatial Challenge-Youth Edition. This annual event headed by the SLA brings youth in the ASEAN region together to use geospatial technology and information to support member nations in achieving the Sustainable Development Goals (SDGs).

In the local scene, NAMRIA has been actively collaborating with various elementary and high schools across the Philippines through its information and education campaign, *Abot-Mapa.* This initiative, part of the annual Maritime and Archipelagic Nation Awareness Month (MANAMo) celebration, seeks to promote the use of correct Philippine maps and charts, and provide teachers with essential instructional materials. *Abot-Mapa* also aims to inspire students to pursue studies in geomatics and related disciplines, equipping future generations with skills and knowledge to engage effectively with geospatial information and contribute to national development.

These collaborations not only enhance the capability of NAMRIA but also contribute to the global discourse on geospatial innovation.

4. Building Capacity and Human Resource Development

Innovation in NAMRIA is not limited to technological advancement but also extends to capacity building and human resource development. The strategic plan emphasizes the importance of equipping NAMRIA's workforce with the skills and knowledge needed to understand and use the new technologies and methodologies. During the COVID-19 pandemic, the NAMRIA Geomatics Training Center (NGTC) conducted GIS training with its staff through online platforms. Since then, the online training has been extended and offered to the public so that more users can learn different geospatial technologies.

...continued on next page

Geospatial Insights... *from page 9*

In addition, NAMRIA consistently sends scholars to pursue studies both locally and internationally. Through training programs, workshops, and partnerships with academic institutions, NAMRIA ensures that its staff remains at the forefront of geospatial innovation. Capacity building is a crucial component of NAMRIA's strategic plan, as it ensures the sustainability of its innovation efforts and alignment with UN-GGIM's focus on the development of human capital in GIM.

Challenges and the Way Forward

While NAMRIA has made significant strides in advancing geospatial information management in the Philippines, it faces ongoing challenges. The rapid pace of technological change requires investment in new tools, capacity building for its personnel, and ensuring the interoperability of geospatial data across different platforms and agencies. As the demand for GI continues to grow, NAMRIA must ensure the accuracy, recentness, and security of all data it provides to the public.

Looking forward, NAMRIA is committed to further enhancing its capabilities by adopting emerging technologies such as artificial intelligence (AI) and machine learning (ML) for more sophisticated data analytics and interpretation. The agency is focused on building partnerships with local and international organizations, as well as with academic institutions and the private sector. These collaborations are essential for sharing knowledge, accessing modern technologies, and developing innovative solutions to emerging geospatial challenges.

NAMRIA's journey from a traditional mapping agency to a leader in geospatial information management proves its commitment to innovation, which has made the agency a crucial player in the Philippines' pursuit of sustainable development, disaster resilience, and environmental protection. By continually embracing new technologies and improving its services, NAMRIA not only meets the current demands of various sectors but also anticipates future challenges. As the agency continues to evolve, its role in shaping the country's future through GI will only become more significant.

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1. https://ggim.un.org/
2. NAMRIA Strategic Plan

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Developing Automated Generalization Towards Advancing Topographic Mapping

Apolinario, KL., Balais, JPP., Ocfemia, MM.

The art and science of mapmaking have evolved along with the advancement of technology and human innovation over the centuries. What started as old pictorial maps that depicted geography, settlements, and significant landmarks can now be produced digitally. This has made mapmaking easier using remote sensing and geographic information systems (GIS) technologies. While the process of generating maps has come a long way, all kinds of maps throughout history have one thing in common: they aim to provide an easier understanding of the world or a specific place through graphical presentation.

Automated generalization is an innovation that could streamline topographic production processes by deriving smaller-scale maps from larger-scale maps. This simplifies maps by retaining only essential information appropriate for a certain scale while maintaining accuracy and consistency across scales. Generalization involves selective reduction of detail, emphasis on what elements should be highlighted, or combining less important features to avoid clutter and enhance the map's clarity and usefulness. The crucial aspect of developing automated generalization is to define how and which details to reduce as it transitions from a larger to a smaller scale map.

Figure 1 shows a map projected at two varying scales. The map on the left is projected at a scale of 1:10,000, while the other is projected at 1:50,000. As observed, information and features are much more visible and distinct on the 1:10,000 map while the features on the 1:50,000 map are cramped because generalization is yet to be applied to this map.

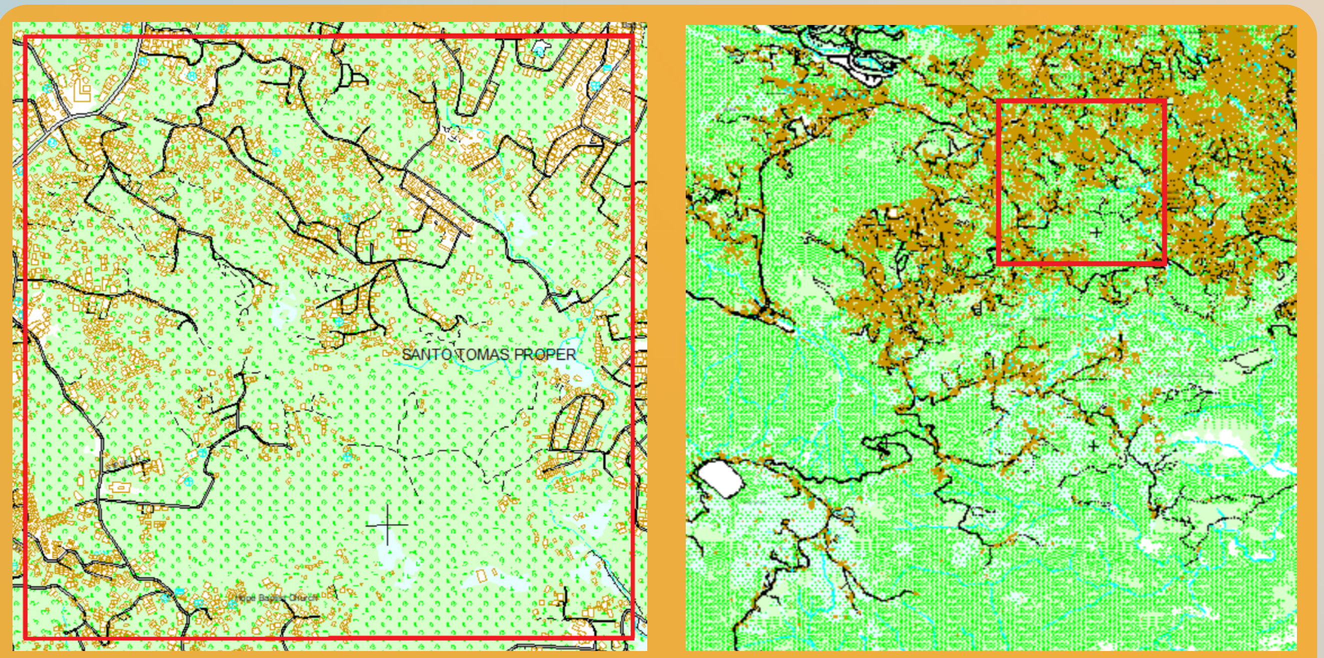

Figure 1. *Planimetric map at 1:10,000 (left) and 1:50,000 (right) scales*

Developing ... *from page 11*

The next two images show the impact of generalization on topographic maps of Dietikon, Switzerland. Figure 2 shows the 1:5,000 scale map, Figure 3 shows a generalized 1:25,000 scale map with the corresponding section of the larger-scale map. This comparison illustrates how features like buildings and roads are simplified at smaller scale to maintain clarity and readability. Topographic maps at different scales cater to varying user's needs, emphasizing different levels of detail depending on their intended use.

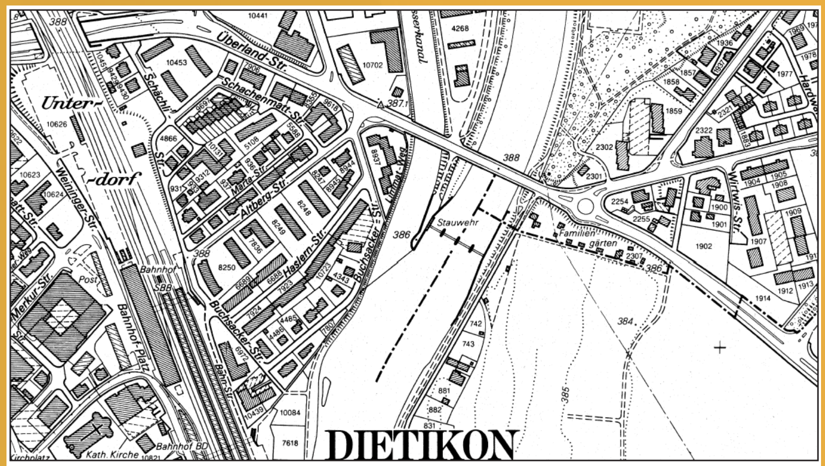

Figure 2. *Topographic map at 1:5,000 scale (Swiss Society of Cartography, 2005)*

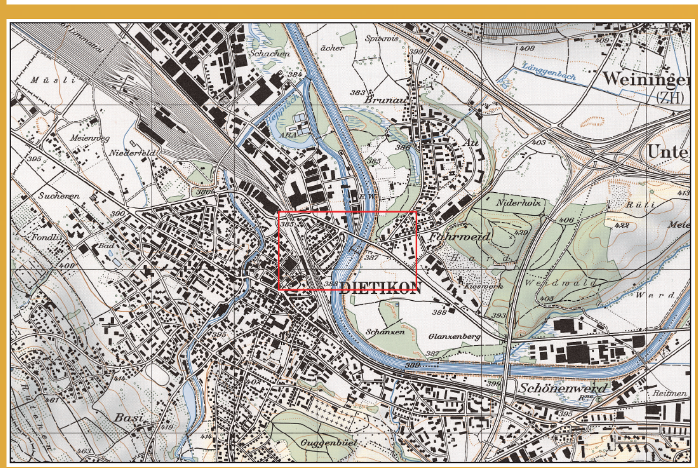

Figure 3. *Topographic map at 1:25,000 scale (Swiss Society of Cartography, 2005)*

National Mapping Agencies (NMAs) are mandated to produce topographic base maps at various scales. At the National Mapping and Resource Information Authority (NAMRIA), the two topographic map production divisions of the Mapping and Geodesy Branch (MGB) are the Cartography Division (CD) and Photogrammetry Division (PD). The CD produces nationwide medium- and small-scale maps at 1:50,000 and 1: 250,000, respectively while the PD produces large-scale maps at 1: 10,000 nationwide and 1: 4,000 for selected highly urbanized areas.

The current mapmaking process and update cycle of PD and CD, as depicted in Table 1, are operating at a low capacity compared to other NMAs. The production capacity depends on resources such as workforce, workflow/process, technology, time, and budget allotment. The "Universe" in Table 1 pertains to the total number of map sheets covering the Philippines, while the "Cycle" is a rough estimate dividing the universe to the current targets, not considering the yearly target increases. The table shows that the updating cycles take very long periods . These cycles could be potentially shortened through technological innovations such as automated generalization. To remove redundancies in workflows, the application of a semi-automated generalization process in the MGB is envisioned. In this scenario, image acquisition and processing, and feature extraction will be done on the best-scale data (1: 10,000), thereby eliminating these workflows from the CD. Medium- and small-scale maps will be generated from the large-scale map for consistency.

MAPS	SCALE	DESCRIPTIONS	UNIVERSE	STATUS (2023)	CYCLE
Large-Scale Topographic Maps	1:4,000	Digital Line Maps Orthoimages (30 cm VHRSI) - Map Size 1' x 1' - Map Area ≈ 324 ha.	Urban Areas Only 11,786 map sheets	3,303 map sheets **(28.02%)**	**32 years**
	1:10,000	Unified Mapping Project ▪ 2013 IfSAR, ORI, DSM, & DTM ▪ Orthoimages (50 cm VHRSI) ▪ Digital Line Maps* ▪ Carto-Enhanced Maps** - Map Size 3' x 3' - Map Area ≈ 2,916 ha.	Nationwide 12,820 map sheets	*2,780 map sheets **(21.68% new cycle)** **860 map sheets **(6.71%)**	**9 years** **150 years**
Medium-Scale Topographic Maps	1:50,000	Digital Line Maps Orthoimages (1.50 cm VHRSI) Carto-Enhanced Maps - Map Size 15' x 15' - Map Area ≈ 72,900 ha.	Nationwide 680 Map Sheets	194 map sheets **(28.53% new cycle)**	**15 years**
Small-Scale Topographic Maps	1:250,000	Carto-Enhanced Maps - Map Size: 1° x 1'30" - Map Area ≈ 1,790,000 ha.	Nationwide 55 Map Sheets	55 map sheets **(100%)**	**11 years**
Administrative Maps	Varies	Carto-Enhanced Maps	Nationwide 17 Regional 82 Provincial	12 regional **(71% new cycle)** 37 provincial **(45% new cycle)**	**8 years**
Gazetter	1:50,000	Geographical Names	Nationwide 82 Province & NCR	30 provinces **(36.58%)**	**11 years**

Table 1. *Current State of Topographic Mapping in NAMRIA*

Recognizing its value, the development of the semi-automated generalization project is included in the 2021-2028 NAMRIA Strategic Plan as part of the agency's efforts to improve the delivery of its mandate to its stakeholders; and to establish the agency direction for the succeeding years in pursuance of its mission and vision. The MGB is committed to increasing the production of topographic maps, improving printing capacity, and enhancing the accuracy and efficiency of geodetic positioning as an initiative to upgrade topographic mapping and geodetic processes to produce quality geospatial products and services. Large-, medium-, and small-scale topographic and administrative maps and geodatabases are to be updated using a semi-automated generalization process, combining human expertise intervention with automated tools to achieve efficient and accurate generalization.

In 2016, MGB explored automating map generalization by partnering with its GIS software provider. The project included training, workshops, and software configuration aiming to enhance its topographic map production capabilities. Part of the program is prototyping the automated generalization model for 1:50,000 map from 1: 10,000 maps for select feature classes (Biña & Dalde, 2016). A third phase, aiming to deploy an automated generalization workflow, was hampered due to budgetary concerns and initial outputs not meeting the cartographic specifications of the MGB. The project is being revived in compliance with the NAMRIA Strategic Plan as shown in Table 2.

TOPOGRAPHIC MAPPING AND GEODETIC REFERENCE FRAMEWORK DEVELOPMENT AND MANAGEMENT ROADMAP						
Upgrade topographic mapping and geodetic processes to produce quality geospatial products and services			**Increase in the production of topographic maps**			
			Improve printing capacity			
			Increase in accuracy and efficiency of geodetic referencing			
	DELIVERABLES					
KRA	**2021**	**2022**	**2023**	**2024**	**2025**	**2026-2028**
Topographic Mapping	Updated large-, medium-, and small-scales topographic and administrative maps and geodatabases			Development of semi-automated cartographic generalization process for multi-scale topographic and administrative maps		Continuous updating of multi-scale topographic and administrative maps, orthoimages, and seamless and integrated geodatabases.

Table 2. *Topographic Mapping and Geodetic Reference Framework Development and Management Roadmap for 2021-2028*

...continued on next page

Developing ... *from page 13*

Other NMAs have developed automated generalization workflows that exponentially shortened production and reduced costs, such as in the case of Dutch Kadaster, shown in Figure 4. The following are case studies that showcase how other NMAs implemented automated generalization.

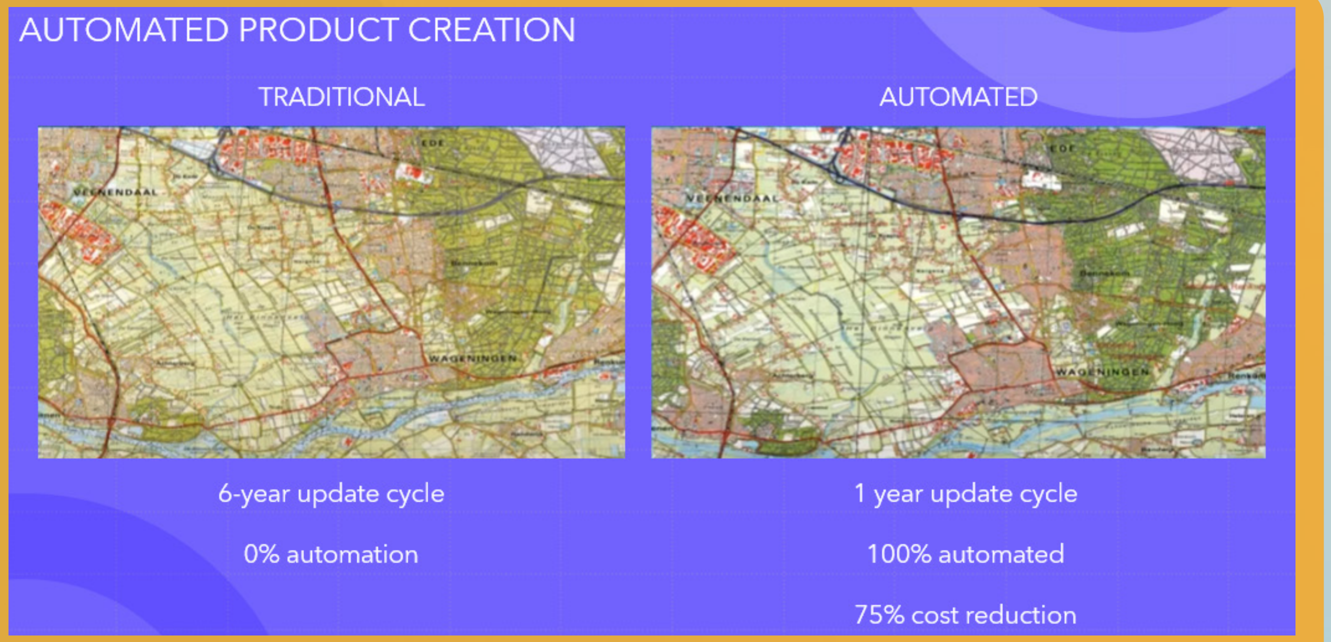

Figure 4. *Dutch Kadaster Map Production Before and After Using Automated Map Generalization (Bong, 2024)*

The experience of several European NMAs (e.g., Germany, France, Spain, Denmark) demonstrates the feasibility of automated generalization. This enabled them to streamline updates to their datasets and databases without requiring to overhaul their entire production processes (Baig et al., 2013).

On the other hand, mapping agencies all over Germany have collaborated to create a more efficient and consistent system. The Authoritative Topographic-Cartographic Information System (ATKIS) project (Stoter, 2005) established standardized data models called Base-Digital Landscape Model (DLM) for the entire country while using a new object-based approach called object generalization along with cartographic generalization. This involves transforming real-world data into a detailed digital model, DLM at 1:25,000 scale (DLM25). This model is then further generalized to derive smaller-scale maps such as the DLM50 (1:50,000 scale). The project's collaborative effort significantly improved map production nationwide.

The goal was the same for the French National Mapping Agency (IGN) as they explored the impact of new technology on automating map creation and updates. Jahard et al. (2003) focused on automating the process of creating smaller-scale maps (1:100,000) from a large, centralized database (BDCarto), encompassing all of France. A comparison of two IGN projects highlights the impact. In 1994, manually generalizing maps took a staggering 1,000 hours per map. By 1999, with automation, this dropped to just 50 hours (plus an additional 100 hours for interactive adjustments). While the entire 1999 project still took 16 months (2,500 hours), it was a ten-fold increase in productivity compared to the 1994 project. The study revealed that adopting automated generalization significantly reduced costs, workload, and production time.

Likewise, different approaches to map generalization are commonly used by mapping agencies like Spain's ICC and Denmark's KMS. Both automated generalization and manual editing play roles in their process. In Spain, a mixed approach is applied as ICC does not generalize all databases. Some maps are automated, while others still rely on manual editing. This is almost the same with Denmark's KMS which utilizes self-developed algorithms in their "Clarity" system to automate map generalization. Even so, the automated output is still manually reviewed and adjusted for accuracy. This implies that there is no single approach to map generalization. NMAs can choose among manual, automated, or a combination of both methods (semi-automated).

Two key approaches for managing multi-scale generalization are the ladder and the star approach. The ladder approach sequentially generates smaller-scale geodatabases from larger-scale geodatabases. On the contrary, the star approach derives all smaller-scale geodatabases directly from the best-scale geodatabase. As illustrated in Figure 5, the ladder approach involves a best-scale geodatabase e.g. 1:10,000 deriving a smaller-scale geodatabase 1:50,000. And from that generalized 1:50,000 geodatabase, a smaller-scale geodatabase 1:250,000 can be derived. While in the star approach, smaller-scale geodatabases 1:50,000 and 1:250,000 will both be derived from the best-scale geodatabase e.g. 1:10,000. Ultimately, the choice between these methods depends on the specific application's needs, resources, and balancing accuracy requirements with efficiency considerations.

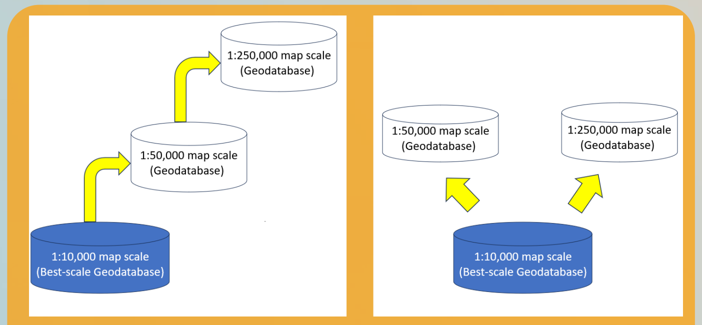

Figure 5. *Illustration of the Ladder Approach (left) and Star Approach (right)*

While a cartographer's job is to represent the geographical, geopolitical, or geological features of an area on the Earth, the real world contains a gargantuan amount of details that cannot all be represented on a flat, two-dimensional surface, however significant they may seem. . This is especially true as the map scale becomes smaller to cover larger areas of interest. The purpose of generalization is to ensure that maps serve their functions as effectively and efficiently as possible for their intended usage, with the most important information perspicuously conveyed.

Reducing the complexity of natural and built features by removing unnecessary details creates simple yet informative and beautiful maps. A meandering river might be represented with much fewer curves and bends. The digitization of the interface where the shore meets the water, including the seaward edge of coastal mangroves is an intricate process. River mouths will be enclosed using straight closing lines to maintain the overall shape of the shoreline. Artificial or built structures, such as stilt houses that appear submerged or below water, shall be excluded as part of the shoreline. Jagged coastlines with small islands adjacent or contiguous to a main island can be smoothed out from a geological and geophysical point of view.

Automated generalization has transformed map production by significantly improving efficiency, consistency, and timeliness. By streamlining the creation of smaller-scale maps from larger-scale datasets, NMAs have reduced costs, labor, and production time while ensuring accurate and frequently updated map products.

However, mapmakers and cartographers should approach the task of generalization with caution. Generalization processes are difficult to standardize due to differences in data models and classification methods used by NMAs (Foerster et al., 2008). Even with identical generalization rules, different cartographers can produce varying results due to the complex interplay between different feature types and the cumulative effects of applied rules (Stoter, 2005). Despite these challenges, automated generalization remains a valuable tool in modern map production, empowering NMAs to better meet the evolving demands of their users for reliable and timely spatial information.

Presently, a research, development, and extension (RD&E) team from MGB has started to harmonize and optimize the geodatabase schema of the CD and PD which is a crucial first step before the development of the generalization process. Figure 6 shows the proposed road map for the development of the semi-automated generalization process and workflows for generating 1:50,000-scale from 1:10,000 topographic maps. The initial phase involves preparing for the transition by reviewing current workflows, harmonizing geodatabases, and addressing skill gaps. The second phase centers on developing a generalization model for automated map production, and the third phase tests this model in a pilot study area before full implementation. Successful transition depends on a comprehensive assessment of workflows, model performance, technical skills, and resource requirements.

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Developing... *from page 15*

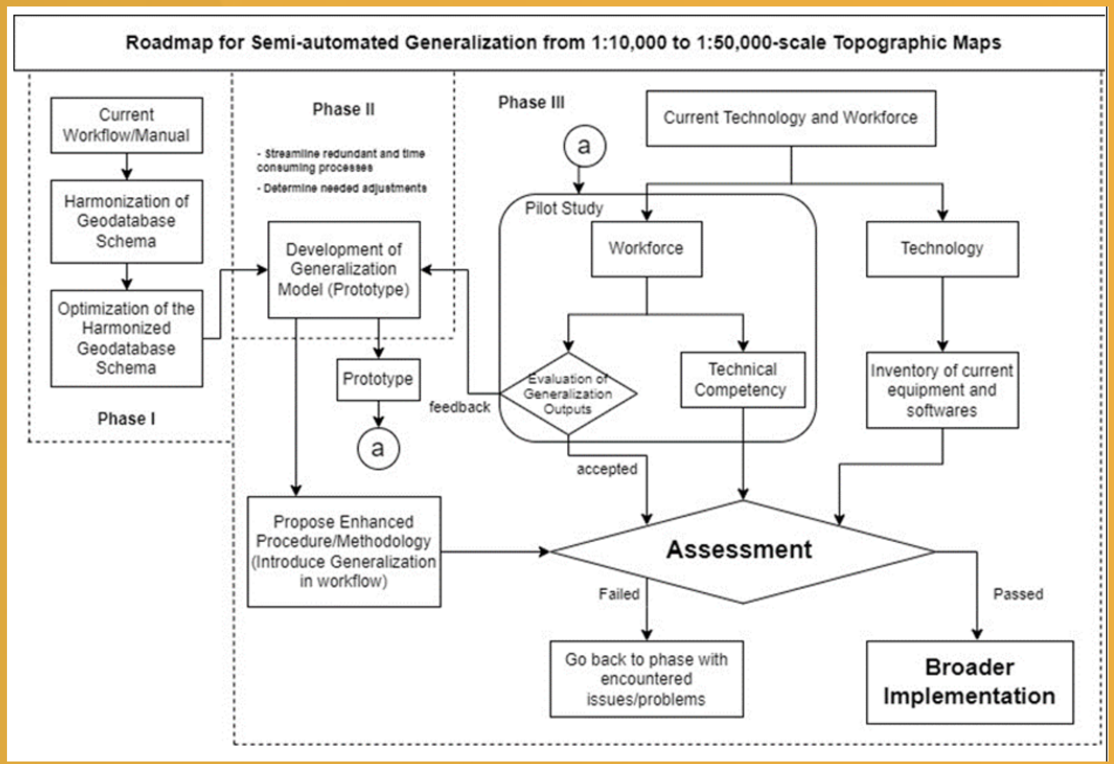

Figure 6. *Proposed Roadmap for Semi-automated Generalization from 1:10,000 to 1:50,000-scale Topographic Maps*

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Uncertainty Estimation in Hydrographic Surveys

Montemor, KLA, Abraham, AV., Gregorio, RMP., Advincula, ARA.

In all measurement work, an estimate of measurement accuracy (or inaccuracy) is as important as the measurement itself. For example, a soft drink bottle must both be faithful to the reported content volume of 1,000 milliliters (mL) as well as be consistent in content volume for every bottle. The bottling company measuring accuracy may report their results as 1,000 mL ± 50 milliliters at 95% confidence level, where the uncertainty interval ± 50mL indicates how inaccurate the volume is and the 95% confidence level is how sure the company is that the nominal volume of 1,000 mL (or 1 liter) will not go beyond the specified uncertainty interval. A small uncertainty interval with high confidence level implies accuracy and reliability in the underpinning measurement systems.

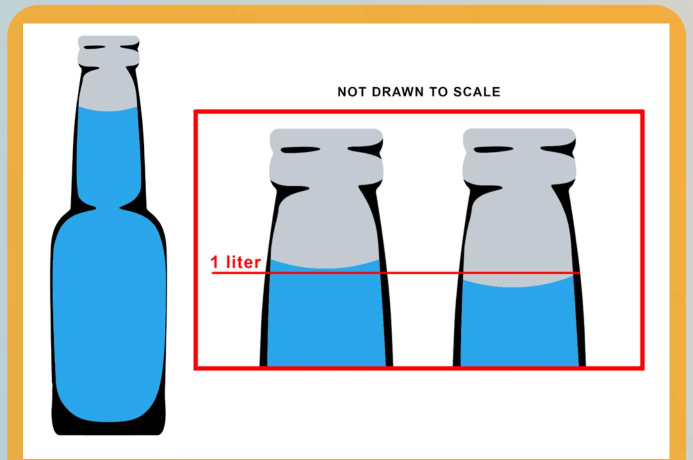

Figure 1. *Example of liquid volume variability in bottled products*

While accuracy and uncertainty are used synonymously in discourse, they have distinct meanings in metrology. Accuracy pertains "to the closeness of the agreement between measurement result and the true value" (Bell, 1999), while uncertainty pertains to the "range of values in which the measurement is estimated to lie within a given statistical confidence" (National Physical Laboratory, 2020). Since the true value is unknowable (Joint Committee for Guides in Metrology Working Group 1, 2010), it follows that measurement accuracy is formally unknowable as well – hence the use of the term uncertainty.

Understanding Uncertainty

Operationally, uncertainty is the estimate of how small or large the measurement inaccuracy is and how sure we are with the reported inaccuracy. In the previous example, we are 95% sure (confidence level) that the content volume will be anywhere between 950 mL and 1,050 mL (uncertainty interval a.k.a. confidence interval).

The International Organization for Standardization (ISO) categorizes uncertainty evaluation into two types: Type A and Type B (International Organization for Standardization, 2016). Type A is the assessment of the uncertainty through "statistical analysis of series of observations," while Type B is the assessment of the uncertainty by other means (Joint Committee for Guides in Metrology Working Group 1, 2010, p. 3). A usual example of Type A uncertainty is the accuracy range found in user manuals of measuring equipment where manufacturers usually conduct multiple tests of their equipment to come up with its accuracy range. For our purpose, we will refer to Type A uncertainty as Statistical Uncertainty and to Type B uncertainty as Model-based Uncertainty[1].

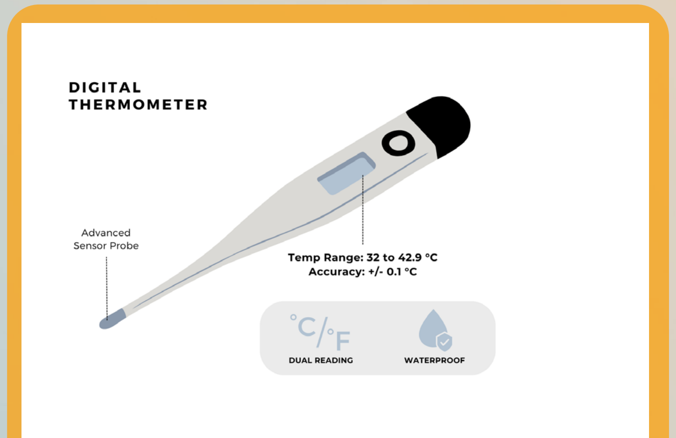

Figure 2. *The digital thermometer uncertainty in temperature readings (± 0.1°C) is an example of Type A uncertainty.*

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[1]Type B evaluation includes all uncertainty evaluations not covered under Type A evaluation. Boumans note that Type B evaluations are more subjective than Type A evaluations, and the same author has shown that objective Type B evaluations are achieved when using model-based evaluations (Boumans, 2013). Since the Hare-Godin-Mayer model for Total Propagated Uncertainty (TPU) provides the uncertainty attribution required for the Combined Uncertainty Bathymetry Estimator (CUBE) (Byrne & Schmidt, 2015), the writers, for the purpose of this article, decided the use of "Model-based Uncertainty" as another name for Type B uncertainty evaluations as appropriate.

Uncertainty... *from page 17*

The evaluation of statistical uncertainty (Type A), in practice, requires repeated measurements of the same quantity. From these repeated measurements, the central tendency (e.g., mean, median, mode) and the standard deviation are calculated. From these repeated measurements, the mean and the standard deviation of the data are calculated. The mean is the average value of the measurements, while the standard deviation measures how far data values are from this mean. For example, depth measurements for a feature are (in meters): 1.1, 1.1, 1.0, 0.9, 1.2, 1.1, 1.0, 0.9, 1.0, 1.0, 1.1, 0.8. The mean depth is 1.0m, and the standard deviation (SD) is 0.1m. The depth uncertainty is calculated as 1.96 x SD at a 95% confidence level. Hence, the foregoing example can be written as: Feature Depth = 1.0m ± 0.2m (95% CL). It is consequent that the larger the number of samples of a quantity, the more reliable the statistical uncertainty estimate is. However, in hydrographic surveys, repeated depth measurements are not practical due to limitations in time and resources as hydrographic surveys are usually expensive and complicated to undertake. In the IHO S-44 6[th] edition Table 1 (see Figure 3), the Exclusive Order survey only requires a bottom ensonification of 200% or two repeated measurements of the same depth cell (International Hydrographic Organization, 2020). Ensonification refers to the process of acquiring data using sound waves or sonar equipment.

7.3 TABLE 1 - Minimum Bathymetry Standards for Safety of Navigation Hydrographic Surveys

To be read in conjunction with the full text set out in this document, m = metres, all uncertainties at 95% confidence level, * = Matrix Reference.

TVU: **a** represents that portion of the uncertainty that does not vary with the depth
b is a coefficient which represents that portion of the uncertainty that varies with the depth
d is the depth

$$TVU_{max}(d) = \sqrt{a^2 + (b \times d)^2}$$

Reference	Criteria	Order 2	Order 1b	Order 1a	Special Order	Exclusive Order
Chapter 1	**Area description** (Generally)	Areas where a general description of the sea floor is considered adequate.	Areas where underkeel clearance is not considered to be an issue for the type of surface shipping expected to transit the area.	Areas where underkeel clearance is considered not to be critical but features of concern to surface shipping may exist.	Areas where underkeel clearance is critical	Areas where there is strict minimum underkeel clearance and manoeuvrability criteria
Section 2.6	**Depth THU** [m] + [% of Depth]	20 m + 10% of depth *Ba5, Bb2	5 m + 5% of depth *Ba8, Bb3	5 m + 5% of depth *Ba8, Bb3	2 m *Ba9	1 m *Ba10
Section 2.6 Section 3.2 Section 3.2.3	**Depth TVU** (a) [m] and (b)	a = 1.0 m b = 0.023 *Bc7, Bd4	a = 0.5 m b = 0.013 *Bc8, Bd6	a = 0.5 m b = 0.013 *Bc8, Bd6	a = 0.25 m b = 0.0075 *Bc10, Bd8	a = 0.15 m b = 0.0075 *Bc12, Bd8
Section 3.3	**Feature Detection** [m] or [% of Depth]	Not Specified	Not Specified	Cubic features > 2 m, in depths down to 40 m; 10% of depth beyond 40 m *Be5, Bf3 beyond 40m	Cubic features > 1 m *Be6	Cubic features > 0.5 m *Be9
Section 3.4	**Feature Search** [%]	Recommended but Not Required	Recommended but Not Required	100% *Bg9	100% *Bg9	200% *Bg12
Section 3.5	**Bathymetric Coverage** [%]	5% *Bh3	5% *Bh3	≤ 100% *≤ Bh9	100% *Bh9	200% *Bh12

Figure 3. *IHO S-44 6th Edition Table 1*

Recognizing the limitations of hydrographic survey operations, model-based (Type B uncertainty) estimation is performed instead to provide uncertainty estimates for the seafloor bathymetry. The most common model for bathymetric uncertainty estimation is the Hare-Godin-Mayer (HGM) uncertainty model (Calder, 2013) – the same has been integrated with current implementations of the Combined Uncertainty and Bathymetry Estimator (CUBE) in the most popular hydrographic survey processing software in the market. The HGM model provides a mathematical model for the propagation of uncertainty in each step of the measurement process. The following datagram model provides the flow of data from each component of the survey system until the reduced depth is finally reached (Calder & Wells, 2007):

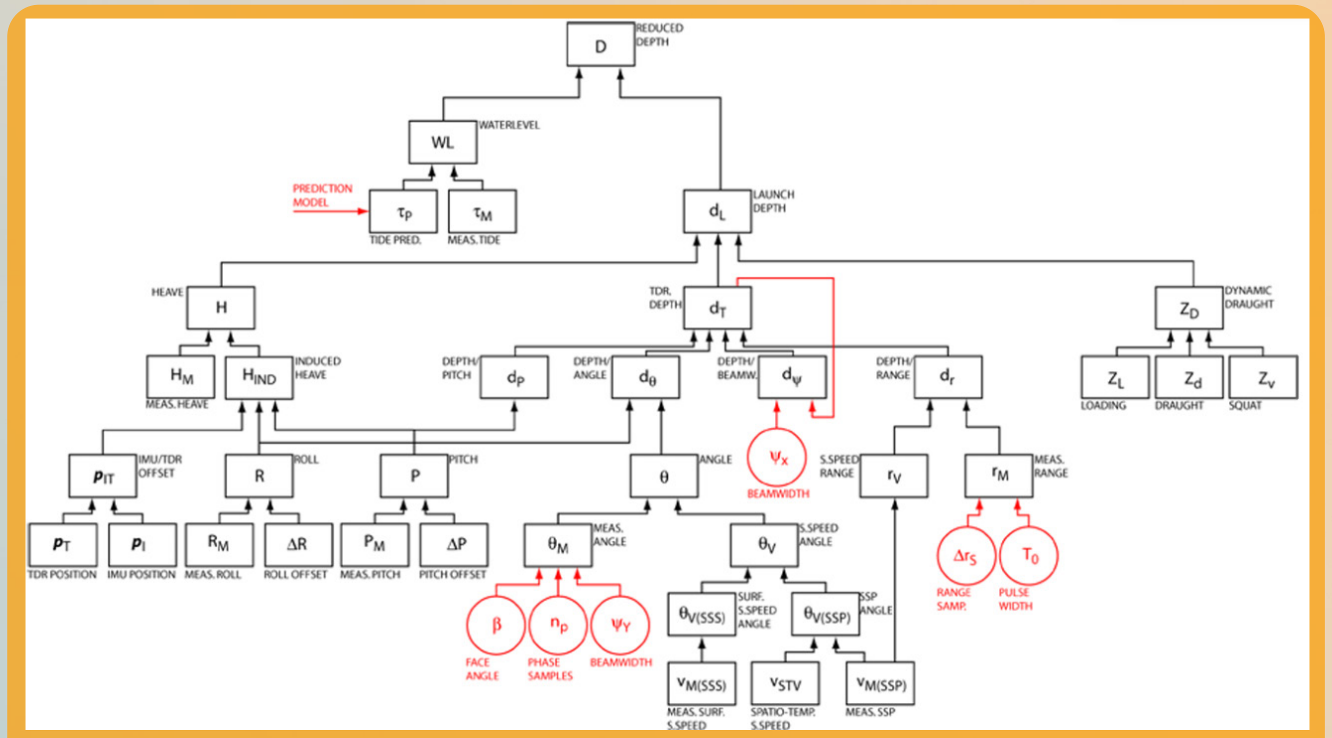

Figure 4. *Data flow diagram for the vertical uncertainty component of the HGM multi-beam echosounder uncertainty model (Calder & Wells, CUBE User's Manual, 2007)*

The HGM Model combines the uncertainty sources on a hydrographic survey system and propagates the final uncertainty value to the reduced depth. Reduced depth is the final corrected depth that is referred from a vertical reference (e.g. mean sea level).

Sources of Uncertainties in Hydrographic Surveys

The primary sources of uncertainties in hydrographic surveys are: platform, sensor measurement, environment, integration and calibration (Hare, Eakins, & Amante, 2011).

Figure 5. *Common sources of hydrographic survey uncertainty*

In a survey system, for example, the positioning may be inaccurate by ± 1 cm (e.g., GNSS RTK), the tide measurements by ± 0.05 cm (typical of NAMRIA's primary tide stations), and the instrument installation offsets by ± 0.50 cm. The uncertainty values are collated into an uncertainty profile that can contain over 60 variables affecting the final uncertainty of the reduced depths as well as the final uncertainty of the position of each depth measurement. An oversimplification of how these uncertainties combine into a final uncertainty value is illustrated in Figure 6.

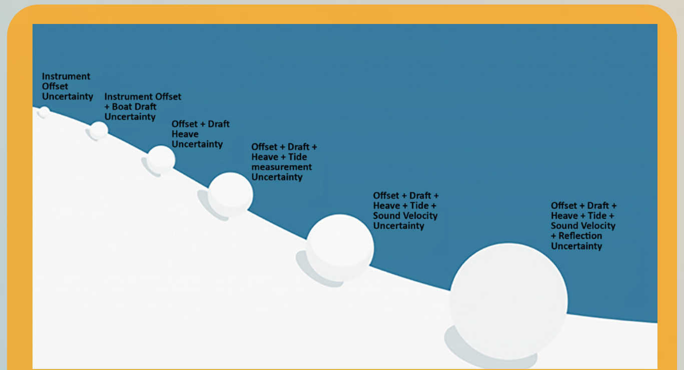

Figure 6: *Oversimplified illustration of uncertainty propagation*

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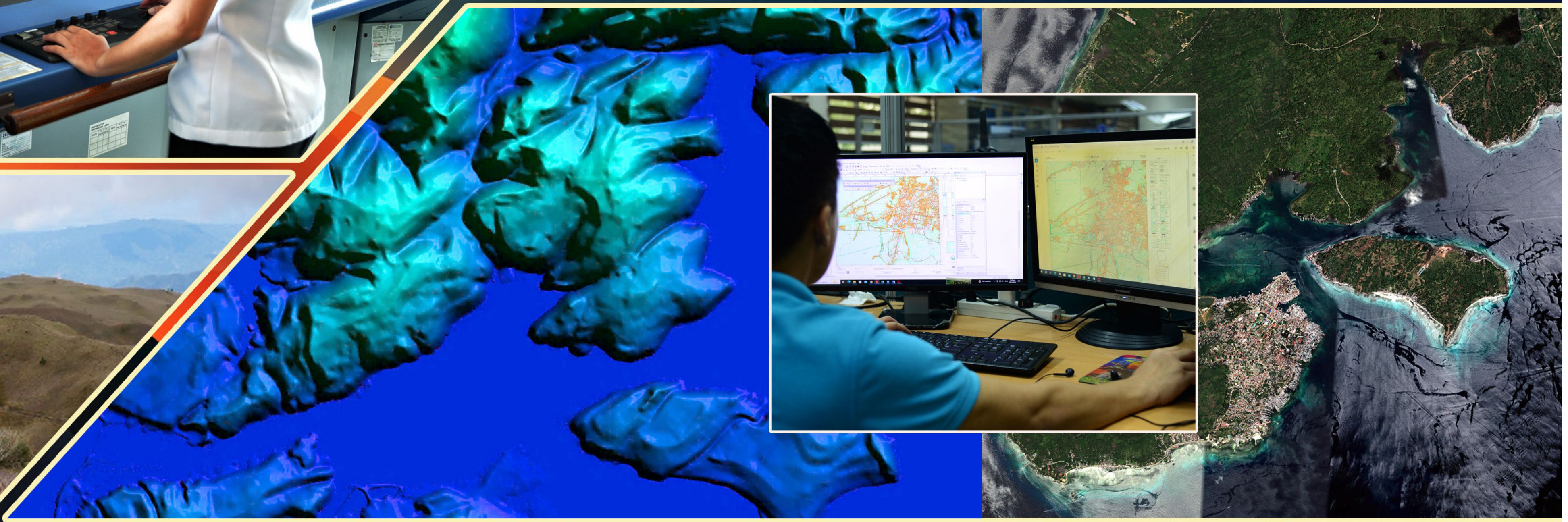
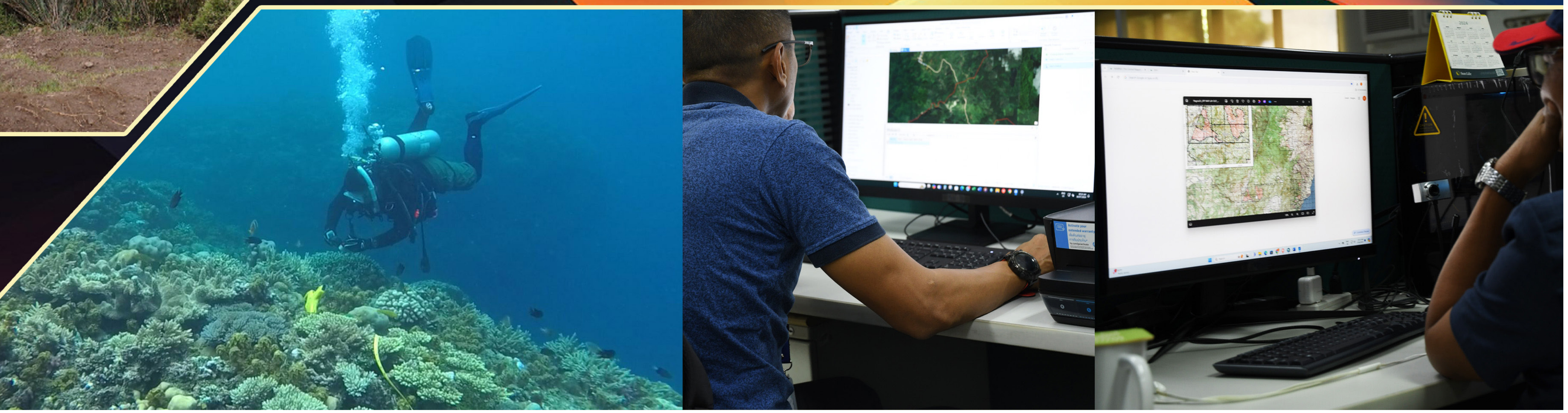
Advancements in NAMRIA:
Shaping the Future of Mapping and Geospatial Technology





The following photos showcase NAMRIA's innovation, resilience, and resourcefulness in continuing operations and advancing geospatial innovations to support sustainable development and environmental protection across the Philippines through state-of-the-art technology, adaptation to various challenges by making the most of available resources, and the dedication of its people.

Uncertainty... *from page 19*

In general, the total uncertainty is the root of the sum of squares of each uncertainty. For the rigorous mathematical formulation of the HGM Model, the reader is referred to the Depth and Position Error Budgets for Multibeam Echosounder by Rob Hare (International Hydrographic Review, LXXII [2], September 1995).

The hydrographer must be diligent in documenting the individual uncertainty sources. Hydrographic survey software like HYPACK and CARIS HIPS and SIPS allow hydrographers to input each uncertainty source and automatically calculate the uncertainty value per sounding per the HGM model (a sounding is a depth measurement that may or may not be fully corrected).

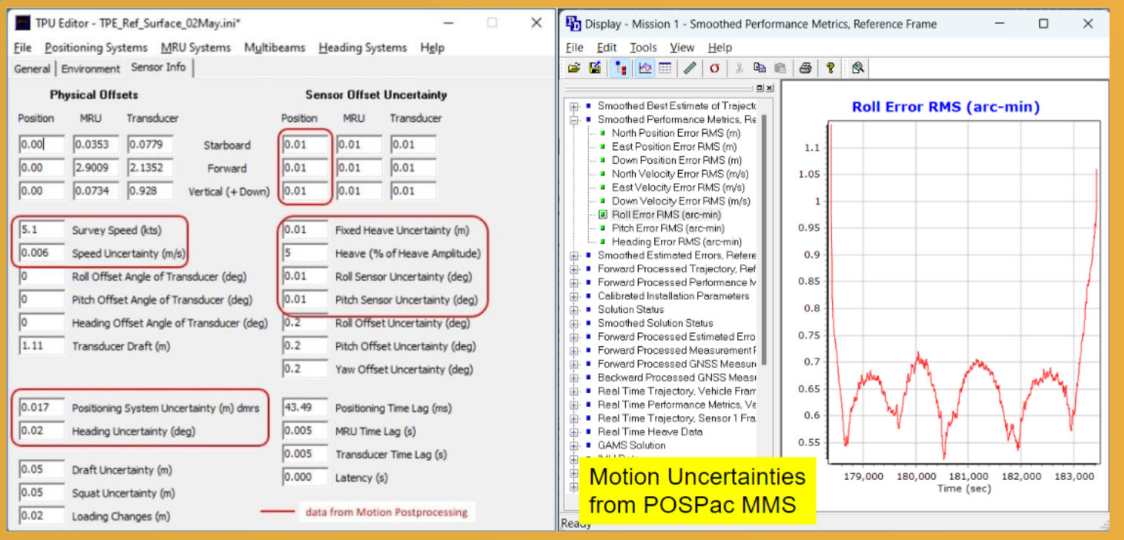


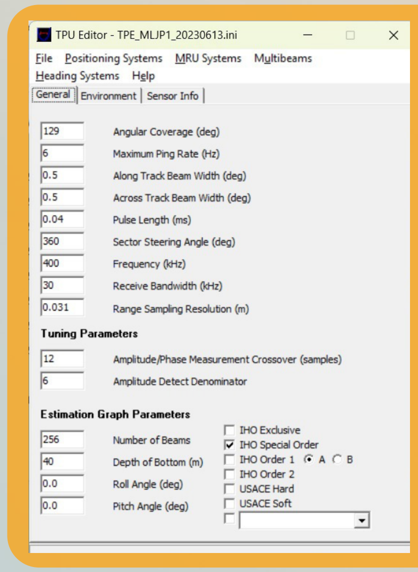
Figure 7. *Example hydrographic survey uncertainty profile encoded in HYPACK TPU Editor*

The quality of the uncertainty estimate depends on the faithfulness of the hydrographer in collecting, documenting, and applying the uncertainty information to the survey data. Dr. Jonathan Beadouin remarked that the HGM model has been mathematically proven and should be trusted and that any "squirrelly" and "weird" uncertainty estimate results will only come from the inadequate knowledge of the hydrographer (Beaudoin, 2024). Pat Sanders, former HYPACK President, notes that some hydrographers guess individual uncertainty values or retain the software defaults – hence the unlearned use of TPU programs will result in "bogus computation" (Sanders, 2011). Thus, reliable uncertainty estimation depends on the hydrographer's expertise and due diligence.

Hydrographic Survey Uncertainty Estimation (using HYPACK software)

While *a-posteriori* uncertainty information is preferred, the IHO allows the combination of *a-priori* and *a-posteriori* uncertainty for the final uncertainty values (International Hydrographic Organization, 2020). *A-priori* uncertainties are usually the instrument specifications, while *a-posteriori* uncertainties are the uncertainties of field measurements. Various hydrography software offers different interfaces for estimating the TPU, though the concept remains the same.

HYPACK can generate a graphical estimate of uncertainty for a certain depth value for the entire swath angle of a multibeam transducer. This information, when derived using *a-priori* uncertainties, partially satisfies the requirements of Section 2.6 of IHO S-44 6th edition to prove the survey system's capability to meet the uncertainty requirements of a survey.



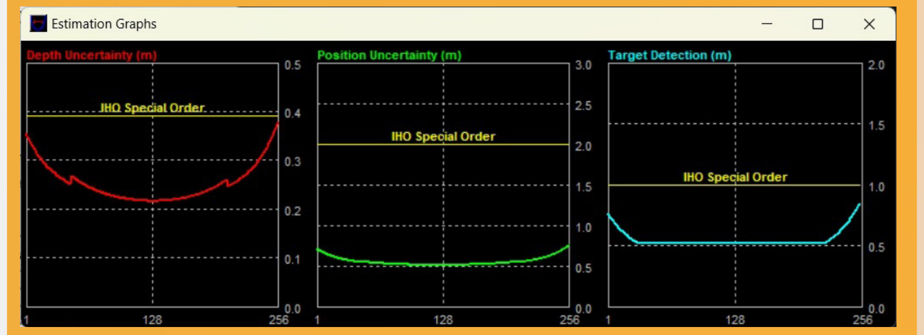


Figure 8. *Estimated IHO S-44 Special Order survey compliance at 40m depth*

When using only *a-priori* information, the graphical display is insufficient to prove the survey's compliance with the IHO horizontal and vertical uncertainty requirements. In practice, the uncertainty profile is created to calculate uncertainty values per sounding. The overall multibeam survey may consist of hundreds of millions of soundings - hence, additional analysis is required to determine the overall bathymetric uncertainty.

Programming languages like Python can be used to analyze the overall uncertainty for the entire hydrographic survey and to determine whether the survey met the IHO, NAMRIA Standards for Hydrographic Surveys (NSHS), or specific client requirements. In this article, a Python code was written to calculate the best-fit quadratic regression curve for the total vertical uncertainty (TVU) vs depth plot and total horizontal uncertainty (THU) vs depth plot at two standard deviations.

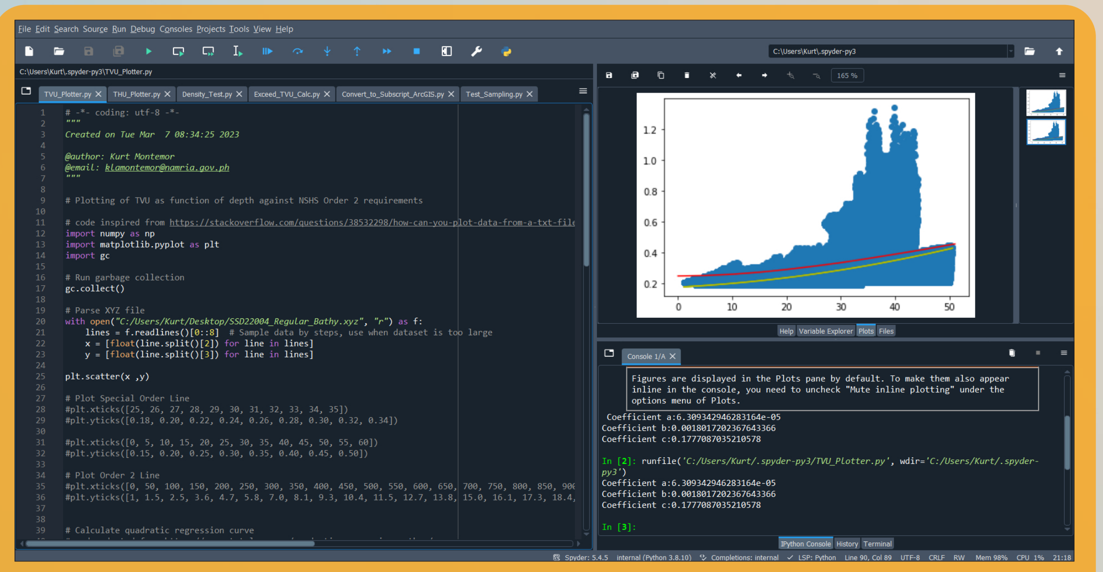


Figure 9. *Use of Python program to calculate uncertainty functions, and check against IHO/NSHS limits*

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Uncertainty... *from page 23*

NAMRIA Hydrography Branch's Uncertainty Estimation Example

In one of its surveys conducted in 2022 along the west coast of Subic Bay, the field survey team applied the HGM Model to propagate the uncertainty to individual soundings. There were 266,828,098 processed soundings used to estimate the final horizontal and vertical uncertainty functions and check against the IHO/NSHS Special Order survey limits.

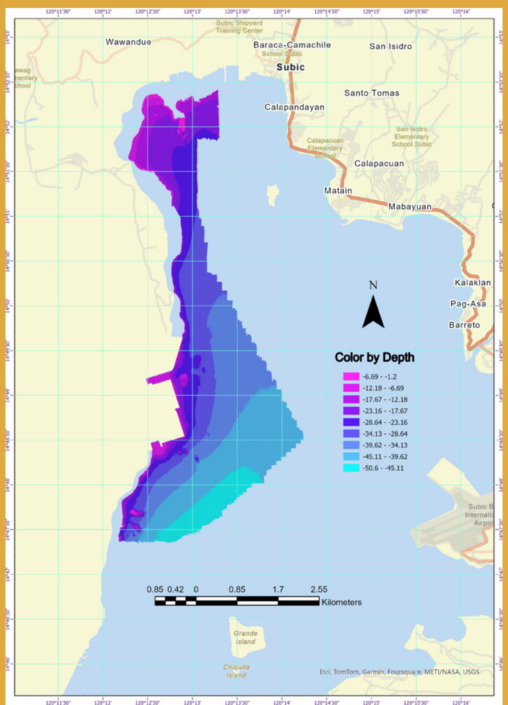

Figure 10. *2022 West Coast of Subic Bay Survey*

The *a-posteriori* uncertainty sources were obtained from processing field-collected data, while the *a-priori* uncertainty sources were obtained from instrument specifications and/or from communication with the manufacturer.

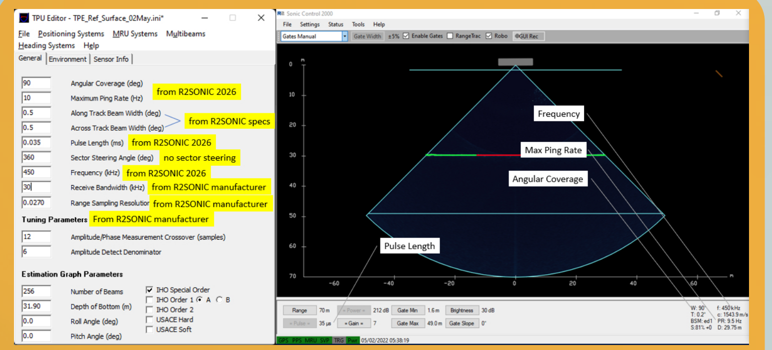

Figure 11. *Example multi-beam a-posteriori information source*

Figure 12 shows a simplified process workflow for uncertainty estimation and analysis:

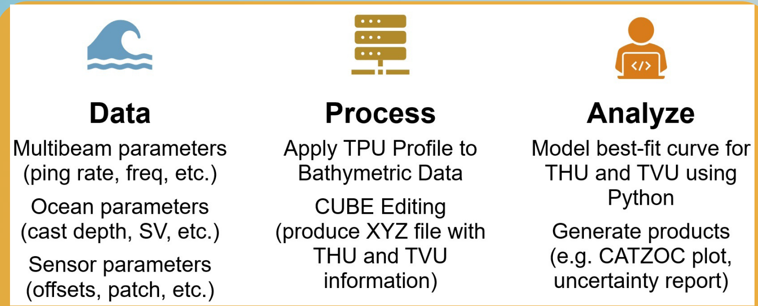

Figure 12. *Simplified uncertainty estimation workflow*

Once the uncertainty has been propagated per individual sounding, the point cloud is run through a Python code to determine a quadratic regression best-fit curve and generate the uncertainty function at 2-sigma for both the THU and the TVU of the survey. The processed soundings were analyzed to generate the propagated uncertainty functions (33,353,512 of 266,828,098 processed soundings were used).

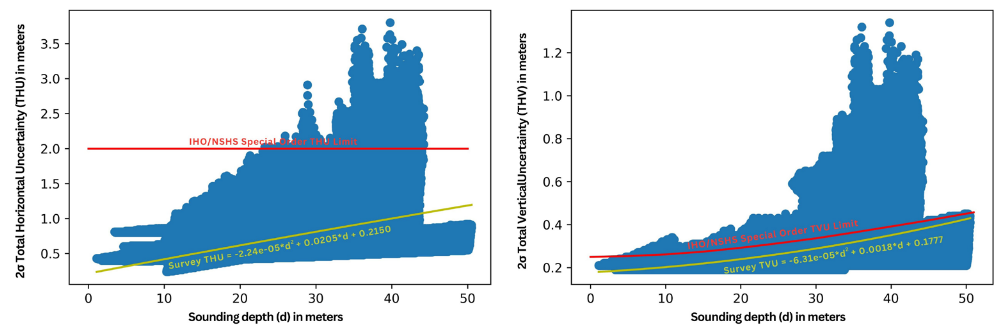

Figure 13. *Survey THU (left) and TVU (right) plotted against the IHO/NSHS Special Order limits*

Based on the analysis of the propagated uncertainty, it was concluded that the abovementioned survey has met the IHO/NSHS Special Order limits for total horizontal and total vertical uncertainty. There are other requirements the abovementioned standards have set in order to fully qualify the survey as Special Order and those have been met. However, for purposes of brevity, those will not be discussed in this article.

Accurate assessment and quantification of measurement uncertainties in hydrographic surveys are vital in ensuring precise results. By employing various uncertainty models, hydrographers can effectively combine and propagate different sources of uncertainty to determine final values for individual depth measurements. It is essential for hydrographers to thoroughly understand and document different sources of uncertainties during hydrographic surveys; including platform, sensor measurement, environment, integration, and calibration, to ensure the reliability of collected data. Integration of uncertainty estimation tools into hydrographic survey software, alongside adherence to the standards outlined in the NSHS guidelines, enables hydrographers to enhance the quality of their survey data and fulfill survey requirements. The expertise and due diligence of hydrographers in uncertainty estimation play a pivotal role in enhancing the accuracy, reliability, and compliance of hydrographic surveys, ultimately contributing to better decision-making processes and outcomes in marine mapping and navigation.

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Innovations in Resource Assessment and Mapping: Exploring Web Mapping Applications and Artificial Intelligence (AI)

Montoya, CM., Borlaza, RAE., Perdido, MTMD.

Mapping has progressed from manual/traditional surveying to precise survey instruments, and from analog to digital mapping. New techniques for data gathering, processing, and visualization are made possible by the use of the global navigation satellite system (GNSS), remote sensing (RS), and geographic information systems (GIS). With the growing demand for accurate, timely, and relevant geospatial data, the Resource Data Analysis Branch (RDAB) has been imposed on the challenge of employing advanced technologies for resource assessment and mapping, one of the core functions of the National Mapping and Resource Information Authority (NAMRIA).

The branch is comprised of four divisions, namely: 1) Land Classification Division (LCD), 2) Land Resource Data Analysis Division (LRDAD), 3) Geospatial Integration Division (GID), and 4) Physiography and Coastal Resources Division (PCRD). Forestland evaluation and mapping fall under the purview of the LCD; LRDAD is responsible for land cover mapping; the GID is in charge of environment and natural resources (ENR) data integration for mapping of existing land uses; and the PCRD is responsible for coastal resource assessment and mapping. The datasets produced by RDAB are vital inputs for local and national planning and development, disaster risk reduction, policy development, and climate change mitigation.

Aligned with the NAMRIA 2021–2028 Strategic Plan (NSP), RDAB employs advanced remote sensing and land surveying technology to produce quality ENR data. Its strategies include the acquisition of the most recent GNSS survey and information and communications technologies (ICT) equipment, investing in human resource competence, and strengthening linkages through partnerships with local government units (LGUs) and stakeholders. Furthermore, RDAB has been actively exploring various innovative technologies, such as web mapping applications and artificial intelligence (AI), to optimize workflow, increase efficiency, and enhance the delivery of products and services.

Utilizing the Web Mapping Capabilities of ArcGIS

During the last decades, significant web-related developments in mapping have been observed. Through different innovations, the number of online maps, the construction of virtual globes for a worldwide community, and interactive Web 2.0 technologies have been profoundly changed. Web mapping has quickly evolved as a highly dynamic and interactive mapping experience (Veenendaal, 2015).

In NAMRIA, ArcGIS Online and ArcGIS Enterprise are the web-based products currently used for web mapping.

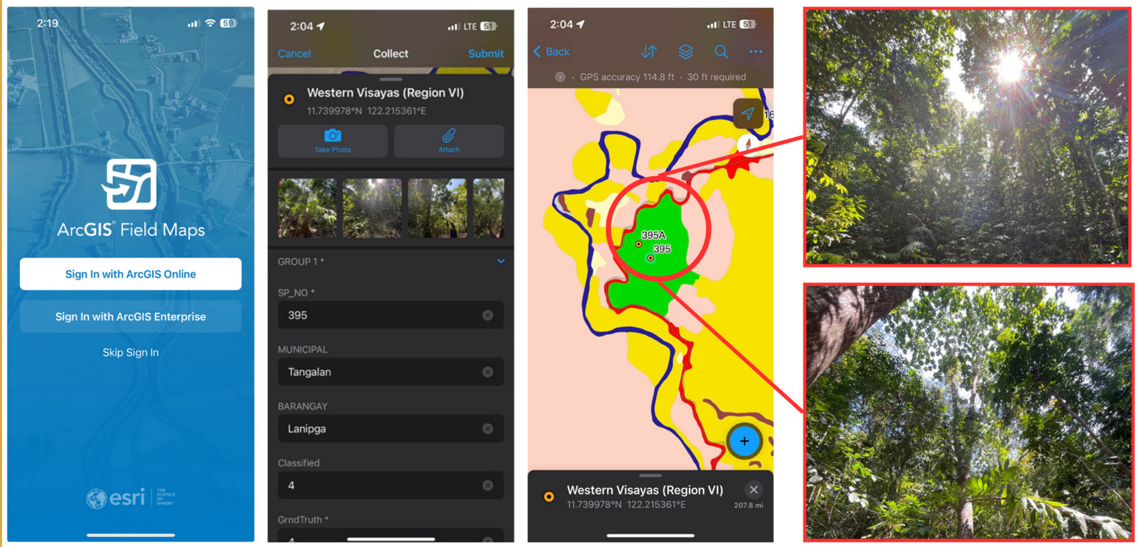

Figure 1. *ArcGIS Field Maps interface and actual use during the field validation of preliminary land cover map*

These products allow users to create, share, and use various maps, apps, scenes, layers, analytics, and data. In 2022, RDAB started to create web maps and identify useful web apps for resource assessment and mapping. As defined in ArcGIS Developer Glossary, a web map is "a map stored as a JSON object that defines map properties" while a web app is "a mapping, analysis, or data-driven application that runs in a web browser."

Initially, RDAB explored ArcGIS Field Maps, a mobile application that allows customized map viewing, data collection, markup of preliminary sampling points, and navigation while conducting field activities. This mobile application was pilot-tested by LRDAD for their land cover mapping project and has been used during the field validation activities. This application features easier data entry, such as smart forms, the capture of photos and videos, and the updating of information on multiple features simultaneously (Figure 1). In 2024, the GID, PCRD, and LCD followed suit in the pilot testing of this application.

Another ArcGIS web mapping application being used now in RDAB is the Site Map, a tailored web page experience for users to help share GIS data with other departments and stakeholders easily. Using the ArcGIS Experience Builder, Site Maps for the Land Cover Mapping Project and Coastal Resource Mapping Project were

Figure 2. *The landing page of the Land Cover Mapping and Coastal Resource Mapping Site Maps*

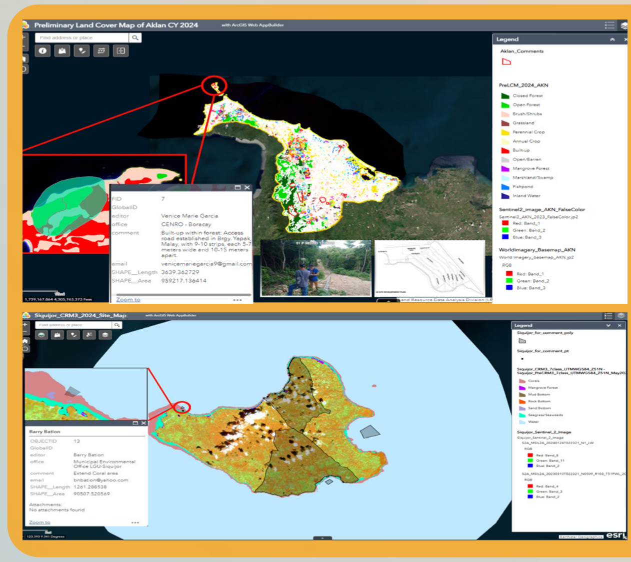

Figure 3. *Web Maps are accessed through the Site Maps where stakeholders provide comments on the preliminary maps*

Figure 4. *Use of Site Maps and Web Maps during output presentation with various stakeholders*

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Innovations... *from page 27*

developed by the Geospatial Database Management Division (GDMD) of the Geospatial Information System Management Branch (GISMB) in 2023 and 2024, respectively. These Site Maps have links to web maps per region where clients/stakeholders can comment on the preliminary maps and provide additional data. The LRDAD and PCRD introduce these Site Maps to the different stakeholders during their output presentation activities (See Figures 2-4).

To fully maximize the capabilities of the ArcGIS web mapping applications, several capacity buildings were conducted by RDAB in collaboration with the Geomatics Training Center (GTC) and GDMD, both of GISMB. The development of Site Maps for the GID and LCD for their respective projects is also underway. For continual improvement, more web apps, such as StoryMaps, Survey123, and Dashboard, will be explored to enhance and complement the current resource assessment and mapping workflows.

Research on the use of AI in Land Cover and Coastal Resource Mapping

The development of AI led to a worldwide study of new techniques for mapping natural resources and comprehending their distribution and utilization patterns. Deep learning algorithms are being used to automatically classify features from massive datasets (Liu et al, 2018 as cited in Zaabar, et. al, 2021).

For the past years, RDAB has been exerting efforts on research regarding the application of AI in resource assessment and mapping, particularly in land cover and coastal resource mapping. The main goal is to shorten the current 5-year updating cycle of land cover maps and coastal resource maps into a 2- or 3-year cycle. Achieving this would allow NAMRIA to provide its stakeholders with more updated datasets of the country's natural resources for programs and policy formulations. In 2020, the Department of Science and Technology - Advanced Science and Technology Institute (DOST-ASTI) conducted capacity building on Artificial Intelligence for Earth Observation (AI4EO). Through this, an in-house research activity was started by LRDAD and PCRD in 2021 in collaboration with DOST-ASTI. Several land cover classes, including mangrove forests, built-up, wetlands, and open/barren, were the focus of the research. Training samples were created by the research team and were processed using the AI Object Detection application developed by the DOST-ASTI via the Computing and Archiving Research Environment (COARE) facility.

In 2022, LRDAD and PCRD explored the deep learning capabilities of ArcGIS Pro, a full-featured professional desktop GIS application from Esri. This time, the research focused on classifying built-up areas, vegetation, mangrove forests, corals, and seagrasses. The Convolutional Neural Network (CNN) is applied to extract potential spectral and spatial satellite imagery features essential in land cover and coastal resource classification. Using Sentinel-2 satellite images from the European Space Agency (ESA) as input raster, training samples were created and used to train a model that classified the selected land cover and coastal resource classes. The ArcGIS Image Analyst extension of ArcGIS Pro was used to perform the entire deep learning workflow with imagery. Four geoprocessing tools which include training samples manager, export training data for deep learning, train deep learning model, and classify pixels using deep learning were utilized for the whole process.

This research process was continued in 2023 where segmented training samples, created through Object-Based Image Analysis (OBIA), were included as another variable of the research. Segmented training samples were used and compared to manually digitized training samples. A model for built-up, forests, inland water, mangrove forests, corals, and seagrasses was trained and created. Promising results were observed as this research progressed, especially in the case of mangrove forests. However, with the limited time frame of one month per year, a lot of refinement on the training samples and fine-tuning of the settings in training the models are still needed.

An executive course on Research, Development, and Extension (RD&E) was implemented to further support the conduct of research among the branches of NAMRIA. The program ran a six-month course from January to June 2024. The RDAB research team maximized this opportunity to focus on mangrove forests as it has shown the most promising results in the previous in-house research. Sample results of the trained AI model for mangrove forests have shown significant improvement (Figure 5). The final results of this study are expected to be presented and/or published this year.

Aside from these in-house researches, RDAB has also been actively creating linkages with other agencies and organizations through various collaborations in the use of AI for land cover and coastal resource mapping. The upcoming capacity buildings from these collaborations are very timely for the Land Cover Mapping and Coastal Resource Mapping Project as the current updating cycle will end in CY 2025. Together with the results of the in-house research, NAMRIA RD&E, upskilling in RDAB through these capacity buildings will make the transition to AI-employed mapping methodologies possible. Thus paving the way for more up-to-date maps suitable to the demands of a technologically advanced society.

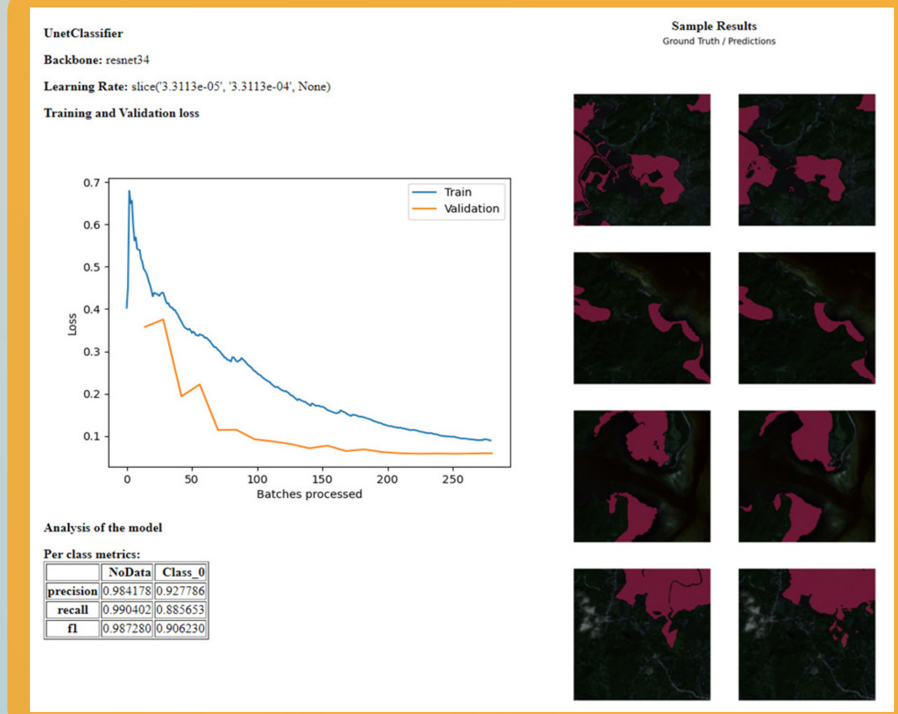

Figure 5. *Sample results from the model metrics of a trained AI model for mangrove forest using the Deep Learning (Image Analyst) tool in ArcGIS Pro show that the ground truth and predictions of the model are greatly similar. This means that the AI model was able to classify most of the mangrove forest in the satellite image (Sentinel-2).*

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Innovation in a Crisis:

Supporting the COVID-19 Response through Geospatial Information and People Strategy Innovations

Administrator Tiangco during the 14th Investors in People Concourse

Did you happen to visit our website, namria.gov.ph? If not, may I invite you to do so and explore its contents. In the lower left corner, you can see a map with a header entitled COVID-19 on Map.

This is a recently developed app which we call the COVID Map App. It aids the national government and the general public to better understand the COVID-19 case information in the Philippines and to disseminate the pandemic statistics geographically through maps.

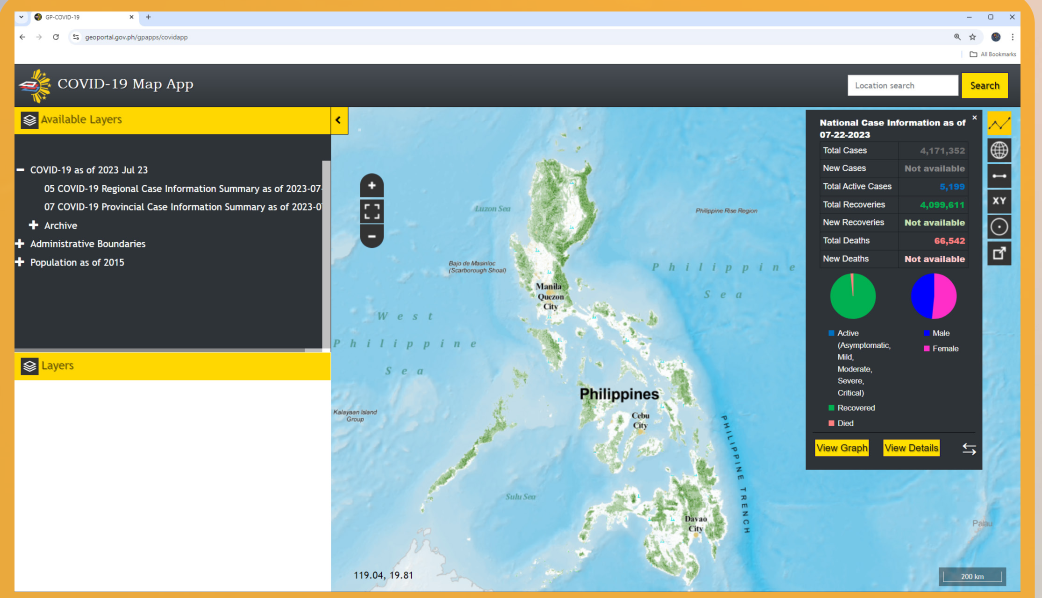
The COVID Map App is a collaborative project between the National Mapping and Resource Information Authority (NAMRIA) and the Department of Health. It is a basic functional online geographic information system. It features a collection of up-to-date digital maps and geospatial data on COVID-19 case information in the Philippines, at the national, regional, provincial, and city/municipal levels. Included in the App are health status and sex-disaggregated data on patients as well as the location of licensed testing laboratories. Concerned authorities use the App information in formulating plans and instituting measures to combat the spread of the virus.

The COVID Map App is accessible to the public through Geoportal Philippines, a web mapping portal service that provides a system for sharing of and access to geospatial information using one common multiscale basemap.

Did you know that our team of in-house developers created the COVID Map App? Talk about innovation in a crisis! These are the same people who made a robust portal where we can access 31 information systems in support to the agency's human resource processes and technical operations.

More so, all at or above 2019, we produced 2,320 maps, 36 charts, with a 100% client satisfaction rating for our products and services. We are proud of the dedication and commitment of our people to public service despite the pandemic greatly affecting the agency's continuity and our people themselves.

Our projects are survey-intensive and require fieldwork for data gathering, validation, and completion for the production of maps and charts, thereby exposing our people to COVID-19.



The COVID Map App

We had 23 positive cases at the end of 2020 and this number quadrupled at the second semester of the year. Sadly, we have already had three mortalities as of last month; thankfully, we do not have an active case as of this month.

Indeed, the pandemic has a staggering impact in the way we keep our agency functioning and in the strategies that we implement in leading and managing our people. It has forced us to reexamine the way we do things and how we interact with each other.

Let me share with you some of these practices which spurred innovation in delivering our products and services and improving our operations while working safely and productively in a hybrid work arrangement. These practices are repurposing resources, providing supportive mechanisms, fully embracing digital transformation, and retooling the mindset.

First is repurposing resources. At the onset of the pandemic in 2020, the agency grappled with a tightened fund resource which had to be balanced with the implementation of its targets and the protection and safety of our people.

With the adoption of economy measures in the government due to the emergency health situation, we had to cope through:

- Strict monitoring of project implementation and fund utilization through the conduct of physical and financial performance reviews to ensure that targets are met in accordance with the timetables specified in the General Appropriations Act and agency work and financial plan;
- Formulation and implementation of catch-up plans;
- Holding virtual consultation as much as practicable for some activities/projects;
- Strengthening the ICT infrastructure to adapt to the new normal situation and focusing on the delivery of the agency's products online
- Strict implementation of minimum health protocols and preventive measures against COVID-19.

Second of the practices is providing support mechanisms under our Morale and Welfare Program. At the early part of the pandemic, we (1) implemented health and psychosocial interventions as well as alternative work arrangements; (2) provided appropriate personal protective equipment, handwashing and sanitizing areas, and COVID-19 supplies and materials; (3) conducted anti-flu vaccination program; and (4) provided reasonable transportation facilities/shuttle services and housing quarters within the office premises to employees assigned as skeleton workforce, while working within budgeting, accounting, and auditing rules and regulations.

We also issued agency policies for the (1) adoption of precautionary measures in response to the COVID-19 threat; (2) adoption and implementation of alternative work arrangements with a combination of skeleton workforce and work-from-home schedule depending on the community quarantine restrictions; (3) implementation of guidelines in the management of reported COVID-19 cases in the organization; and (4) implementation of guidelines in the procedure for borrowing equipment and requesting access to servers during work-from-home alternative work arrangement.

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In Focus... *from page 31*

Through these support mechanisms and policies, we maintained our people's health and wellbeing, offered them flexibility on how to work and deliver their work on time, and ensured the availability of IT resources and equipment for our people's home office to help them work efficiently.

This year, NAMRIA is continuing to provide support mechanisms to COVID-19 cases such as:

(1) Reimbursement of the cost of the rRT-PCR testing of a confirmed, close contact (1st level/A), and indirect contact (2nd level/A1) cases in workplace-related instances of exposure;
(2) Supportive and emergency care to employees, which include appropriate PPE, antipyretics for fever, oral fluids for hydration, transportation or ambulance service for transfer to hospital or temporary treatment and monitoring facility, pulse oximeter, digital thermometer, blood pressure monitor, and the like;
(3) Access to telemedicine services through health maintenance organization, in partnership with the Organization of NAMRIA Employees, with emphasis on the effectiveness of prevention and treatment measures as well as early screening, testing, and treatment;
(4) Transportation of suspect, probable, confirmed, and recovered cases going home or facility-based isolation/quarantine and vice-versa;
(5) Mental health and psychosocial support;
(6) Engineering controls such as proper ventilation for workplaces and shuttle services, visual cues, and barriers;
(7) Communication of vital COVID-19 information and resources through the agency website and email system;
(8) Use of leave benefits and facilitation of entitlement to compensation and benefits as well as assistance in case of COVID-19-related death;
(9) Establishment of dashboard/bulletin for monitoring of agency COVID-19 cases and vaccination status; and
(10) Promotion of active use of transport to work, such as bicycle use.

We also established linkages with the City Government of Taguig for the vaccination of our employees and the Subic Bay Metropolitan Authority for the quarantine of our survey vessel crew in a temporary treatment and monitoring facility. We even provided full logistical support for the transportation of our people to and from vaccination sites.

Through their self-initiative, our people also have recently established NAMRIA Active, a group of health and wellness advocates among the agency's community. This is a platform that would facilitate and motivate NAMRIAns to improve their physical and mental well-being by encouraging them to engage in physical activities.

The third practice I would like to share with you is about fully embracing digital transformation. Through digital technologies, we were able to provide platforms for virtual interaction between managers and team members for virtual team meetings, check-ins, and feedback and coaching sessions; create formal groups to communicate continuously about managing work from home and supporting our people; and use group SMS service for sending messages to teams and peers.

We were also able to hold virtual liturgical and ecumenical activities; webinars and virtual sessions on fitness and health talks; and virtual celebrations such as agency anniversary, civil service anniversary, and personal milestones.

We also continued the operation of our NAMRIA Day Care Center through online classes, which forms part of our support mechanisms for our employee parents.

Through online meeting platforms, we strategically shifted one of our high-demand frontline services, the conduct of geographic information system training, from traditional classroom instruction to online or virtual GIS training. We also conducted online training on basic hydrography and webinars on Mapping of Safe Open Spaces and Critical Lifeline Facilities and The COVID-Map App: Tracking and Visualizing the Pandemic Numbers in the Philippines.

Digital solutions allowed some form of continuity in our business and day-to-day life during the periods of community quarantine. We leveraged on virtual communication technology and information systems to establish connection with our people and stakeholders and encourage their participation and engagement in our programs, activities, and projects.

The fourth and final practice that I will share is retooling mindsets to gain new skills, to focus on safety measures and healthy work conditions, and to set new directions.

We foster resiliency and innovation through providing learning and development to our people. With our employees in a state of coping with the pandemic – from lacking a stable internet that would make connectivity meaningful at work to working from home as a parent – the need for continuous learning has never been more relevant.

With the transition to a virtual environment, online trainings such as Virtual Communication 101 and On-Screen Impression Management were conducted. Through webinars, we also equipped our leaders in managing and engaging employees virtually, strategies for work-life integration, and managing energy to prevent exhaustion and burnout. Our people were also provided learning and development interventions on work-life balance, understanding mental health, and maintaining wellness and coping strategies after surviving COVID-19.

We explored all areas of learning– workplace learning, formal training, and social learning– and provided innovative fun activities for our employees such as photo story contest, online spoken poetry contest, and vlogging to process their pandemic experience.

These activities helped retool the mindsets of our people to focus on their wellbeing and helped us realize the need to formulate and implement the NAMRIA Mental Health Program as well as to build our capacity to institutionalize the Occupational Safety and Health Program and Standards for the Public Sector. We are now implementing our mental health program and offering psychological services to our employees through our partner organization. We have also conducted an online training on Basic Occupational Safety and Health also through a partner organization.

The past months have been especially difficult for us due to COVID-19 restrictions. But with the dedication of our leaders to set and adjust the agency's direction in response to a changing environment and the active engagement of our people in long-term planning, we were able to update our strategic plan to focus our priorities on and to strengthen our operations.

We undertook a strategic planning process this year which redefined our strategy map, strategic position, roadmaps, and scorecards. Our 2021-2028 Strategic Plan reflects the agency's strategic shift and future considerations in response to the continuously changing trends in technology to meet our stakeholders' expectations.

Repurposing resources. Providing support mechanisms. Fully embracing digital transformation. Retooling mindsets. These are the reasons why we were able to innovate—just like the COVID Map App and pivot in the time of the pandemic. These strategies resulted in our significant accomplishments and transformed us into a resilient organization that it is today. We have now become savvier in using resources and digital technology, wiser in taking care of our wellbeing, and more committed and engaged in delivering our services to our stakeholders.

We rose amidst the crisis and we were able to pursue our direction as a people and as an organization. We even have achieved a three-year ISO 9001:2015 Quality Management System recertification just this August and are set again to be recognized in the 2021 Freedom of Information Awards this November 25 as one of the awardees under the FOI Champion for Agencies/Bureaus/Commissions/Councils Category.

Despite the challenges of the pandemic, we maintain an optimistic outlook, taking into account the individual potentials and the collective strength of our resources in order to innovate and achieve the agency's mandates in the years to come.

Thank you.

*The TED talk was delivered by NAMRIA Administrator, **Usec. Peter N. Tiangco, PhD, CESO I** during the 14th Investors in People Concourse, virtually conducted on 12 November 2021. Entitled "Thriving through Agility," the event was held for organizations to share their leadership innovations with the public.*

PROFILE

Empowering NAMRIA Women in Hydrographic Survey and Innovation: A Transformative Journey Towards Gender Equality

Habitan, JT.

The hydrographic survey career field faces a significant gender disparity worldwide, with only 10% of the 99 member states of the International Hydrographic Organization (IHO) having female hydrographers (IHO, 2024). The IHO is the leading global hydrographic organization that collaborates with coastal countries in promoting maritime efficiency, safety, preservation, and sustainable use of the marine environment. Its mandate is to ensure that all seas, oceans, and navigable waterways are surveyed and mapped.

The National Mapping and Resource Information Authority (NAMRIA), aside from being the central mapping agency of government, is the National Hydrographic Office representing the Philippines in the IHO. It recognizes the roles of woman-hydrographers with equal capacities to men following the enactment of Republic Act No. 7192, otherwise known as the Women in Development and Nation Building Act. The Act directs all government departments to review and revise all regulations, circulars, issuances, and procedures to remove gender bias. Based on the provisions of Department of Environment and Natural Resources (DENR) Administrative Order (DAO) 31 Series of 1988 or Guidelines Implementing Executive Order No. 192 and DAO 2000-54 or Amendment to Section 10.2 DAOs 31 Series of 1988 signed by then DENR Secretary Elizea Gozun, the then Coast and Geodetic Survey Department (now Hydrography Branch) of NAMRIA started accepting women in the Commissioned Corps of Officers. NAMRIA started accepting women commissioned officers (COs) in 2004, where five young women successfully surpassed the rigorous screening procedure. Currently, there are 20 female and 39 male COs.

CDR Lerio in full naval uniform

To ensure our new woman-COs' smooth way in, knowing that hydrographic surveying is considered a highly specialized field that requires a deep understanding of the job processes and map outputs, the participation in multiple specialized trainings on data acquisition, precise positioning and leveling (locating horizontal and vertical control and sounding) including data processing became necessary. These training programs on technological advances and innovations in bathymetric mapping opened new challenging roles in both technical and supervisory spheres.

CDR Lerio at an event organized by Geoscience Australia

CDR Lerio speaks during the Workshop on Enhancing Safety of Navigation with Maritime Digitalization held at Daejeon City, Republic of Korea.

The path of **Commander (CDR) Lorena Jasmin Daniolco Lerio**, as one of the pioneer woman-COs and the first woman officer to reach the rank of Commander, is considered one of the most significant journeys of women in the Philippine hydrographic survey history. She joined the uniformed corps in July 2008 as a Probationary Ensign. She experienced both ship and land-based assignments and became the Deputy Staff for Comptrollership and Chief of Operations Support from November 2015 until 2019. As a comptroller, she successfully persuaded the Hydrography Branch (HB) management to push for stricter fiscal policies, training modules for COs on government budget management and procurement, and interventions for improved competencies in operations support. Consequently, this increased budget spending and utilization of the Branch has paved the way for the current Logistics Management Section, which implements systematic and collaborative budget management and a clear capacitation and succession program for business continuity.

In 2020, she successfully completed her Master's Degree in Development Management conferred by the Development Academy of the Philippines. Her capstone project was an effort at innovation through the Online Maritime Safety Information System (OMSIS). The institutionalization of the OMSIS provided the public with efficient and convenient access to organized chart corrections. To date, the OMSIS has a total of 29,509 hits and is continually increasing in number of subscribers and users. She envisions that the OMSIS will soon become a single platform for hydrographic information. With this success, she was assigned as the Deputy Chief of the Survey Support Division, HB in the same year.

CDR Lerio became the Chief of the Maritime Affairs Division (MAD) - HB in 2022 where she has been managing the delivery of maritime spatial and safety information services, the production of nautical publications, the undersea feature naming, and the mapping of maritime zones and boundaries. In the same year, she successfully completed her post-graduate Diploma in the Law of the Sea conferred by the Yeosu Academy on the Law of the Sea, South Korea.

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Profile... *from page 35*

Outside her usual duties at the HB, CDR Lerio functions as one of the senior NAMRIA Internal Quality Auditors for ISO 9001:2015 and is a member of the NAMRIA Gender and Development (GAD) Focal Point System.

With her remarkable achievements and contributions, this inspiring woman has been making a lot of difference in her undertakings, lauded as a pioneer and the first female Commander leading in some of the gency's crucial responsibilities.

When asked about the organizational efforts to ensure inclusive opportunities and spaces, CDR Lerio surmised that the inclusive policies of NAMRIA have tremendously increased the number of women hydrographers and enabled women participation in many technical trainings, and foreign engagement opportunities. She is proud that woman-hydrographers are at the forefront of instilling strict discipline for uniformed personnel. She acknowledges two other woman-hydrographers leading innovations toward major digitalization projects. These women are Lieutenant Junior Grade (LTJG) Clarizza Mae B Biong, who took the lead for S-101 implementation, and Lieutenant (LT) May Anne L Javier for the institutionalization of the mobile application for PH Tides. The S-101 is being adopted as a standard in the production of electronic navigational charts that are being used in the Electronic Chart Display Information System (ECDIS). The PH Tides application provides users with information on the times and heights of tides at various sites in the country where users can use it to organize and plan their activities around the tides, ensuring safety and optimizing time spent in or on waters. It is useful not only for individuals whose livelihoods rely on the tides but also for anyone interested in the ocean and its ecosystems which may include the protection and maintenance of our coasts and their inhabitants. The innovations that our woman-COs successfully implemented are just plain remarkable considering the unique journeys they had to take into the field of hydrography.

While CDR Lerio is proud of the many achievements of NAMRIA and the uniformed corps in this aspect, she recognizes that the lack of resources continues to challenge the effective implementation of hydrographic services including the sustained capacitation of personnel. So far, there are only two women in the service with Category B Certifications in Hydrography, none with Category A Certification in Hydrography, and only three women with Category B Certifications in Nautical Cartography. The availability of locally-accredited institutions for hydrography and nautical cartography would have increased these numbers but to date, the Philippines is highly reliant on foreign funding and offerings.

NAMRIA's commitment to gender equality influenced a meaningful transformation that will hopefully attract other woman-underrepresented fields to follow. The impact of this advocacy extends beyond leaving a lasting legacy of empowerment, excellence, and an inclusive environment.

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Mobile No: 0961 4552583

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DENR-PENRO Santa Monica, Puerto Princesa City
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DENR-Operation/Survey Division, Rizal Street, Sagpon, Legazpi City, Albay
Mobile No: 0919 8944613

Region VI
Manuel Lagunilla Bldg., DENR Compound, Parola, Iloilo City
(Temporarily Closed)

Region VII
DENR-CENRO Building, Arellano Boulevard corner V. Sotto Street Pier 3, Cebu City
Mobile Nos: 0922 7910372 / 0931 0010341 / 0961 4552579

Region IX
Pres. Corazon C. Aquino Regional Government Center, Balintawak, Pagadian City, Zamboanga Del Sur
Mobile No: 0935 5962917

Region IX
DENR CENRO West, General Vicente Alvarez St., Zone 4, Zamboanga City
Mobile Nos: 0955 8928777 / 0961 4552574

Region X
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Region XI
Kilometer 7, SPED Road, Bangkal, Davao City
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Region XII
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Mobile No: 0909 9324745

CARAGA
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Our Products

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- Land/Forest Cover Maps
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- Geospatial and Maritime Publications

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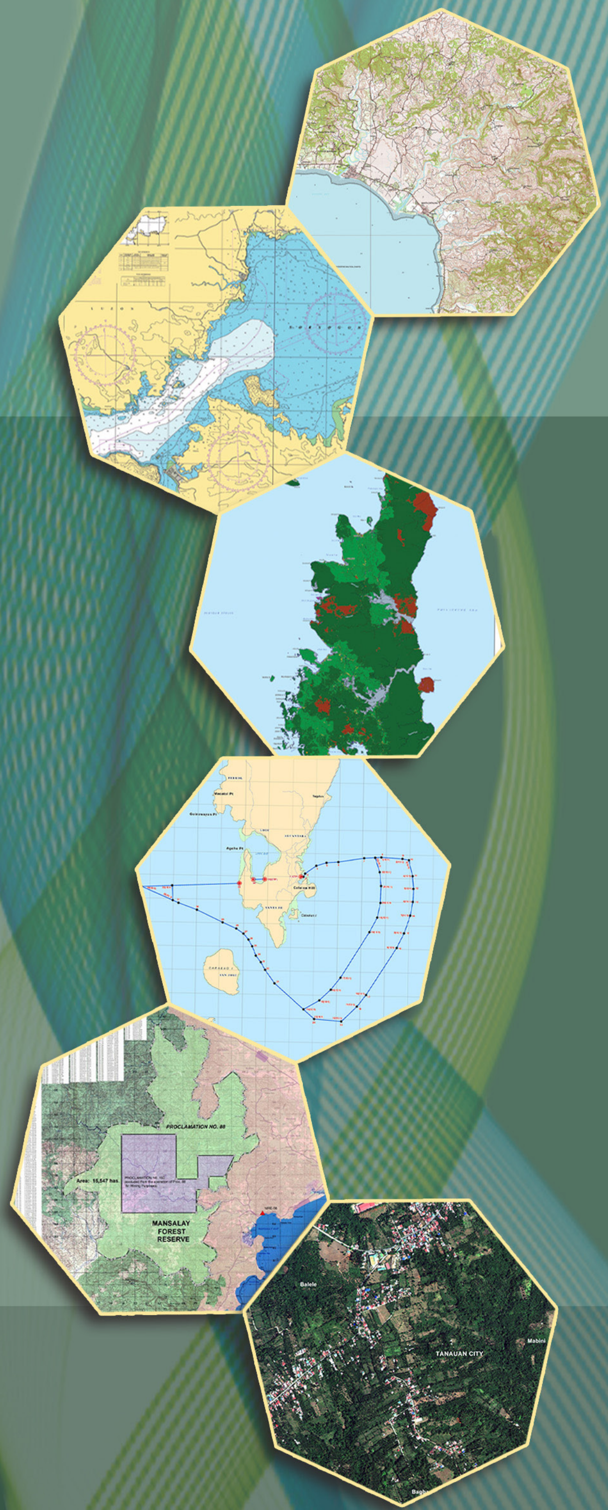
- Physical Oceanographic Surveys
- Geodetic Surveys
- Topographic Mapping
- Geodetic Reference Frame Development and Mapping
- Remote Sensing
- Geospatial Information Management
- Geomatics Training
- Map Sales
- Tour of Facilities

Our Applications

- Geoportal Philippines
- PH Tides
- NAMRIA Mojon Finder PH



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