


Enabling the Geospatial Ecosystem - Policy Considerations for Governments and Industry





On behalf of WGIC, this report was
researched, and authored by:
Lokendra Chauhan

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Background

Knowing what happens where and when is the vital component of understanding the world around us better at the levels of an individual, community, city, nation or planet. Effective evidence-based decision-making or policy-making is not possible without leveraging spatiotemporal information. For governments, the “where” part of the data enables measurement and integration of their efforts to achieve national prosperity and sustainability. With the increasingly pervasive digitization of everything, building integrative mechanisms that leverage the location dimension of data is imperative for effective governance, which translates into citizens’ trust in their government. Therefore, the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) has developed the Integrated Geospatial Information Framework (IGIF)¹ to provide strategic guidance to assist the development and implementation of country-specific action plans for managing all geospatial information in an integrated and inclusive manner.

As an important stakeholder responsible for actual implementation and realizing the geodata-enabled future, the geospatial industry is conscious of its responsibilities and excited about the opportunities presented by the exponential growth in spatiotemporal data. The trends are clear. We are heading towards a future where every small change in our physical environments would get measured directly through sensors or indirectly through remote sensing. Additionally, vast amounts of user-generated data are created through interactions with the systems and each other at different places. These make our world a complex super-system with multiple dynamic sub-systems (regionally and relationship-wise) that interact and affect each other differently. The exponential growth in data further increases the modeling complexity. Additionally, the focus must be on resilience, whether we want to model urban mobility, environment, soil health, supply chains, healthcare, or markets. The enabling technologies of this 4th industrial revolution are digital twins, the internet of things (IOT), artificial intelligence (AI), 5G, and earth observation – maturing fast to assist humanity in achieving its goals.

The unprecedented pace of technology change is transforming how individuals and groups across society live, work, and interact. Governments are increasingly recognizing the need for new principles, protocols, rules, and policies to align technology development with sustainability and inclusive growth while mitigating the associated risks. The UN Sustainable Development Goals (SDGs) Agenda is the north star, and initiatives like IGIF help countries align with and move in a specific direction.

On the other hand, policymakers are realizing the existing policy devices and methods are asynchronous and would soon become obsolete. Therefore, agile policy development and governance are being promoted to live up to the needs and expectations of 21st century citizens, who increasingly believe that the private sector and non-profits can also take the lead by acting responsibly before the policy process catches up with the technological progress. Recognizing this demand-driven push and the need for diversification in governance and regulation, the World Geospatial Industry Council (WGIC), a not-for-profit trade association, has been commissioning studies that identify how the private sector can support the governments e.g. proactive self-regulation to enable agile policy development.

In the last four years, WGIC has conducted policy research and published reports on geospatial data economy, data privacy issues, resilient infrastructure, public-private partnerships, geospatial AI (GeoAI), digital twins, and greenhouse gas monitoring from space. The objective has been to facilitate the exchange of knowledge within the geospatial industry and share their perspectives with governments, multilateral agencies, and other relevant bodies. WGIC's in-depth research on these topics covered a policy scan of all applicable legislation and policies around the globe along with recommendations for industry and governments on how to move forward. Effectively, the WGIC's policy work complements IGIF's efforts in a piecewise manner. Geospatial professionals from around the globe are consulted for all WGIC research reports to ensure the real implementation challenges are not missed out. WGIC recommendations to companies favor starting with voluntary self-regulation in the absence of regulatory frameworks, being human-centered, and often suggesting specific pilots to test low-cost low-risk versions of policies, enabling timely response to technology change through agile policy development.

The UN-GGIM has been instrumental in ensuring national governments recognize the essential role of geospatial data and technology in government and society. Since its creation in 2011, UN-GGIM has been a platform for developing effective strategies to build and strengthen national spatial data infrastructure (SDI) of the member states. It has underscored the role of governments in creating fundamental datasets and the challenges experienced in integrating data due to siloed organizational structures and inefficient bureaucracy. While technologies have been maturing at a rapid pace and increasingly moving towards seamless decision support mechanisms, realizing their potential requires scalable interoperability across the spatial data infrastructure. To address the SDI interoperability issue, the scientific consensus recommends transitioning from the data supply driven paradigm of SDI towards capabilities for delivering machine readable knowledge-on-demand, or geospatial knowledge infrastructure (GKI), which integrates real-time geospatial knowledge into everyday decision-making for problem solvers.

The Integrated Geospatial Information Framework (IGIF)¹ by UN-GGIM is a holistic model for national SDIs to transition toward GKIs. Building up the data collection capacity of the SDIs, IGIF focuses on the implementation of technology by making the data easily machine-readable in real-time and everywhere. Therefore, IGIF devotes significant attention to developing the geospatial capacities of the governments to deliver on their diverse responsibilities. Beyond SDI, IGIF outlines the role of education, communication, financing, governance, and innovation policies. The IGIF resources guide governments to implement 'nationally' integrated geospatial information frameworks by accounting for the national circumstances, priorities, and local perspectives. IGIF establishes geospatial data as a critical element of national social and economic development via seven underpinning principles, eight goals, and nine strategic pathways that transparently enable sustainable transformational change.

As technology innovation and its adoption has been happening somewhat independently through markets, WGIC policy research has focused on connecting and informing the two worlds of private industry and policy initiatives. WGIC takes up the topics of significant industry or policy interest and does deep dives to bridge the two domains about each other's priorities, efforts, and objectives. These reports recommend how both sides can tackle the challenges together. For example, both the private sector and the policy apparatus are excited about the prospects of digital twins. For this reason, WGIC brought out the Digital Twins report², which details the potential value (including socio-economic value) added by geospatial data to digital twin implementations for governments, industry, and multilateral agencies. It also identifies the prominent use cases and makes recommendations to realize the potential of digital twins - e.g., standards for interoperability, funding models like PPP, and assessing viability and returns on investment. Similarly, WGIC's GeoAI³ and GHG monitoring⁴ reports dig deep into the use cases, policy recommendations, and guidelines on self-regulation. The PPP report⁵ recommends innovative funding mechanisms for impact.

Mapping WGIC Work with IGIF Pathways

This section identifies the WGIC reports which best align with the three IGIF pathways that map strongly with WGIC’s work. The IGIF pathways that directly benefit from WGIC’s existing body of work and future studies are Policy and Legal Pathway⁶, Innovation Pathway⁷, and the Financial Pathway⁸.

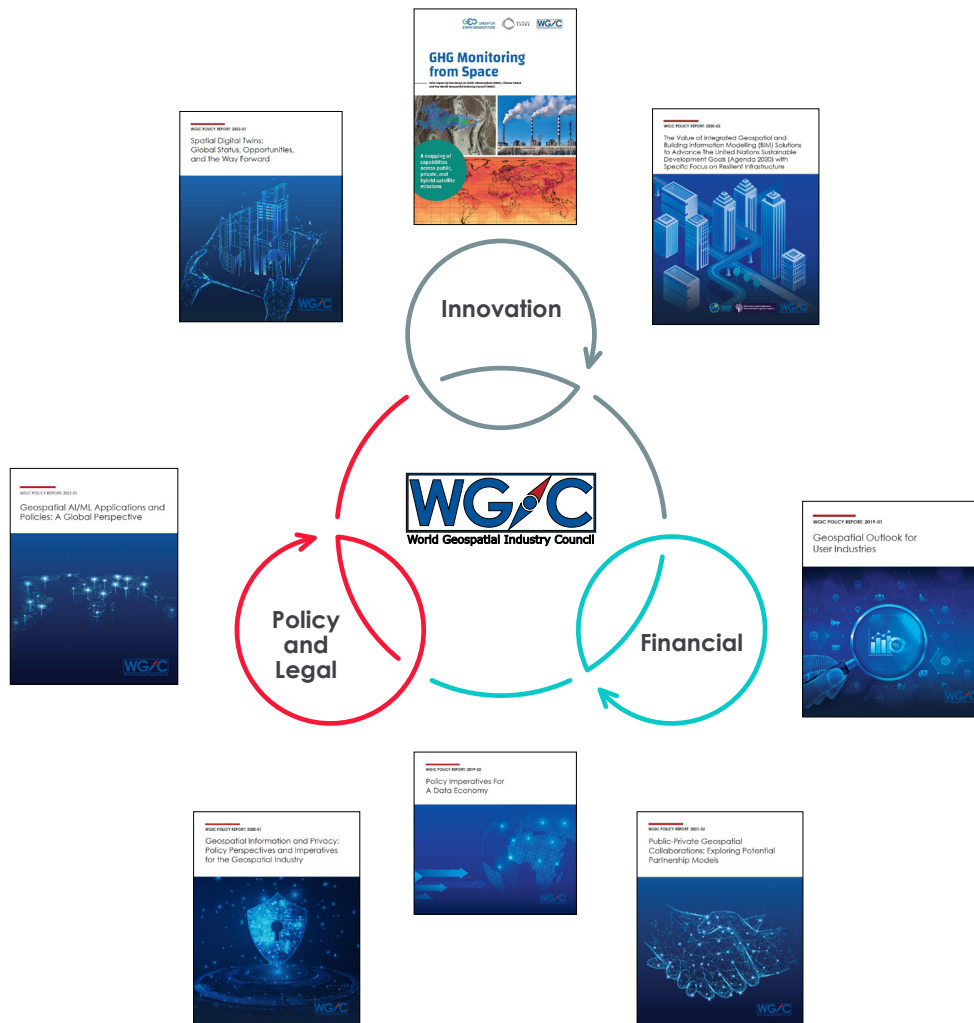


Figure 1: Mapping of WGIC Reports with IGIF Pathways

This mapping will facilitate IGIF with a reliable body of research based on holistic and inclusive stakeholder consultations. Further, this will provide insights that help countries make evidence-based decisions for implementing integrated geospatial solutions.


Policy and Legal Pathway

IGIF recognizes the vital role of robust policy and legal framework in effective and efficient GKI implementation. Governments need policy tools to influence the information and technology landscape for the greater common good. They systematically use policies and regulations to increase the overall supply of knowledge-based products and services in the economy. In the past, technology changes were slow and regulatory efforts were slower and often took decades to catch up with the negative externalities created by new technologies and the associated business models. The fourth industrial revolution enabled by today's technologies pose much greater risks due to the speed and scale at which these technologies get deployed across traditional borders, industries, and nations. Therefore, it is critical to quickly identify the gaps between current regulatory approaches and the rules needed to regulate new technologies and the business models enabled by them. It is apparent that to govern these technologies, we need new methods that are interoperable, inclusive, agile, and don't stifle innovation.



Figure 2: Elements of Policy and Legal Pathway





WGIC's policy research has prioritized these objectives. For example, WGIC proactively monitors legislative activities and policy processes to ensure compliance by keeping its private sector members updated on the existing and anticipated policy landscape in different jurisdictions. Similarly, WGIC makes the policymakers aware of the industry perspective and the policy gaps it identifies based on the evolving technologies and their business models. Additionally, WGIC explores how the geospatial industry can set an example by acting responsibly. It implies self-regulation using globally-accepted norms in cases where no regulations exist.

WGIC reports on Data Privacy⁹ and GeoAI³ presented detailed policy scans and analyses of relevant laws, legislations, and policies around the globe on the topics to help the private sector in compliance. These reports also clarify and present the policy trends to help the private sector prepare for expected regulatory requirements without any loss to future revenues for lack of compliance. For example, the GeoAI report explained the risk-based classification of AI applications that the European Union's then-expected "AI Act" proposed. As no repository of AI use-cases categorized by risk levels existed, the report recommended creation of an open registry of GeoAI use-cases classified by their level of risks of bias and adverse impacts. Similarly, the report on data economy¹⁰ and public-private partnerships (PPPs)⁵ identified the business models that need to be supported through policies to successfully implement IGIF by realizing the full potential of new technologies. The same report assessed countries for the maturity level of their geospatial policies by developing a policy-maturity pyramid framework. The report on data-economy categorizes the countries in four progressive levels starting from the "In-development geospatial governance tools" to "Developed geospatial policy", followed by "Developed geospatial legislation", and finally to the level in which countries have "Integrated geospatial policies and strategies" to represent they have implemented IGIF successfully.

All WGIC policy reports identify and recommend areas where standards could help, and collaborates with partners like Open Geospatial Consortium (OGC). These reports identify the common principles and themes of existing laws, proposed policies, and new legislations to determine the prevailing consensus in the policymaking community. This approach helps organizations prepare for upcoming regulations even in lagging jurisdictions. At the same time, it serves policymakers in lagging jurisdictions by identifying the fundamental principles, ideas, and means to draft new regulations, like having a model concept note to guide the drafting of the actual legislation.

Innovation Pathway

Innovation in emerging technologies enables the creation of new products and services, open up hitherto new market sectors, contribute to growth of existing industries and transform the value chains in ways that deliver greater value to users and consumers. Tracking technological advances and innovation is essential for understanding new possibilities. For example, advances in AI technologies have allowed reimagining the complex skill of driving a vehicle into a set of prediction problems of how other vehicles or persons in the view would act and how to respond in that situation.

This reframing of the problem allowed imagining a future with autonomous vehicles and the emergence of a whole new industry of components, data services, and related business models. Similarly, building information modeling (BIM), greenhouse gas monitoring, and digital twins are all on their path to becoming huge industries. AI innovation, which plays a foundational role in all these application areas, is increasing exponentially. As mentioned earlier, this pace of technology change brings a lot of new challenges for policymakers to strike the right balance in leveraging these technologies without stifling in-

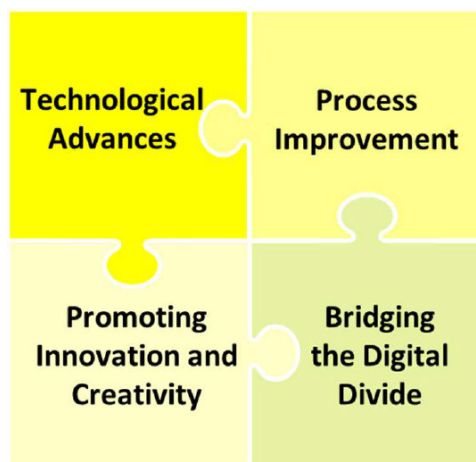


Figure 3: Elements of Innovation Pathway



novation while limiting the risks involved for their citizens and the environment. It is especially helpful to the marginalized communities, which are not represented well in the datasets used for training AI models.

WGIC reports on GeoAI³, digital twins², resilient infrastructure¹¹, and GHG⁴ monitoring provide an overview of the new opportunities, use cases, business models, and how policymakers can build conducive environments for innovation and safe deployments of these technologies within their jurisdictions. They also outline the challenges faced in developing and in the large-scale adoption of emerging technologies. For example, lack of annotated open data covering most edge-cases for training the AI models, interoperability challenges due to lack of standardization, and the dearth of experts to implement these technologies appear to be the most common challenges limiting developing countries, even after the demanding challenges of financing have been overcome.

Technology monitoring priorities based on requests from the geospatial industry make WGIC’s work in the domain much more relevant and usable for the stakeholders. In addition, IGIF’s innovation pathway would also benefit from these studies by getting access to the stakeholder and industry inputs at the level of selecting the study areas and directly through the expert responses received during the consultations conducted for these studies.

Financial Pathway

Financing the SDIs and IGIF at the country level has been limited by the resources available. At the same time, the growth in the value and use of geospatial data for various use cases that are possible beyond the public sector has been astonishing, if not overwhelming. The creation and availability of such geospatial data, combined with new technologies like cloud computing, AI, and broadband, significantly expand business opportunities for small and large businesses. Thus governments can leverage their investments in better delivery of public services with geospatial data (or building SDIs) with additional investments from the private sector through public-private partnerships (PPPs). In fact, due to the culture of open data, interoperability, and open-source collaborations, the geospatial industry

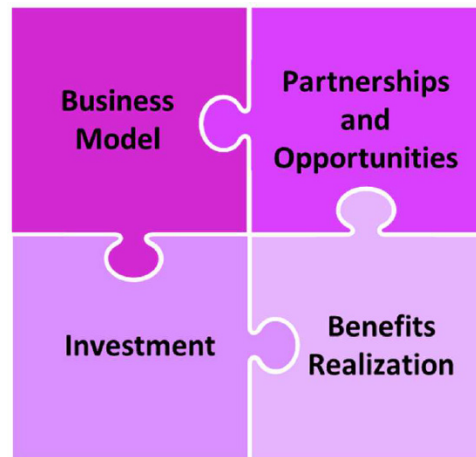


Figure 4: Elements of Financial Pathway

ecosystem is already a conducive environment for new business models like PPPs.

Recognizing the untapped potential of PPPs in the geospatial domain and their benefits to IGIF, the WGIC report, “Public-Private Geospatial Collaborations: Exploring Potential Partnership Models”¹⁵ studied the potential of PPPs in IGIF implementation. The report highlighted that PPP business models could be placed “along a continuum of related models, differentiated by their contractual arrangements, areas of business focus, and procurement arrangements”. The report identified twelve PPP-based business models with unique characteristics and relevance to building national SDIs. It also showcased eight case studies. WGIC will continue its work in identifying and detailing such new business models

Additionally, the WGIC report on data economy¹⁰ recognized how policies could impact the development of business models in an economy. The report on the geospatial outlook¹² for user industries highlights the need and opportunities for new and innovative business models. Additionally, the GeoAI³ report underscored the possibilities for creating new business models by recognizing trained AI models as assets. The UN IGIF High-Level working group has a sub-working group on sustainable finance for the country level action plans. The WGIC report may provide some insights on how PPP could support sustainable financing models. Overall, WGIC’s policy work brings the industry perspective on how IGIF implementation can leverage new and innovative business models at all levels.



Key Recommendations

Emerging technologies such as digital twins, cloud-based data and compute services, and GeoAI are fundamentally changing the applications spectrum and altering the geospatial industry's business landscape. Moving from the paradigm of licensing software that works on-premise to "software as a service" (SaaS) subscription models that allow multiple parties to work on the same data at any time and don't require version updates are enormous changes to grapple with for the implementors. Also, data as an asset has different meanings when we can only query it versus when AI algorithms have learned the rules to model the phenomena and can make predictions without needing to query the same data again. From the IGIF perspective, the frameworks and policies to work with these fast-evolving technologies require an agile approach. In the same spirit, WGIC policy studies consider policy agility of prime importance. As these topics of data, data governance, and technology policies are highly interrelated, even WGIC's recommendations across its different reports have significant overlaps. Therefore, for the sake of brevity and to communicate WGIC's policy approach and positions, we have distilled the following key recommendations based on the various WGIC reports in three groups:

A. Agile policymaking

- **For integrated policy development to achieve SDGs:** As IGIF is a holistic framework that takes implementation challenges into account, it must also stress the importance of striking a balance across government (public sector), standards and regulatory bodies, and industry as well as skilling/training providers to ensure each contributes towards a collectively agreed future vision.
- **Private sector participation in planning national initiatives:** Governments could take the example of UNGGIM including the Private Sector Network (PSN) as part of its ecosystem to bring a diversity of thoughts from the private sector to support the geospatial initiatives of the UN. Examples are, UNSD GKI Alliance project, SDG Alliance. The National Geospatial Advisory Committee (NGAC), USA brings in private sector participation to discuss geospatial initiatives at national level. Similarly, including private sector at the planning stage of IGIF or GKI rollout is critical to source early and useful inputs from them.
- **Encouraging innovation:** During the early evolution of any technology, regulators should trust the innovators and facilitate a conducive environment to spin out innovative applications and solutions. It would be best to not restrict innovation without clearly outlining the reasons and providing supporting evidence.

- **Adopt a staged-gate approach for agile policy making:** When new technologies are abused to violate laws in a jurisdiction, policymakers should first encourage the industry to develop technological solutions to prevent such violations. It should be done through contracts and issuing policy guidance. If such solutions are not feasible while limiting risks, then:
 - Self-regulation should be encouraged through soft-law guidance
 - Conduct contained experiments like regulatory sandboxes.

The experience from these methods would help governments come up with appropriate policies and legislations.

- Drafted legislations should keep maneuvering room for the regulators and empower them to adjust their enforcement approach without breaching the alignment in spirit with the principles of the law. This approach would make the laws agile enough and not become obsolete soon.
- **Ensure interoperability through the adoption of standards for software microservices, data formats, metadata, and annotations:** Standards are vital to building the SDI and SKI at any level because they allow for interoperability and vendor independence. Furthermore, for developers and users of geospatial software, it provides a common language and means for transacting. In the case of data, standardized formats reduce the friction in conducting various analyses. Additionally, for AI algorithms, the value of the data is derived mainly from the annotations and metadata. Therefore, ensuring that there are universally accepted, clear, and comprehensive metadata standards is critical.
- **Right to self-determination for privacy:** Geospatial data can be analyzed to derive personally identifiable information (PII); hence geospatial data related to people is classified as “Sensitive”. As the debate around personal data ownership has been gaining momentum, governments and people everywhere recognize that data privacy is a right of the people. Therefore, we recommend the “Right to informational self-determination” as a policy position aligned with most privacy laws. It allows people and groups to decide which data may be made public or used.
- **Technological progress, the enforceability of regulations, and sensitive data:** Policymakers need to recognize that future technology developments could change the definition of what is considered private by most people, sensitive information, or a state secret. Therefore, policies should be adaptive to the state of technology and conscious of ever-changing new normals and enforceability of regulations.
- **Compliance to standards:** Successful implementation of IGIF would require a liberal policy to make it easier to comply and firm enforcement to ensure adherence to the standards. Mandating data access and compliance to standards as part of the contract specifications and project deliverables would help.

- **Investments in pilot projects and business models at an early stage:** Governments need to promote innovation by taking the risk of investments in proof of concept (POC) pilots and new business model development. The US's small business innovation research (SBIR) program is an excellent example of government stimulating technology innovation and commercialization.

B. Enabling innovation through data

- **Increase access to open data from the government:** Across the expert consultations conducted for most WGIC reports, there was unanimous agreement on continuously working towards making more government-owned data accessible to everyone. Governments sharing data as a public good is critical for realizing the benefits of emerging geospatial technologies.
- **Test datasets and benchmarks:** There is a strong demand for creating labeled geospatial data (e.g., satellite imagery, LIDAR point clouds, etc.) for training, testing, and benchmarking models. Performance benchmark tests on such datasets will allow comparing algorithms and their results.
- **Promote and support open source:** Sharing algorithms/models openly is vital for the benefit of the geospatial community and for reducing costs/efforts in implementing IGIF. For example, companies have been putting their AI models and algorithms under open source because the business models for AI benefit from the ability to crowdsource new ideas from everywhere.
- **Multilateral data exchanges:** Most developing countries are data-poor compared to the data required by today's algorithmic systems. Promoting data exchanges among countries could help them overcome this challenge for many use cases. Technological solutions like federated learning systems or secure sharing mechanisms exist today that allow for learning insights without breaching data residency requirements or have data-free-flow-with-trust across borders. This way, data-poor countries could together benefit from technologies like AI and digital twins.
- **Clarifying the fair use of data:** In the context of public data used for training algorithms, it is increasingly becoming critical for lawmakers or courts to define what constitutes "fair use" and what is modification. A more open interpretation of the fair-use of public and open data will create a level playing field. Therefore, it will significantly increase innovation as inventors and startups could use such data to train their models and solve problems without risking litigation.

C. Intellectual property perspective

- **Regulatory regime for data:** Legal protection for data varies by national jurisdiction. Raw data are considered facts and not original works of authorship in the US. So, data cannot be copyrighted unless the way it is presented and structured is unique and valuable. Europe allows copyrighting data-

bases when the contents have been selected using objective criteria. A new and common set of regulatory principles or regime for data can allow monetization of the siloed data anywhere by creating a market for it.

- **Incentivizing private data access:** While a significant amount of geospatial data is freely available through open data programs of governments or non-profits, most data is still proprietary and resides in silos. This results in sub-optimal data utilization because startups, researchers, or other companies cannot easily access such data. Therefore, governments should consider incentivizing organizations to share such data at reasonable costs and promote data trusts/exchanges and new rules to make it easier for corporations to share such data while getting the rightful returns. For example, soft law approaches like Fair, Reasonable, and Non-Discriminatory (FRAND) for patents would also suit the treatment of such proprietary data. The American IP Law Association has recommended USPTO consider creating mechanisms to facilitate sharing data from large companies to small ones and avoid further monopolization of data.
- **Traceability and veracity of data:** Systems in use make predictions based on what they have learned from training datasets. Therefore, it is imperative to ensure data is trustworthy and not modified. The capability to track data sources or any modifications in data along the value chain makes it reliable. Policymakers promoting reliable solutions to this problem based on either technology or cooperative agreements (e.g., embedding digital signatures at every stage) would increase the likelihood of data-sharing among corporations.
- **Trained model as IP:** The code for machine learning models often gets open-sourced. They become valuable only after training them on task/context-specific datasets. Currently, there is no differentiation in law between the open-source code of models and the trained models. Due to this reason, we recommend creating a new category of IP rights for trained models. That would provide data monetization opportunities to the individuals and organizations that don't have the capabilities to build models but have data that could be used for training models.
- **IP disclosure requirements:** AI algorithms evolve their internal decision-making criteria (i.e., weights) by learning from the new data used for further training. As the effectiveness and functionality of the model depend on the training data, it must be clarified whether training data should be disclosed for AI patents, and should it be done after each update in the training data?

Call for Action

WGIC strives to advance the geospatial industry globally and strengthen its contribution to the world economy and society. It helps facilitate knowledge interactions and partnerships within the geospatial industry and the co-creation of larger business opportunities for the industry. As outlined above, WGIC commissions studies to report on the policy issues impacting the geospatial industry. These studies engage multiple stakeholders in private and public sectors around the globe. They demonstrate WGIC's commitment to ensuring that the most up-to-date technologies and services are understood, accessible, and utilized for dealing with location-based data in the service of sustainable development goals (SDGs).



Figure 5: WGIC's Strategic Plan

All activities and initiatives of WGIC are guided by our strategic plan that relies on the following three pillars of our strategy:

- **Climate Action:** WGIC has made climate as the overarching theme of its strategy. All initiatives and activities must align with the climate agenda. Within the climate domain, our initial focus is on themes like disaster resilience, energy transition and sustainable infrastructure.
- **Policy Research and Advocacy:** Ensuring that the geospatial industry's voice gets represented and informs the policy discussions around the country-level IGIF rollouts. We focus on developing the ecosystems for emerging geospatial technologies, identifying the implementation and adoption related challenges and recommend regulatory changes, new business models and technical solutions.

- **Partnerships:** Building industry-level and cross-cutting efforts that enable collaborations among stakeholders. It and will benefit all stakeholders significantly by coming together and generate positive returns for the society e.g. industry academia collaborations, local and international geospatial associations. Promoting diversity, equity, and inclusion across the geospatial industry is another priority for the partnerships work.

No single entity can implement IGIF alone in any place or country. It is a job that requires all stakeholders to come together, collaborate, exchange knowledge and work together for common goals. This has been the underpinning and guiding philosophy of WGIC and we invite all organizational and individual stakeholders to partner and collaborate with us on this mission.

References

This document was created using the findings and ideas from the following WGIC reports and IGIF documents extensively:

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About WGIC

The World Geospatial Industry Council (WGIC) is a registered Not-for-Profit trade association of commercial geospatial companies representing the geospatial ecosystem's entire value chain. WGIC enhances the geospatial industry's role and strengthens its contributions to the global economy and society. WGIC facilitates the exchange of knowledge within the geospatial industry and creates more significant business opportunities for the stakeholders through partnerships and collaborations in thematic areas of global significance.

For more information, please visit www.WGICouncil.org.

For collaborations and membership inquiries, please write to info@WGICouncil.org.



World Geospatial Industry Council,

Fluwelen Burgwal 58,

2511 CJ, The Hague

The Netherlands

Email: info@WGICouncil.org

Website: www.WGICouncil.org