WGIC POLICY REPORT: 2021-02

Public-Private Geospatial Collaborations: Exploring Potential Partnership Models

World Geospatial Industry Council

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Acknowledgments

This Policy Report owes its existence to the leadership and guidance provided by the Public-Private Committee of the World Geospatial Industry Council. It also benefited from a considerable body of work that has been developed by a variety of organisations and research institutions that attempted to define and understand the evolving nature of public and private sector partnerships. Although the sheer number of studies and think pieces made for accessible reading, it did not make the task easy. Different perspectives, national contexts, and specific industry perspectives underscored why one of our interviewees said, "if you see one public-private partnership – you have only seen one public-private partnership". This quote provided some humour to a task of considerable scope. Finding depth proved to be another exercise.

Missing depth was addressed considerably by the timely and welcome release of two of some of the most comprehensive and thoughtful reviews of the public-private partnerships within the geospatial sector. On November 17, 2020, the World Bank released "Public-Private Partnerships in Land Administration: Analytical and Operational Frameworks". It provided in-depth analysis of how public-private partnerships are to be operationalized in land administration. If the World Bank Report added much-needed depth, then in December the United States National Geospatial Advisory Committee, an advisory body of the US Federal Geographic Data Committee, provided a more strategic focus and compelling understanding of the breadth of private-public collaborations across various aspects of the geospatial market.

Both studies substantively influenced this document as did the members of the World Geospatial Industry Council (see next page), who contributed valuably in terms of their time and perspectives.

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Introduction and Context

Geospatial Business Model Innovation

It is often said that the speed of technological change is transforming almost every aspect of our lives. In the public and private sector, there is an ongoing drive to establish new heights of competitive advantage at the level of nation-states and the level of firms. Trans-national organisations, formed out of a common desire to bridge the gap between the developed and developing worlds, have also identified technological adaptation as a key element to achieve progress and close a growing digital divide.

In recent years, executives have paid particularly close attention to the impact of new technologies on their businesses or, more specifically, their business models. In 2011, the Harvard Business Review underscored the importance of business-model innovation to executives, indicating that 7 out 10 companies were in a cycle of constant business model innovation, and with ninety-eight percent of companies implementing some degree of business model modification[1]. This article was prescient – it suggested the ongoing convergence and integration of information and communication technologies, forces of de-regulation, globalization, and sustainability necessitated continual business model innovation for long-term success.

In the third decade of the 21st century, these forces are again driving the need to examine the responsiveness and sustainability of business models. The clearest and most present force is the global spread of the Covid-19 virus. At the time of writing of this paper, the global caseload had neared 93 million, with global death counts estimated around 2 million.[2]

"Geography is key to integrating work across communities. GIS is all about collaboration, interconnecting and sharing. As geography becomes more integral to our lives and work processes, we need a geospatially literate society going forward."

...Jack Dangermond, Esri

1 How to design a winning business model, Ramon Casadesus-Masanell and Joan Ricart, Harvard Business Review, January-February 2011.

2 John Hopkins Coronavirus Resource Centre, January 15, 2020. See https://coronavirus.jhu.edu/map.html for updated data that uses geospatial data, tools and analysis.

To respond to this pandemic, not-for-profit organizations, governmental agencies, trans-national institutions, and the private sector mobilized to deliver drugs, medical equipment, and situation awareness.

Geospatial leaders such as Jack Dangermond, Esri founder and global geospatial thought leader, highlighted how the geospatial community developed "billions of maps, apps and dashboards". Reams of data were processed, analyzed, and disseminated around the world. The 2020 pandemic underscored a lack of global preparation, weaknesses in supply chains, and an inability to target buildings and locations to optimally place emergency response centres. It serves as a clear message to us all – that where the scope of a global challenge is staggering, new ways of delivering services are necessary.

The Fiscal Context

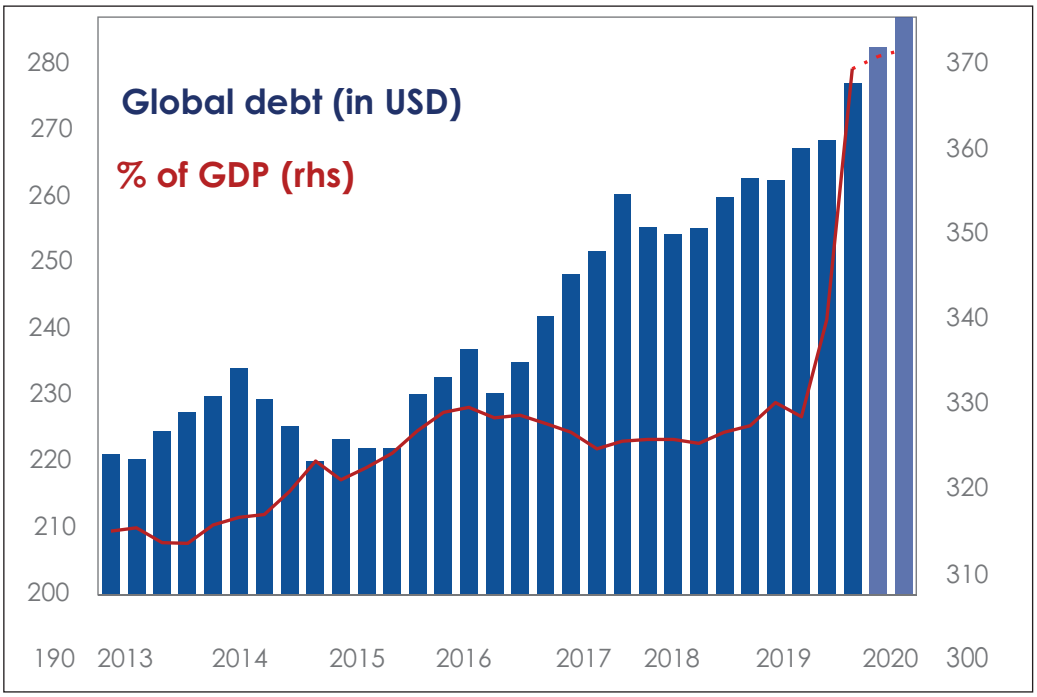
The second imperative for business model review is the growing debt levels of nations associated with the global pandemic. In previous years, periods of deficit spending were followed by periods of deficit and debt reduction. For geospatial organisations, especially national mapping and space agencies, the need to adopt new business models was a direct response to deep program and operational budget reductions. Budgetary decreases had the twofold effect of not being able to deliver on national geospatial programs, as well as slowing the integration of new technologies and processes into operations.

To find new ways to continue or better deliver essential public good services, data, and knowledge, governments worked with private sector partners to explore such options as privatisation, creation of special operating vehicles or agencies, and the contracting-out of services. These early experiments with new public service delivery included early experiments in the relatively new concept of public-private partnerships (PPPs), primarily in large scale transportation and construction projects. The geospatial community was not an early experimenter with formal PPP arrangements but its members did adopt other transformative innovations including open data, open-source collaboration, a focus on interoperability, and a clear call for efficiency and effectiveness through the mantra of "build once, closest to source, and use manytimes". By embracing these innovations, the geospatial community created an environment that is conducive to new business models, especially public-private partnerships.

By embracing transformative innovations like open data, open source collaboration and a focus on interoperability, the geospatial community created an environment that is conducive to new business models, especially PPPs.

Today, fiscal deficits and debts are higher than during the first wave of experimentation with public-private partnership models. According to the Institute for International Finance, record global debt levels will continue to rise through 2020 and 2021, and sharply declining revenues will make debt servicing more onerous despite lower debt servicing costs. Debt levels are expected to stabilize post-2021, but demands for badly needed expenditures in climate change, infrastructure, and healthcare will continue. These circumstances present both a challenge and an opportunity for the global business community: how best to continue our efforts in an environment of scarce resources and in the face of staggering global challenges?

Graph 1: Global Debt topped $272 trillion in 2020



IIF, BIS, IMF, National sources

Rising Costs, Growing Divides

The final factor that underscores the importance of delivering new business collaborations is whether investments in geospatial will hold as high a priority as health care, infrastructure, and large-scale initiatives to transition to a carbon-neutral global market.

In short, the global geospatial community may wish to consider proactively positioning itself for sustainability through business model evolution away from traditional approaches of relying on governmental contracting and procurement models.

It is therefore easy to conclude that developing new private-public partnership models, or pursuing concepts that had mixed success decades ago will be no mean feat. Members of the WGIC and the broader geospatial community will require a deep understanding of the contexts in which they propose to operate, and in developing models that go beyond simple models of return-on-investment and shareholder value, to ensure that when PPPs are directed at delivering public good and public services, the lens also focuses on the creation and delivery of value to citizens.

When examining national or specific contexts of operation, it is very clear that some jurisdictions are better suited, legislatively and ideologically, to the embrace of new models of public service and public good delivery. Over the past thirty years, many developed nations have experimented with a variety of business models through which public services were delivered. Their legislative and regulatory environments have adapted to the new realities of fiscal constraint and have embraced the idea that the private sector is better able to adopt and implement rapidly changing technologies and business approaches. It would appear, however, that in developing regions legislative and regulatory frameworks for new private sector led business models evolved more slowly. This situation has had the effect of limiting the adoption and trust in public-private partnerships and is at the core of why the United Nations and the World Bank have undertaken extensive analysis and research. Their report, mentioned earlier, provides an exceptional guide for the private sector to review and understand the level of maturity and issues that need to be addressed when implementing PPPs in the developing world.

"Developing new public-private partnership models, or pursuing concepts that had mixed success decades ago will be no mean feat and the geospatial community will require a deep understanding of the contexts to ensure delivery value to citizens."

The Geospatial PPP: Key Concepts

Based on the feedback and the views of participants in the PPP workshops led by the WGIC, it is clear there is a strong consensus and desire to explore, advocate, and implement a new business relationship with governments. There is widespread optimism that governments and the private sector, by working together, can rise to meet current and future challenges. In a presentation to the Public-Private Partnership (PPP) workshop of the Americas, Preetha Pulusani, President, Rolta International Operations, observed that the developed world profited from information and technology – driven growth ("with geospatial at its core") but the developing world viewed such capabilities as a luxury. Pulusani emphasized that new business models – such as formal public-private partnerships – were within reach due to the proliferation of cloud computing, the broad availability of geospatial data, global bandwidth expansion, and the phenomenal growth in the value and use of geospatial data.[3] She further highlighted that the current economic crisis provided an opportunity for the geospatial sector to bring initial financing, technology, data, and know-how to the table. In taking such action, the WGIC could play a strategic role in addressing deep backlogs of technology and data innovation needed across governments around the world.

3 Preetha Pulusani, Emerging Business Models in PPP, August 28, 2020. Summary of a "Presentation given to the Regional Workshop of the Americas on Private-Public Partnerships sponsored by the World Geospatial Industry Council.

This report attempts to capture some of the sentiment expressed by Pulusani and participants in the WGIC PPP workshops. It also captures the importance of avoiding the creation of more backlogs and greater divides in the global adoption of geospatial technologies, services, and data. But the words of Pulusani also contain a cautionary note. Pulusani identifies geospatial at the core of information, technology, and communications. However, many others see geospatial as part of other disciplines or as a stand-alone segment of the global economy. This divergence in thought around the role, definition and place of geospatial fosters an ongoing difficulty to define the geospatial community as a coherent and commonly understood aspect of the global economy. For the purposes of research, the lack of a unifying definition creates challenges. These challenges are in turn exacerbated when there are no commonly agreed upon definitions or views of public-private partnerships.

Table 1: the Geospatial Value Chain

Scanning	Earth Observation	GNSS and Positioning	Spatial Analytics
• Lidar • Radar	• Satellite Platforms • Aerial Platforms • Ground Platforms • Sub-surface • Marine • Sub-marine	• GNSS • Surveying • 5G • Autonomous vehicles • Indoor Positioning	• BIM • Location Intelligence • Image Analytics • Geospatial Data • Statistical Data

"New business models - such as formal public-private partnerships - were within reach due to the proliferation of cloud computing, the broad availability of geospatial data, global bandwidth expansion, and the phenomenal growth in the value and use of geospatial data."

At this point some definitional clarity is needed. The "geospatial" community operates in domains that include but are not limited to the location industry, mapping, geomatics, or geography. It has sub-domains or related disciplines with strong international associations such as photogrammetry, surveying, and remote sensing, and is sometimes seen as synonymous with these disciplines. Land administration, land management, and the creation of cadastral surveys and maps are critical elements along with geography, geological, or topographic surveys and national censuses. Not only does the geospatial community embrace these historical "mapping" roles, but it also now intersects with key players in the data, information, communications, and technology sector as Pulusani rightly points out. The geospatial community's long history with data acquisition, processing, visualization and dissemination has made it a critical capability that is now meshed with advanced and traditional industrial sectors such as space and aerospace, agriculture, natural resource development, emergency management and meteorology, to name a few. Geospatial tools, technology and know-how are also used within the construction, healthcare, aviation and automotive sectors. And finally, geospatial is both being used by and is benefiting from such exciting and advanced technologies as artificial intelligence, quantum computing, Building Information Modeling and the Internet-of-Things.

However, to try and maintain an acceptable scope to this paper we have adopted a framework that has been developed by Geospatial World (see Table 1) as part of its annual assessments on the state of the Global Geospatial Sector. Within this framework, we will attempt to identify opportunities for geospatial PPP implementation.

"PPPs are not just defined by a singular definitional phrase - they are also defined by specific business models, choice of contractual relationships with governments, procurement arrangements, and way they earn revenue. "

Defining Public-Private Partnerships (PPPs or P3s)

Just as the scope of geospatial businesses and disciplines is broad, so too are the scope and depth of public-private partnerships. Defining and identifying opportunities for PPPs in the entire geospatial sphere is akin to riding a camel through the eye of a needle in a sandstorm. It may even explain why numerous studies have taken an approach to examine one domain or activity in the context of a PPP. For the geospatial community, only two such studies over a period of thirty years of experimentation stand out.

The first report, issued by the World Bank, in November of 2020, was a multi-year, multi-stakeholder report that benefited from four rounds of global consultation with a deep team of contributors and dedicated staff. It advances thinking that PPPs can deliver effective land administration services. It identifies specific services such as field surveys, land information systems development, and e-services as areas for potential partnership.

It also adopts the following benchmark definition:

> *"a long-term contract between a private party and a government entity, for providing a public asset or service, in which the private party bears significant risk and management responsibility, and remuneration is linked to performance."*[4] *The same can be said of other segments of the geospatial industry."*[5]

The second report, released in December 2020, by the United States National Geospatial Advisory Committee (NGAC) summarized a multi-year review of the feasibility of utilising a PPP (or a series of them) to deliver the next generation of the United States' National Spatial Data Infrastructure (NSDI). The NGAC Public-Private Partnership Sub-Committee was tasked with specifically identifying areas for PPP implementation, and developing recommendations to the FGDC. As part of its review it formulated the following definition:

> *"an agreement between one or more public agencies (federal, state, and/or local) and private sector entity or entities that includes shared risk and reward among the parties. Through this agreement, the skills and assets of the private sector are employed in delivering a product, service, or infrastructure for use by the public at large."*

It is not surprising that these two landmark studies on geospatial PPPs arrived at remarkably similar definitions. They were, after all, informed by decades of effort to better improve upon their implementation and sustainability in large-scale projects in construction, healthcare, energy and agriculture.

This report, therefore, explores territory highlighted by NGAC and posits the view that PPPs are not defined by a singular definitional phrase: they are, instead, more effectively defined by business models, choice of contractual relationships with governments, procurement arrangements, and the way they earn revenue.

PPP business models follow along a continuum of related models, differentiated by their contractual arrangements, areas of business focus, and procurement arrangements.

In short, this report argues that PPPs are very specific and well defined. Based on the literature review conducted for this report, it is concluded that PPP business models follow along a continuum of related models, differentiated by their contractual arrangements, areas of business focus, and procurement arrangements. There are twelve PPP models outlined in Table 2 with each having unique characteristics.

4 www.pppknowledgelab.org

5 Public-Private Partnerships in Land Administration, Executive Summary, page

Table 2: Table of PPP Contractual Relationships and Business Models

Business Model	Description
Design and Build (DB):	Where the private sector designs and builds infrastructure to meet public sector performance specifications, often for a fixed price, or a turnkey basis, so the risk of cost overruns is transferred to the private sector. (Some do not consider DB's to be within the spectrum of PPPs and consider them as public works contracts.)
Operation and Upkeep Contract (O & M):	Where a private operator, under contract, operates a publicly owned asset for a specified term. Ownership of the asset remains with the public entity and the specific instrument often takes the form of a service contract.
Operating License:	Where a private operator receives a license or rights to operate a public service, usually for a specified term. For the geospatial community, these types of arrangements are sometimes utilized to operate such governmental assets as earth observation ground receiving stations, and to provide the opportunity for private sector providers to establish and develop their own ground stations.
Design-Build-Maintain (DBM):	In this category there are a series of variations on the model, which include extensions of responsibilities for operations (DBO) and operations and maintenance (DBMO). This family of P3 models allows for a private entity to design and build (and perhaps maintain and/or operate) a new facility under a long- term lease, with a clear operational ambit. At the end of the lease, the private entity usually transfers the facility to the public sector, ostensibly in a well-maintained state, while ensuring profitability from the nature of a stable long-term contract.
Build-Lease-Operate-Transfer (BLOT):	A private entity receives a franchise to finance, design, build and operate a leased facility (and to charge user fees) for a defined period (longer-term), against payment of a rent.
Buy-Build-Operate (BBO):	Transfer of a public asset to a private or quasi-public entity usually under contract that specifies the assets are to be upgraded and operated for a specified period of time. Public control is exercised through a contract at transfer. (e.g., transfer of Crown or government-owned lands for development)

Business Model	Description
Build-Operate-Transfer (BOT):	The private sector designs, finances and constructs a new facility under a long-term Concession Contract and operates the facility during the term of the Concession, after which ownership is transferred back to the public sector if not already transferred upon completion of the facility. In fact, such a form covers BOOT and BLOT with the sole difference being the ownership of the facility.
Build-Own-Operate-Transfer (BOOT):	A private entity receives a franchise to finance, design, build and operate a facility (and to charge user fees) for a specified period, after which ownership is transferred back to the public sector.
Build-Own-Operate (BOO):	The private sector finances, builds, owns, and operates a facility or service in perpetuity. The public constraints are stated in the original agreement and through on-going regulatory authority oversight function.
Rehabilitate-Operate-Transfer (ROT):	Identical in structure to the BOT but instead the private-sector takes on the responsibility to rehabilitate, upgrade, or extend existing assets.
Concession:	The concession model is generally used to permit the design, rehabilitation, extension, building, financing, or operations of a set of services to users. It is generally funded through a governmental subsidy; or in some cases a fee is paid to government; and user-pay almost always forms a critical element of the model.
Private Finance Initiative (PFI):	This approach, first piloted by the United Kingdom, focuses on government contracting private firms to complete and manage public projects. Generally speaking, this model does not involve the direct delivery of services to citizens or clients and also does add an element of private finance. It has also been criticized for taking government debt off of national balances, thereby hiding national debt.

PPPs In Geospatial: The Rationale and Concerns

Potential benefits and rationales for utilising any of the models described in the previous table can be grouped into three broad areas: financial benefits, technological flexibility, and competency exchange. As one example, financial benefits to PPPs are derived at macro-economic as well as at micro-economic levels. At the level of the global and national economies, growing governmental indebtedness and the upcoming possibility of potential fiscal restraint within governments, are occasions for the private sector to supplement gaps in government funding. PPP business models have matured over the past thirty years and are defined by rigorous business models and contracts and informed by lessons learned.

To develop a good PPP

1. Prepare properly
2. Create a shared vision
3. Understand partners
4. Ensure risk and reward clarity
5. Encourage clear decision making
6. Emphasize research
7. Provide clear and consistent leadership
8. Communicate clearly and often
9. Develop a detailed negotiation strategy
10. Build trust

The use of PPPs for large-scale project delivery is a means to manage the political risk of cutting public services or ineffectively delivering public services. The use of PPPs provide the added benefit of enabling the re-allocation of finite resources to other areas of priority, thus enabling political opportunity and support. At the level of firm-governmental entity interaction, well defined PPPs provide for the effective allocation of risk concerning project delivery. Hence, at the level of government officials (public servants) and business leaders, the PPP provides an effective framework for mutual understanding of effective financial accountabilities and responsibilities.[6]

6 This summary was prepared extracting input from the various sources listed in the appended bibliography

It is almost axiomatic that the private sector can adapt and adopt new technologies more quickly and effectively than the public sector. Government procurement in most jurisdictions is an arduous process, sometimes given to inefficient pricing mechanisms or corrupt practices in the purchase of goods and services. In a PPP, pricing and purchasing mechanisms are usually clearly laid out and are seen to be more efficient and responsive to market fluctuations. As a result, the ability to invest in leading-edge and not bleeding-edge technology and data capabilities are a positive in the delivery of public services.

"Within the geospatial context, the ability to develop long-term contracts for delivery, and a clear and transparent business model to develop national mapping (geospatial data) as a service, is far preferable than the short-term fluctuations in funding that change with political priorities. "

Commentators in the WGIC workshops observed that private sector familiarity with rapidly changing service delivery channels in the Business to Business (B2B) and Business to Consumer (B2C) space contribute a greater connectedness and understanding of stakeholder, client, and citizen needs and expectations. In an age where trust in institutions of government is eroding around the world, even small but positive interactions with public service delivery could go a long way to restoring institutional trust.

The third broad category of benefits is said to draw upon the private sector's deeper management capabilities, access to financial resources, and ability to provide an emphasis of time and priority to key objectives, such as achievement of the Sustainable Development Goals. Specifically, the ability to manage the following are said to underscore the strength in PPP business models:

- technology adoption and integration; novel and multi-channel expertise in service delivery;
- better access to financial resources and capital markets;
- a clear focus on return-on-investment;
- more dispersed and varied large-scale project management expertise;
- and a better ability to understand real-time knowledge of shifts in consumer and market behaviour

Often, these strengths are gained over a stable and long-term time horizon where the business entity is able to adjust and innovate in a rapidly changing consumer environment. This PPP feature – long-term contracts and stable planning and change management horizons – enable more effective project delivery, better services, and as the outcome, critical benefits for citizens.

Although early failures with PPPs models slowed their adoption, the past 30 years of PPP experimentation has resulted in the creation of well-defined and mature organizational models. The concept is not as much in question any longer as there is a growing recognition that the fault of the model lay in individual implementation. Today, lessons learned and rigorous accountability regimes inform PPP successes and overall acceptability.

But in the silver lining of acceptability there is the cloud of past failure and lessons learned. Specifically, PPP processes and rigorous structures that conform to mature governmental processes often impose heavy administrative burdens, especially during procurement phases. Insufficient mutual knowledge between the government and private sector lead to cultural clashes and ongoing procedural delays if processes are not followed well, or if public reaction and feedback suddenly influence project acceptability. In less mature economic and regulatory environments, corrupt practices do impinge on cost and time over-runs while essentially undermining a well-defined and rigorously implemented business model. The strength of partners and their ability to respond to project demands also have determined project success as much as such key enabling capabilities as clear and transparent revenue streams, and well-defined project milestones and outcomes.

The strength of partners and their ability to respond to project demands also have determined project success as much as such key enabling capabilities as clear and transparent revenue streams, and well-defined project milestones and outcomes.

In November of 2020, The World Bank released an extensive and detailed array of operational guidelines andstudy materials to encourage PPP implementation in the domain of Land Administration. This body of work drew upon extensive consultations and strong contributions from a global network of practitioners, business leaders, governmental agencies, and experts. The effort was multi-year in nature and, to date, there is no equivalent study in any other geospatial area of activity.

NGAC, in contrast, also identified a specific focus of its work. Rather than a specific domain, it examined a series of potential projects that supported the large-scale project of creating or renewing the United States' National Spatial Data Infrastructure. It is to be noted however that NGAC's efforts on PPPs date back to 2009 when it examined the use of P3s to advance a National Parcel Database. In 2012, it issued a white paper on Innovative Strategies for Geospatial Programs and Partnerships and has helped steer projects leading to such innovations as the highly successful 3DEP program, the National Address Database, and the idea of Geospatial Data as a Service.

Potential Geospatial PPPs: Where Next?

The World Bank Report on PPPs and Land Administration identifies field surveys, land information systems development, and e-services as potential areas of activity that can be delivered using PPPs. The NGAC report more broadly identifies building or renewing its national spatial data infrastructure as a potential project for PPP use. In some jurisdictions, effective land administration regimes and land information systems are critical elements in a national spatial data infrastructure. In Canada, for example, it was the creation of the National Land and Water Information Service[7], within the national Department of Agriculture that provided early Canadian experimentation and implementation of geospatial information systems and spatial data infrastructure.

7 The National Land and Water Information System was an idea and project envisioned and led by Dr. Roger Tomlinson, and set the stage for geospatial information systems and service development.

The concept of a national spatial data infrastructure is one that built upon the ideas of land information services and has since undergone tremendous evolution since it was first introduced in the 1990s. It emerged as a technological solution that could better harness the power of the internet by sharing geospatial data with users connected by broadband. SDI's were scalable and could be deployed in highly localized or large global scale situations. All were dependent on an abundant supply of accurate, assured and accessible geospatial data. Because they were steeped in a tradition of interoperability, they enabled global to local connection in a fashion that led to the early "big data" movement.

Today, the concept of Spatial Data Infrastructure (SDI) intersects with the idea of a critical national digital infrastructures. A national spatial data infrastructure operates through constituent elements such as portals, platforms, highly connected and massive data stores of satellite imagery, GPS coordinates and frameworks, land information and data, topographic data, and geology. In effect, this structure enables a nation to unlock most any question relating to "where". As the SDI evolves, so do business models that respond to the growing scope and ambit of global to local SDIs. From many global arrangements, NGAC selected 8 case studies which have been mapped below against the geospatial landscape defined by Geospatial Media and Communications.

Table 3: NGAC projects mapped against the Geospatial Value Chain

GEOSPATIAL LANDSCAPE ASSESSMENT	SCANNING	EARTH OBSERVATION AND POSITIONING	GNSS AND NAVIGATION	(GEO) SPATIAL ANALYTICS
Alberta data partnerships	✓	✓	✓	•
National geospatial agency intermediary agreement	•	•	•	•
Geospatial insurance consortium	•	•	•	•
India state level property tax management	•	•		•
3D elevation program	•	•		•
GPS benchmarks initiative	•	•	•	•
California public safety power shutoff partnership	•	•	•	•
TomTom data maintenance pilots	•	•	•	•

✓ Clearly defined business model

• Applicability across geospatial "landscape"

This simple mapping exercise indicates that the collaborative business model case studies selected by NGAC have applicability across the entire range of the geospatial "landscape" or value chain. Of the case studies selected, NGAC has indicated that only one – the Alberta Data Partnerships falls within clearly defined business model, financial, and contractual arrangements. In effect, it is the exemplar PPP arrangement while others clearly outline exceptional collaborative arrangements between public and private sectors.

Table 3: NGAC PPP Maturity Map

As these projects touch nearly every aspect of the entire geospatial value chain, it would in coming months be worth considering whether those projects not considered true PPPs could, in fact, undergo a further set of exercises to develop long-term multi-year agreements to provide geospatial technology, data and services as public goods.

For the future, the FGDC and the NGAC have committed to ongoing efforts to identify additional use cases for NSDI development. For the WGIC, this forms an excellent opportunity to align resources and policy research capabilities with the FGDC and the NGAC to develop consortia to deliver specific public good geospatial projects. It is also an opportunity to align research to develop deeper market assessments and intelligence to inform WGIC members of business opportunity.

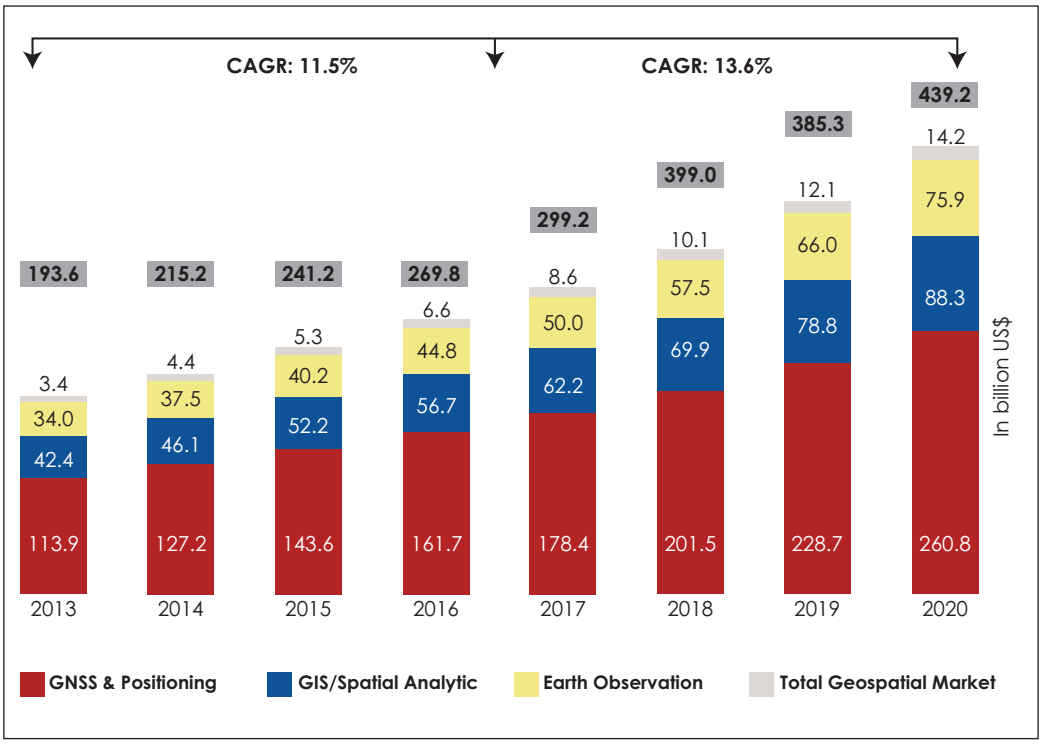
Such a strategic alliance – at the research level would not only avoid duplicative activities, but it would also bring expertise together to develop implementation frameworks, and guides for the broader geospatial value chain. In turn, these studies, knowledge, and networks could also facilitate the development of geospatial consortia to lead PPP deployments in the global geo-economy. Such activities hold significant potential to align to ongoing efforts at implementing the Integrated Geospatial Information Framework and the United Nations' 2030 Sustainable Development Goals.

Throughout the course of this review, it became apparent very quickly that much work was being done in PPPs in sectors of the economy that draw upon geospatial technologies and data. For example, the agricultural industry and government departments have used geospatial data and tools to provide accurate crop forecasting for national accounting purposes. Specifically, the use of optical and radar data has enabled near and real-time crop forecasting and accounting capabilities. These capabilities are also used to predict agricultural shortages. Sensor technologies are being deployed within the agricultural context to facilitate better farming practices such as the power to remotely sense and control irrigation and water consumption, thus providing optimal moisture content for seed germination and water conservation practices.

Within the natural resource industry, similar technological and data capabilities are facilitating the creation of 3D geological or sub-surface maps for use by environmentally conscious mining and exploration companies. Greenhouse gas emissions are tracked along pipeline corridors and in areas of carbon sink through greenhouse gas observing satellites that then share their findings via spatial data infrastructure and other forms of mapping applications.

This once again brings us back to the framework of the geospatial value chain that has been developed and used by Geospatial Media to conduct its annual market surveys. Based on market breakdowns, it clearly indicates that the smallest segment – 3D scanning has seen as near 300% growth in size from 2013 to 2020.

Graph 2: Geospatial Technologies: Global Market Size



Source: GeoBuiz, 2020 Edition

If, as previously suggested, WGIC chooses to partner with the FGDC and the NGAC, and the World Bank to bring the organizational structure of PPPs to enable e-services (land administration, property tax administration), technical architecture (spatial data infrastructures, earth cubes and data lakes, satellite receiving stations) it can build on a set of concepts that can, for the first time be identified and measured in a meaningful manner. These measurements of market potential, firm performance, employment, and the level of competitiveness within those sectors will also give rise to a much-needed understanding of whether PPPs need to be utilized, or whether existing procurement and firm arrangements are serving the market.

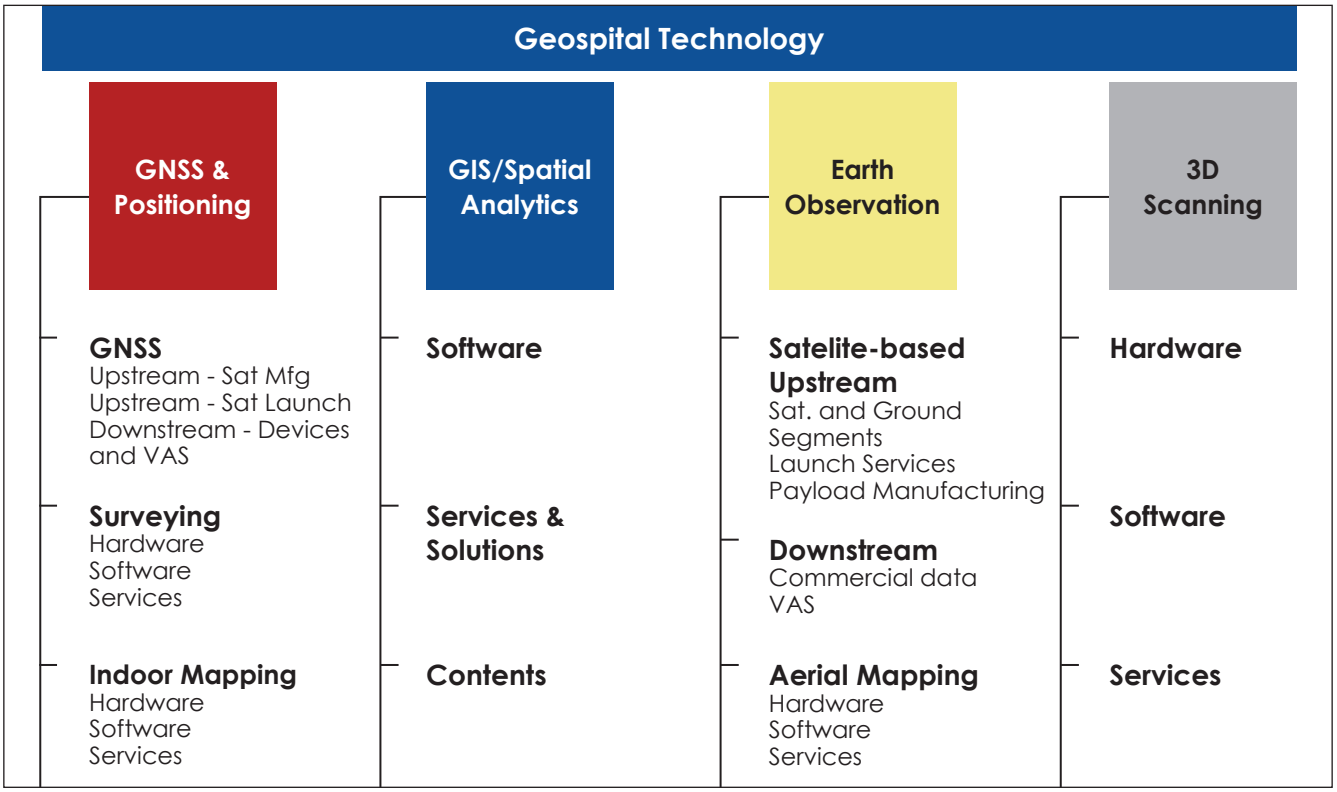
It may also be useful, for many within the WGIC community, to consider and contextualize such concepts as Hardware-as-a-Service; Data-as-a-Service (DaaS), Mobility-as-a-Service (MaaS), Knowledge-as-a-Service (KaaS); Location-as- a-Service (LaaS); Software-as-a-Service (SaaS); Security-as-a-Service (SECaas); and many other new "service" models. Broadly speaking these activities can be grouped under the term "digital or e-services". Like the terms geospatial, and public-private partnerships, it is defined by many in a variety of different ways but has at its core several defining characteristics. The first is that the service (regardless of which type it is) is delivered or built upon activities that are delivered or depend on the internet or other electronic networks. The second is that these services tend to be highly automated and require little to no further automation. The third is that the data upon which a service offering is created tends to be highly structured, highly interoperable, and standards dependent. And, finally, the need for cybersecurity adds another critical consideration to the employment of these services. (e.g., tax assessment and administration).

In the World Bank report, e-services are explicitly mentioned as an area for PPP. As one of the most mature elements in the geospatial value chain, delivery of Land Administration services through electronic channels is gaining considerable momentum. It is, however, not a new concept. It is rooted in the concept of a National Spatial Data Infrastructure which provides electronic connectivity, interoperable data, and facilitates location data sharing. The NSDI has provided the backbone and means by which open and proprietary data are being monetized and commoditized around the world. It is not surprising therefore that both the World Bank Report and the NGAC case studies highlight a range of different business models or collaborations that can be used to monetize or share geospatial data. In effect, the early creation and implementation of structured and interoperable technologies and data have paved the way for a wide variety of innovative business models.

The World Bank Report and the NGAC case studies highlight a range of different business models ,that can be used to monetize or share geospatial data. The early creation and implementation of structured and interoperable technologies and data have paved the way for a wide variety of innovative business models.

With respect to the specific types of business models specifically falling into the category of PPPs, two critical areas stand out. The first is in the domain of a data collaborative seen in the Alberta Data Partnership case study, and which has been implemented under the Government of Alberta's PPP enabling legislation. The second area, given the high degree of collaboration and potential is the Geospatial Insurance Consortium, which in addition to the high levels of maturity, also has a very significant level of partnership potential as well as access to a pool of available capital. Finally, because it focuses on reducing financial, personal and organizational risk for public and private sectors, and citizens, it is likely that market forces will impose high levels of discipline on getting the PPP right.

Table 4: Geospatial Technology Ecosystem



Source: Geobuiz, 2020 Edition

Finally, on 21 January 2021, new United States Transportation Secretary Pete Buttigieg indicated that the time was right for a "big, bold infrastructure package as large as $1 trillion". The authors of this report are of the view that given the infrastructure sector's long experience with PPP implementation provide an historic opportunity for partnerships with WGIC members, not just in the United States but globally. Technology and data services that are tied to mobility, location intelligence, internet-of-things, insurance, monitoring, building information modeling all converge with WGIC interests. In this spirit, the following recommendations have been made.

Way Forward

Given the growing interest within the geospatial community on private-public sector partnerships, WGIC aims to undertake the following efforts.

WGIC undertake "socialization" activities to communicate and deepen the understanding of public-private partnerships based on this report and the work of the Federal Geographic Data Committee and the National Geospatial Advisory Committee, and the World Bank. WGIC secretariat would prepare a roadmap on PPP that would be integrated into its broader 2021 policy and outreach activities.

WGIC conduct a scan of legislative frameworks and/or experiences with PPP implementation globally. Once, completed WGIC secretariat would develop communications and advocacy materials to support WGIC member interactions with governmental officials responsible for PPP implementation.

WGIC establish formal ties at the policy and market research levels to harness synergies in mutual areas of interest with the United Nations, the World Bank, and the National Geospatial Advisory Committee to capture lessons learned and build an ongoing body of robust literature to be used in future geospatial PPP implementation.

WGIC develop a thought piece to help position converging technologies such as, but not limited to, artificial intelligence, quantum computing, building information modelling, the internet of things and geospatial capabilities. This paper would identify potential areas for business model experimentation, and specific types of private-public partnership models (building to task).

Appendix A - PPP Use Cases

With permission from the National Geospatial Advisory Committee (NGAC)

National Geospatial Advisory Committee, PPP Use Case

Use Case 1: 3D Elevation Program

Piloting public-private partnerships: cooperative geospatial data collection and maintenance

Background

The 3D Elevation Program (3DEP) is managed by the U.S. Geological Survey (USGS) on behalf of the community of Federal, State, tribal, local and other partners and users. The goal of 3DEP is to complete acquisition of nationwide lidar (IfSAR in Alaska) by 2023 to provide the first-ever national baseline of consistent high-resolution elevation data – both bare earth and 3D point clouds – collected in a timeframe of less than a decade. High quality elevation data are critical to flood risk management, infrastructure construction, resource management, conservation, energy development, agriculture, and a host of other nationally significant applications. The National Enhanced Elevation Assessment documented more than 600 business uses of elevation data across 34 Federal agencies, all 50 States, selected local government and tribal offices, and private and non-profit organizations (https://www.dewberry.com/services/geospatial/national-enhanced-elevation-assessment). 3DEP is designed based on the NEEA to provide a 5:1 return on investment and to conservatively provide new benefits of $690 million/year with the potential to generate $13 billion/year in new benefits through applications that span the economy.

3DEP presents a unique opportunity for collaboration among all levels of government, to leverage the services and expertise of private sector mapping firms that acquire the data, and to create jobs now and in the future. The NEEA further estimated the cost to acquire and deliver the required elevation data for the Nation at $1 Billion in total over 8 years. As a result, 3DEP was designed from the onset to be built upon collaborative partnerships and leverage the expertise and capacity of the private sector.

Case Study: 3DEP Lidar Acquisition Partnerships

3DEP solicits proposals annually to acquire high-quality lidar data from Federal agencies, State, local, and Tribal governments, academia, non-profit organizations, and the private sector through a Broad Agency Announcement (BAA). The 3DEP BAA is a fair and equitable process that allows prospective partners to propose data acquisition projects. The cost of data acquisition for approved BAA proposals is shared between the applicant, USGS, and other Federal agencies with interests in the project area. All digital elevation models (DEMs) and lidar point clouds from projectsthat include Federal funding are published on The National Map and are available to the public free of charge, without use restrictions.

Private companies can initiate and submit BAA applications to receive funding to augment the project. The recent Arizona Maricopa-Pinal 2020 lidar project is an example of a private company investing in 3DEP data acquisition. For this project, a geospatial solutions provider, VeriDaaS, organized and submitted a BAA application that included an in- kind contribution for a portion of their work to complete the survey, which they valued at 20% of the full project cost. The financial partners on this project are the Natural Resources Conservation Service (NRCS), the Federal Emergency Management Agency (FEMA), and four State and county government organizations. This project will result in 5,033 square miles of new Quality Level 1 (QL1) lidar data collected in the fall of 2020. The data will support the FEMA Risk Mapping Analysis and Planning program (Risk MAP), natural resource management, agriculture, infrastructure, and many other applications. VeriDaaS is assuming some risk by acquiring data at a higher density than 3DEP requires, and plans to deliver to USGS reduced density data that meets 3DEP specifications for unrestricted public use. VeriDaaS will retain the high density LIDAR data for their own use, for derivative analytics, and for reselling value-added products to other customers.

3DEP was also the recipient of an opportunistic Public-Private Partnership (P3) in Alaska. The Alaska Mapping Executive Committee - a governance body focused on improving foundational geospatial data in Alaska comprising several Federal, State, and local governments - prioritized the funding and acquisition of a statewide elevation dataset. USGS managed the multi-year acquisition of the data, with clear plans for contracting statewide collection. The vendors acquiring the data for USGS often were able to extend planned flights to collect additional data speculatively, and with no obligation from USGS to purchase the data. However, USGS was eventually able to purchase interferometric synthetic aperture radar (IfSAR) data at a later date from contractors who initially acquired the data speculatively.

Alaska was mapped using IfSAR rather than lidar due to the remoteness of most areas and persistent cloud cover. This P3 is nontraditional because contractors acquired data to meet 3DEP requirements speculatively in areas that lacked data coverage but were adjacent to areas USGS was already funding. To minimize costs, Fugro, Intermap, and Dewberry acquired data on speculation, valued at nearly $17M, maximizing the efficiency of each flight-plan, which resulted in lower overall program costs.

How Does It Work?

3DEP, by design, is a cooperative program that meets the needs of a broad range of stakeholders and depends on significant data investments and contributions through partnerships. Federal coordination for the program is managed through the 3DEP Executive Forum and the operational 3DEP Working Group, and data acquisition is managed through the BAA process and Federal data partnerships. Strides have been made to move beyond an ad hoc process that had long primarily emphasized information sharing about agency acquisition plans, to one that more fully integrates acquisition investments across levels of government. As a result, 3DEP-quality data is available or in progress for over 77% of the Nation at the end of FY20. In spite of this success, developing partnerships and funding for data acquisition in the western U.S. remains a challenge to meeting the 8-year goal of nationwide data completion by 2023. The difficulty in obtaining control points over large tracts of road less area, a reduced State tax base due to lower population, and significant Federal land ownership from agencies with little available funding require us to take innovative approaches with partnerships in western states. Continued Federal, State, local, Tribal, and private partnerships are critical to the successful campaign to produce nationwide coverage of modern, 3D elevation data.

Why Does It Work?

USGS has outlined several best practices to aid the 3DEP community in reaching a higher level of coordinated implementation and maximizing data investments. Acquiring data through a unified approach significantly benefits partners and the Nation's taxpayers in multiple ways:

- Reduced unit costs by pooling funding with other partners;
- Reduced unit costs through the economy of scale achieved through larger project sizes;
- Access to qualified and experienced mapping firms under contract to acquire and process data;
- USGS programmatic infrastructure that issues and manages data acquisition contracts, and inspects, accepts, and distributes point cloud and derived data products;
- Reduced costs for not replicating the same infrastructure in multiple agencies;
- More consistent data from standardized acquisition and larger project areas;
- Increased State, local, Tribal and other data acquisition partnerships through advanced planning and earlier notification of opportunities enabled by a defined, stable Federal acquisition budget;
- The opportunity to "buy up" higher-quality data for specialized applications;
- The opportunity to receive 3DEP cost-share funding to acquire LIDAR data and data made publicly available to support countless other uses.

Lessons Learned

Because 3DEP relies heavily on partnerships, the program has learned to be creative with developing funding collaborations. For example, the BAA process has the flexibility to acquire data via a USGS acquisition project using the Geospatial Products and Services Contracts (GPSC) or partners may request 3DEP funds toward a lidar data acquisition where the requesting partner is the acquiring authority. Another example is the 3DEP partnership with the National States Geographic Information Council (NSGIC) to work directly with states to develop state lidar acquisition plans that consider the unique requirements, geography, and funding partners in each State. USGS has also leveraged key applications for lidar such as critical minerals and hurricane and wildfire disaster recovery to secure new funding for data acquisition. As the lead for 3DEP, USGS also transparently communicates on the status of the program, expenditures, and budget requirements through the 3DEP Working Group and Executive Forum, and the 3DEP webpage. To date, over 260 organizations have partnered with 3DEP, however many other potential partnerships remain.

Conclusions

These case studies provide varied examples of how private companies can partner with USGS to acquire high quality elevation data. Because the resulting data are available to the public, these partnerships benefit not only the USGS and funding partners, but also the entire elevation data user community. While not a textbook P3 yet, the BAA process does allow the government a mechanism to bring in multiple partners in concert with the private sector to 'map once, use many times.'

Use Case 2: Alberta Data Partnerships

A public-private partnership supporting long term management of spatial assets for stakeholders

Background

The Alberta Data Partnerships (ADP) Public-Private Partnership (P3) began in 1997. ADP is a not for profit company established to assume the responsibilities for digital mapping in Alberta on behalf of the provincial government. The P3 concept grew from a strong push by the Government of Alberta (GOA) to privatize operations that they believed could be scaled and accomplished more efficiently by the private sector. Each of the initial ADP stakeholders, the Government of Alberta and five major provincial utility companies, committed significant funding to start the activity. Since the mid- 1990s, the list of stakeholders has expanded beyond utilities to include municipalities, energy, forestry, and mining organizations, as well as regulatory organizations and associations. In 1997, ADP created a business plan and released a Request for Information to identify and secure a joint venture (JV) partner to be the private sector partner to perform day to day operations for the digitization, management, and distribution of an integrated provincial spatial data set that included cadastral and base mapping data such as legal surveys, subdivisions, pipelines, roads, some utility rights of way, and to create an integrated map of the province. Altalis, a consortium of companies, was selected as the initial JV partner to operationalize the day to day management and distribution of ADP data. Altalis has continued to be ADP's joint venture partner, while its ownership structure has evolved since 1997.

How Does It Work?

The ADP not for profit entity plays a key role in driving the success of this P3 – serving as the partnership lead and coordinator, with the following characteristics and functions:

- **A well-balanced Board of Directors**
  - Representation from all key stakeholders.
  - Active participation of leadership from GOA is imperative to maintain balanced public-private interests.

- **Strong provincial stakeholder engagement**
  - Identifies stakeholder product / service priorities and requirements (e.g., certificate of title mapping, pipeline right of way, base mapping data, municipal boundaries).
  - Convened via external advisory groups operating as technical working groups.
  - All stakeholders have a voice

- **Organizational and data governance**
  - Negotiates and establishes partnership agreements and ensures clearly defined roles and responsibilities with stakeholders and with the JV partner
  - Although GOA holds ownership of mapping data, the ADP holds exclusive license arrangements with the JV partner to enable a portion of the data and specific services to be sold to generate revenue.
  - Assures distribution arrangements are in place for cadastral, titles and disposition mapping, public land survey plans, and GOA open data products.
  - Responsible for strategic oversight of Altalis' day to day operational organization responsible for data collection, management, distribution, sales, reporting, and revenue sharing.
  - Responsible for negotiating other JV partner relationships as required to meet ADP requirements.

- **A Shared Revenue Model**
  - Assures contributions from and realization of value to each and every stakeholder.
  - Establishes profit sharing and reinvestment approaches.

Looking at the shared revenue model in more detail, several revenue sources flow into the JV Company to make this model work:

- **Regulated filing**
  - Each survey plan registration includes a $100 fee which goes to ADP to offset the cost of integrating each survey plan into the provincial dataset.
  - Each land disposition application and amendment includes a fee that goes to ADP for the cost of integrating the survey plan into the provincial dataset.

- **Data and Access Fees**
  - For example, this includes revenue collected from the purchase of integrated maps.

- **An intentionally minimal amount of revenue comes from the GOA for access to the integrated datasets**
  - This helps to ensure that potential future government shortfalls in investment do not heavily impact theP3 business model.

- **Directed project funding**
  - This drives innovation on specific topics of challenge and opportunity as defined by stakeholders.

On a quarterly basis, based on formal agreements noted above, the ADP receives a variable level of profit share distribution based on the overall revenue level achieved for that quarter, as well as a flat management fee from the JV partner. The JV partner is charged with investing a portion of their revenue to assure appropriate capital investment, JV management, and operations. One example of capital investment included a recent major update of the operational system to take advantage of new technology and improved web services.

Why Does It Work?

Leadership of the ADP cite trust as a key aspect of why this model works, and ADP is viewed as a trusted organization by its stakeholders. ADP underscores the following conditions as enabling trust:

- **Security.** People, processes, and tools assure integrity, confidentiality, and safeguarding of data and systems.
- **Accountability.** A network of stakeholders take responsibility for upholding defined standards and agreements.
- **Transparency**. Provide stakeholders meaningful ways to understand relationships and outcomes of the process.
- **Auditability**. Checks and balances are necessary to assure compliance with agreements, defined processes, and outcomes.
- **Equity**. Value is apportioned fairly to every stakeholder in the process.
- **Ethics**. These guide everyone through times of potential ambiguity and uncertainty.

To achieve trust ADP cites the following:

- Aligning the goals and expectations of stakeholders (Accountability, Equity, Ethics)
- Establishing a governance structure (Accountability, Equity)
- Clearly identifying and prioritizing business opportunities and challenges (Accountability, Equity)
- Negotiating and executing data sharing, analysis, and management agreements (Accountability, Transparency)
- Return clear results based on transparent methods (Accountability, Transparency, Security)
- Ensure that results are put into practice (Accountability, Transparency, Ethics); and
- Verify outcomes and impacts through appropriate metrics and reporting (Auditability, Transparency, Accountability, Security)

Since its inception in 1997, the ADP estimates that the Government of Alberta has reduced operational costs by $65M - $120M. The ADP has also provided stakeholders with $6.8M in cost savings to government and industry users through lower pricing achieved through greater efficiencies achieved by ADP over original GOA pricing for the same products and services, and increased quality and availability of geospatial data to meet the needs of the province. Additional details on the history, governance, and benefits achieved via the ADP are documented in an ADP P3 Success Story.

Challenges and Cautionary Lessons

ADP leadership noted several key lessons learned that should be considered when entering into a P3:

- Affecting change management within any bureaucracy is difficult, and P3 advocates must work foremost across senior levels in government to gain support as lower levels may be more volatile.
- Communicating the value of change is critical. The value proposition should be compelling, concise, and easy to convey to promote support
- Seeking long term multiyear agreements from the outset to create stability and provide time to succeed.
- When possible, arrange agreement timelines to avoid election cycles.
- Seeking to minimize financial requirements from organizations most vulnerable to budget fluctuations.
- Seeking regular improvement and innovation cycles to increase efficiencies and effectiveness.

Conclusions

The ADP has established a durable partnership arrangement among key public and private sector stakeholders that provides a sustainable process to collect, maintain, and provide access to essential geospatial data for much of the Alberta province. The partnership is grounded in a well-defined governance framework that establishes clear roles and responsibilities, sharing of investment and profit, designation of free and for fee data access, and processes for continuous improvement and innovation.

For more information on ADP, visit http://abdatapartnerships.ca/.

National Geospatial Advisory Committee, PPP Use Case

Use Case 3: California Public Safety Power Shutoff Partnership

An innovative partnership supporting communication, coordination and collaboration between electric utilities and community stakeholders

Background

As of the end of the summer of 2020, there were over 100 major wildfires burning in the U.S. Of these, 30% were in California. 2018 saw the deadliest and most costly wildfire in the state's history, the Camp Fire. It burned over 150,000 acres. An electrical transmission equipment malfunction was blamed for the fire. High winds fanned the fire. Acres of dry vegetation fueled it. Low humidity heighted its intensity. These conditions normally confined to fire season are now happening almost year-round. High temperatures exacerbate the potential for larger and more destructive wildfires and the frequency and severity of wildfires is expected to grow.

Utilities design their networks to withstand high winds. Yet, winds can cause trees and limbs to fall on the lines and equipment, creating damage to the grid. Utilities also design the electric system to automatically de-energize the equipment when this happens. Despite these safeguards, sparks and heavy currents for short periods of time create the potential for igniting a fire. This situation is particularly troublesome in remote heavily forested areas, where fires can spread quickly.

Wildfires can be triggered in many ways. However, wildfires caused by electrical equipment can be better managed or avoided. One way is to de-energize portions of the network in vulnerable areas during conditions conducive to wildfires.

In 2012, San Diego Gas and Electric (SDG&E) requested the authority from the California Public Utility Commission (CPUC) to shut off power to selected circuits during high wind events to minimize wildfire risk. The CPUC regulates Investor-Owned Utilities (IOU) in the state. This process is called the Public Safety Power Shutoff (PSPS). The CPUC agreed.

In 2018 California expanded their PSPS agreement to all IOU's operating in California and in 2020, the CPUC strengthened the regulations to add additional reporting, transparency measures, and consumer protection requirements. This led to a greater awareness by the utilities and the commission of the need for better data, collaboration, communication and coordination among the numerous partners before, during, and after a PSPS event.

Public Safety Power Shutoff (PSPS) - Requirements

Utilities must work to shorten the time of a PSPS. They must minimize the extent and apply technology to make smarter decisions. In addition, the level of communication to all stakeholders must be increased. GIS is critical to meet these requirements. All the factors, such as high fire risk extents, real-time weather, land features, at-risk populations, and properties are location dependent. GIS is the most effective tool to develop and communicate PSPS plans, but requires data from many different sources. It is also essential during a PSPS event to collaborate with the many stakeholders impacted by the power outage. It is also a key tool in assessing the results and effectiveness of the PSPS event after the fact.

Pacific Gas and Electric (PG&E), the largest of the IOU's, has enhanced their PSPS process to meet the new CPUC requirements. This included rethinking how they interact with partners, which resulted in new partnerships and creation of a portal for data sharing and stakeholder collaboration.

What Does It Do?

The success of a PSPS is totally dependent on effective sharing of timely, reliable data, and the only way to achieve that was by forming a creative partnership for sharing information in an innovative way. The partners are private (the utility companies), and public (Federal, State, Tribal and local governments, their agencies and the public) and NGOs (charities). The primary goal of this partnership was to save lives through information sharing, and was not focused on the more traditional Public-Private Partnership (P3) framed around revenue sharing.

The CPUC did not specify exactly how information was to be shared but did detail steps that needed to be taken; convening informational community meetings and workshops in advance (inclusive of special needs customers), advance notification of plans to de-energize during high risk events, communication protocol requirements, and importance of quality data to form a justifiable data foundation to drive PSPS decisions and requests. Executing these requirements involved a new look at the types of data needed, parties who could supply those types of data, and a modern mechanism to efficiently and effectively communicate information in a timely, understandable way to a diverse range of stakeholders, from local authorities to critical businesses like hospitals and care facilities to local homeowners. All of this would be done under tense circumstances and in a rapidly changing environment.

The first step was to address the data challenges. Government and utilities have very defined responsibilities. As a result, silos of processes and data happen naturally. For example, California's wildfire agency, CALFIRE, is responsible for managing wildfires. They do not have or control data about electrical facilities. As another example, cities have data about property ownership. When it comes time to evacuate, cities rely on the California Department of Transformation (Caltrans) for information on roads and possible evacuation routes. None of this information is maintained by utilities. Yet, it would be extremely useful to them if it were easily accessible and could be incorporated into their planning.

In addition to utility infrastructure and operational data, utilities maintain unique information about specific customers that are dependent on electricity for their critical medical needs (respirators, iron lungs, hemodialysis machines, and many others). Utilities gather this information to provide a discount on eligible customers' utility rates. Yet, it is also vital information for other partners, such as first responders. This is one of the many data sources that utilities can sharewith partners if it can be done securely. Since this information is private, no participants can provide it to the general public. Complementing the utility data holdings, partner organizations have a wealth of data useful to PSPS planning and execution. A well-structured, trusted partnership tapping into and integrating these data resources would benefit all.

- **Utility Company Data:**
  - Customers with critical medical needs;
  - High risk fire zones;
  - Electrical network data;
  - Critical electric customers / critical facilities;
  - Circuit switching stations;
  - Damaged facilities;
  - Utility and contractor locations;
  - Tree trimming activities;
  - Location of drone, helicopter and fixed wing assets; and
  - Estimated restoration time.

- **Partner Data:**
  - Damage to infrastructure;
  - Blocked roads;
  - Evacuation routes;
  - Status of evacuations;
  - Shelter locations;
  - Emergency vehicle locations;
  - Wildfire cameras;
  - Community resources;
  - COVID-19 testing facilities;
  - Demographics; and
  - Public transit.

How Does It Work?

None of the many public and private agencies have a complete picture of the situation during a PSPS. Conventional means of data sharing (pushing data to individual organizations) falls short during normal operations and are further challenged during a major event such as a wildfire or a PSPS. The problem with this type of data sharing is that downloaded data becomes out of date, is time consuming to produce, and is a one-way process.

Creating this data foundation to inform decision making brought critical data and many new partners together. The next challenge was how to organize and deliver the right information at the right time to the right people. This meant timely, up to date information needed to be easily accessible and understandable. Homeowners needed certain information delivered to their mobile phones, local first responders needed different information in emergency vehicles and in command centers, and critical facilities and disaster relief workers needed timely information.

To meet these needs, PG&E established the Public Safety Power Shutoff (PSPS) Portal for agencies to access planning and event-specific information to support emergency management efforts prior to and during a power shutoff. Access to the PSPS Portal is provided to Public Safety Partners, including Federal, State, Tribal, and local agencies, as well as critical facilities, telecommunications providers, water agencies, and publicly owned utilities and hospitals.

To streamline the partnership process, the Portal offers a self-service online application form, complete with drop down menus organized by categories of typical partners. From the start the partners are separated into categories for appropriate data access. By default, specific personal customer information is not shared with partners. However, the partnership application process includes a process for rapid review of applications not requesting access to sensitive data and a mechanism to further evaluate special requests for appropriate release of personal information to authorized emergency management officials. Once approved, partners can access up to date information in the Portal based on their approval status.

The Portal leverages ArcGIS Hub, a technology platform which provides many-to-many communication of spatial information among all partners in a controlled and secure process. The Portal provides mechanisms to assure the privacy of sensitive customers and critical infrastructure information. At the same time, it provides selective information to consumers directly impacted by the PSPS. The Portal streamlines notification of customers, fire departments, first responders, critical facilities, other potentially affected entities, and the CPUC of the potential action, before shutting off the power on a line. Here other stakeholders can access consistent information and visualize the extent of the proposed PSPS. Beyond sharing raw data, tailored information products are of particular value, like dynamic GIS based dashboards. These provide real-time maps of the situation on the ground, plus statistics of impacted populations, critical facilities and status of outages. Digital maps of critical facilities impacted are essential to allow stakeholders to make decisions based on up to the minute situations on the ground.

By implementing modern data sharing practices, specifically employing geospatial web services, data is up to date, consistent and the data remains with the source agency. Each partner has direct access to the data from every other partner at the same time. Taking a cue from social media, data communication happens immediately. This partnership process works due to:

- **Transparency:** Each partner is fully aware of changes as they happen.
- **Security:** Utility data is private and sensitive. This process provides safeguards to assure that public information is shared broadly while sensitive information such as specific utility customer information is scrupulously guarded.
- **Interoperability:** The partnership is inclusive, and the portal incorporates open standards to allow sharing of different data sources from multiple technology platforms
- **Expandability:** As new partners become involved in the process, they can be added simply.
- **Accountability:** The process provides for traceability of the information flow, so that after the fact, partners can assess the success or gaps in the process. This allows the process to be refined.

The Power of Partnerships

PSPS involves a tapestry of many partners, many with significantly different priorities. The mission of any power company is to continuously maintain power every minute of every day. Intentionally shutting off power is anathema to utility employees. However, under these perfect storm situations, it becomes necessary. The key to successfully doing this is communication. The challenge is that there are so many stakeholders in the process, from both the public and private sectors. The challenge of any innovative partnership is to provide value to all participants. A traditional P3 involves revenue sharing, where each party provides a share of what the total partnership needs. In this case, it is information that is the true value. While that may seem simple, it is not.

What makes this work is simultaneous sharing of data. Most of that data is in the form of maps – location is the key. A modern GIS platform provides many-to-many sharing of data organized by location. This gives partners the ability to see patterns and relationships that are hidden from each partner separately. It provides a central portal of knowledge and action.

In 2020, in addition to the wildfire situation, we also have COVID-19 to contend with. This means that partners must model vulnerable populations and locations of COVID-19 treatment and testing. As widespread vaccine administration areas become known, additional data about the storage and distribution of vaccines will need to be shared. Each of those will also have to be factored into the planning and execution of PSPS events. The PSPS Portal provides a flexible platform to incorporate this additional information and makes it easier to adapt plans and response.

During a PSPS event, relationships are many-to-many. This complex arrangement requires technology that eases information flow among many parties. It must preserve the privacy of sensitive yet critical information, such as vulnerable citizens. It also must provide near real-time status to the general public. The PSPS Portal meets these requirements. However, PG&E is only one of six IOU's in the State. Overall, there are 46 public utilities and 4 electric cooperatives providing electricity in California. In fact, the Los Angeles Department of Water and Power (LADWP) is the largest public utility in the U.S. These utilities are not immune from the threat of wildfires.

The PSPS process is relatively new and these partnerships are in their infancy, but much has been learned. To increase collaboration statewide, this successful innovative partnership model should be expanded. It may be appropriate for State government (the Governor's office, IT office, emergency management agency, etc.) to serve as the central broker of the partnership, coordinating partnerships and various data hubs throughout the State, including those implemented at the utilities. In this way, all of the utilities (not just the IOU's) can participate and coordinate activities with the various partners. Hubs can communicate with other Hubs. This would provide utility to utility collaboration for resource and information sharing. In this way California can take a leadership position in the complex coordination of actions required during PSPS events, improving safety of its citizens.

Use Case 4: Geospatial Insurance Consortium

An Evolving Public - Private Partnership

Background

The National Insurance Crime Board (NICB) was founded in 1992 as a not for profit organization with a mission to "combat insurance fraud and theft" through partnerships with insurance companies, consumers, and law enforcement. The NICB initiated the Geospatial Insurance Consortium (GIC), which operates as a consortium comprised of insurers and related companies that share proportionally in the cost of collecting and accessing geospatial information and analytic tools for use by insurers for different phases of the insurance lifecycle – including underwriting, claims investigations and adjustments, and disaster response.

The GIC partners with Vexcel Imaging to produce very high resolution vertical and oblique imagery products and elevation data for use by consortium members. Imagery includes "blue sky" annual vertical imagery over the USA, with the addition of oblique imagery over metropolitan areas. The GIC also collects and provides "gray sky" vertical, oblique, and ground level imagery as needed in response to disasters. The GIC can deploy imaging assets within hours of an event. In addition, the GIC makes available automated damage assessment analytic tools developed by its partner, Munich RE, to rapidly identify and quantify losses in disaster areas, reducing the time and effort in assessing damage and minimizing fraudulent claims.

Example View of Post-Disaster Imagery

How Does It Work?

On the surface, the GIC looks like a consortium designed to cater only to the insurance community. However, to speed response, help save lives, and support recovery, the GIC has established a program for the first responder community in the U.S. and other nations to provide free access to pre and post disaster imagery products during disaster response operations. Imagery is made available for viewing for up to 180 days free of charge to requesting first responders including Federal Emergency Management Agency (FEMA), the Red Cross, and other Federal, State and local government, and non-governmental organizations (NGOs) and community organizations.

Once provided credentials, first responders are granted access to the GIC Portal to view before and after disaster event imagery to support response operations. As there is no single point of coordination in the U.S. for first responders,

GIC makes its best effort to advertise its geospatial information and capabilities to the first responder community and provides staff to arrange for access to these services.

Why Does It Work?

The GIC provides a significant economy of scale to its members by collecting, managing, and providing access to a common framework of geospatial information tools for use by the insurance industry as a whole. This eliminates redundant collection and data maintenance for the industry. The shared contributions of its members enable the GIC to provide current, highly accurate imagery, geospatial information, and tools suitable for insurance industry decision making. Economies of scale allow the GIC to delivery capabilities that no single company could efficiently provide.

Because timely response to save lives and assets are of common value to the insurance and first responder community, GIC benefits by partnering with public sector first responders to open access to its geospatial imagery during disaster response. First responders in turn benefit by having no-cost access to geospatial information to help understand the disaster extent and prioritize and plan response operations.

Challenges and Opportunities

First responder free access to imagery and related geospatial data is limited to viewing only, with authorization to display/distribute images only as part of media messaging and alerts and publicly shared apps supporting disaster response and recovery. Extended access and retention of imagery and related products is limited due to licensing terms and the GIC business model.

GIC leadership note that their consortium process is still being shaped, and that expanded membership and service offering opportunities may be on the horizon. The Public-Private Partnership (P3) subcommittee noted the potential for the current GIC model to be expanded to include public-private shared investment via sponsorship or membership of government and other organizations that depend on consistent local to nationwide imagery and elevation data for a range of activities.

Governments at all levels have need for consistent local to nationwide imagery and elevation data to support activities such as managing public lands and properties, identifying and insuring property in flood prone areas, modeling and issuing flood warnings, conducting land use / urban planning, and preparing for and responding to disaster events. Such an arrangement has strong potential to provide a coordinated level of nationwide coverage, reduce redundant data collection and maintenance, and reduce the effort and cost for all parties involved.

Conclusions

The GIC business model has some of the characteristics of a P3. It is an innovative partnership of insurance and related companies that share the risk and reward of establishing and operating nationwide geospatial coverage and tools to support the industry. The model recognizes and supports the inclusion of public safety officials in times of crisis. Thereis significant potential for the current GIC consortium model to be expanded to enable inclusion of government and other non-insurance private sector organizations that have common needs for the nationwide coverage and tools offered by the GIC. This expanded sharing of cost, risk, and rewards to assure a current, accurate and trusted geospatial resource for the private and public sectors would be indicative of the benefits of a national P3model.

National Geospatial Advisory Committee, PPP Use Case

Use Case 5: GPS on Bench Marks Partnership

Background

GPS on Bench Marks (GPSonBM) is the National Geodetic Survey's (NGS) crowdsourcing approach for working with Federal and State government agencies, universities, and private sector firms to improve the local accuracy of national scale models and tools that the NGS builds to serve the Nation.

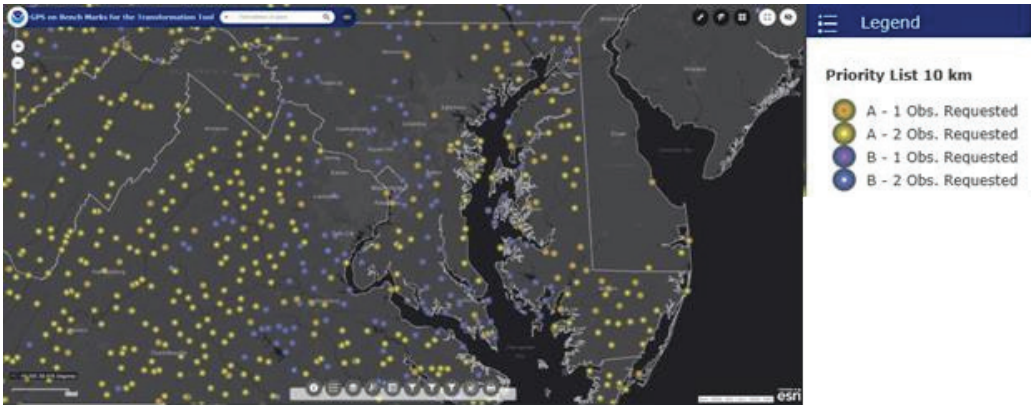
Since 2014, the NGS has invited surveyors to collect and share survey-grade Global Positioning System (GPS) data in celebration of National Surveyors Week. In 2018, participants provided thousands of new data points that were then used to create GEOID18, the NGS' hybrid geoid model. This new data closed significant data gaps and significantly improved the overall fit of the model.

In 2020, the NGS is working with partners on the GPS for Transformation Tool Campaign, the purpose of which is to:

Collect data required to enable the NGS Coordinate Conversion and Transformation Tool (NCAT) to convert from the current vertical datums to the new North American-Pacific Geopotential Datum of 2022 (NAPGD2022); and

Find and report back on existing NGS survey control marks to update descriptive information and provide an up to date status of the bench mark.

To help users prepare for the upcoming modernization of the National Spatial Reference System, all observations submitted to the NGS through the GPSonBM campaign will be reprocessed and used to update coordinates in the new system.



View of and Legend for the GPS on Bench Marks for the Transformation Tool Web Map Application (https://noaa.maps.arcgis.com/apps/webappviewer/index.html?id=6093dd81e9e94f7a9062e2fe5fb2f7f5)

To guide users on where to focus their efforts, the NGS has developed a prioritized list of bench marks where new data will provide the most benefit for improving future transformation tools. The prioritized bench marks can be viewed on this web map application:

The bench marks have been assigned into two categories (priority A and B):

- **Priority A:**
  - Elevation obtained via 1st or 2nd order levelling.
  - Useable for GPS observations.
  - Last recovery indicates that monument was found.
  - One or two observations requested.

- **Priority B:**
  - Lower quality monuments that will be used to fill gaps and considered for use in the transformation tool.

How Does It Work?

The GPSonBM campaign consists of three phases (recovery, observations, and submit the collected information to the NGS).

- Using the information (web application and bench mark description) provided by NGS the participant will recover the benchmark.
- Once the bench mark has been recovered and is determined to be in good condition the GPS observations will be collected.
- After the GPS observation(s) have been collected the information will be submitted to the NGS using Online Positioning User Service (OPUS).
- The bench mark recovery information (description of what was found) will be submitted to the NGS using the Mark Recovery Form (https://geodesy.noaa.gov//surveys/mark-recovery/).
- Once the submitted observations are accepted by the NGS the web map application will be updated to show that the GPS observations has been completed on the submitted bench marks.

Why Does It Work?

Anyone can participate in the program. For mark recovery information anyone using a smartphone can submit recovery information, update the scaled position of a bench mark, and submit photos of the bench mark. Participants with a survey grade GPS receiver can submit GPS observations, in addition to the recovery information, and photographs.

Lessons Learned

Many of the bench marks in the National Spatial Reference System (NSRS) are defined horizontally by a scaled position (latitude and longitude). The submitted GPS information will assist the NGS in the development of a relationship (transformation tool) between the current vertical datum (North American Vertical Datum of 1988) and the North American-Pacific Geopotential Datum of 2022 (NAPGD2022).

Conclusions

The GPSonBM program allows NGS to harness the power of partners across the country to collect the data needed to improve the local accuracy of national scale models and tools. It provides an engaging opportunity for outreach and education through geocaching type Mark Recovery efforts, as well as helping geospatial professionals get more used to accessing the NSRS through GPS observations.

National Geospatial Advisory Committee, PPP Use Case

Use Case 6: National Geospatial-Intelligence Agency

Partnership Intermediary Agreement

Background

The United States National Geospatial-Intelligence Agency's (NGA) Research Directorate engages with industry and academia to accelerate delivery and deployment of capability solutions. Research aims to accelerate delivery of solutions that fulfill the agency's core mission and highest priorities, and to make innovation and acquisition faster and easier. Research uses many available resources to accomplish these goals by developing NGA entrepreneurs, partnering with academia, and teaming with industry in traditional and non-traditional ways to rapidly and easily deliver geospatial intelligence (GEOINT) solutions to the customers in the form and on the timelines they need it.

NGA and Technology Transfer

Use of Federal Technology Transfer (T2) agreements date back to the early 1980s as a Defense Department effort to derive greater value from technologies developed through government research. Federal labs use tools like Partnership Intermediary Agreements (PIAs) to execute the T2 mission. PIAs help industry and academia leverage government developed data and technology. Partnership Intermediaries are state/local agencies or state/local owned and operated non-profit entities, including state universities. PIAs number in the hundreds and exist in every state. Federal labs are not limited in how many PIAs they have or where they are located, and many have multiple intermediary partners in multiple states. Some notable PIAs include The Doolittle Institute and TechLink.

A PIA is a specific type of Public-Private Partnership (P3) defined by 15 U.S. Code § 3715 (Use of partnership intermediaries). PIAs aim to cooperate with small businesses and educational institutions "that need or can make demonstrably productive use of technology-related assistance from a Federal laboratory." All work accomplished through a PIA must support the transfer of technology between the Federal government and the partnered small businesses and educational institutions. A PIA typically involves smaller efforts with shorter duration and a greater focus on innovation and technology development than most P3s.

In October 2018, NGA established a T2 mission that includes the use of PIAs as a tool to engage in technology transfer with industry and academia. PIAs can enhance innovation and increase the speed of acquiring mission-critical solutions. Through engagement with a multitude of local small businesses and educational institutions, a PIA can also stimulate growth in the local economy. A partnership intermediary performs services that increase the likelihood of success in the conduct of cooperative or joint activities with small businesses and educational institutions. PIAs facilitate a wide range of licensing and other technology transfer initiatives.

The Missouri Technology Corporation PIA

In January 2019, NGA entered into a PIA with the Missouri Technology Corporation (MTC). MTC bridges NGA and the local St. Louis industry to match NGA developed technologies and data with viable industry partners who can, in turn, leverage it for commercial purposes. The primary purpose of the MTC PIA was to enhance a geospatial ecosystem in St. Louis. This will help the State of Missouri grow and strengthen its economy and workforce through NGA sponsored opportunities for businesses and academia that grow and mature emerging geospatial capabilities and solutions. This aligns with MTC's primary purpose:

"To contribute to the strengthening of the economy of the State of Missouri through the development of science and technology, to promote the modernization of Missouri businesses by supporting the transfer of science, technology and quality improvement methods to the workplace, and to enhance the productivity and modernization of Missouri businesses by providing leadership and the establishment of methods of technology application, technology commercialization and technology development."

How Does It Work?

In 2020, NGA modified the PIA with MTC to permit the use of funding to support technology transfer efforts. Using a Collaborative Project Order, NGA funded MTC to deliver two technology accelerator cohorts. Both cohorts aim to provide opportunities for local emerging companies to gain experience and guidance for growing their products in line with the NGA Technology Focus Areas. Participants will gain valuable knowledge and insight on working with the Federal government and become better prepared to support NGA's technology requirements.

Why Does It Work?

Reducing product development time and accelerating capabilities to market while reducing redundant investment make this program successful. Through a PIA, new markets and strategies emerge to provide additional space for innovation that does not exist in the Federal government today. The government can create the foundation and opportunity for American companies, but the government cannot do this alone. Private partners are key to the evolution of this data exchange.

Value in This Effort

NGA is building a new campus in the St. Louis area. Establishing a foundation of commercial and academic entities readily available to collaborate with NGA as they pursue their mission is critical to the success of the NGA mission. The value of the PIA for NGA is the ability to nurture the development and growth of small and emerging businesses into a geospatially knowledgeable force capable of assisting in the work NGA does. With this effort, NGA provides the opportunity for small, emerging companies to develop the skills they need to become lean, innovative, and agile enterprises.

How Can One Participate?

NGA will advance its technology transfer efforts for the commercialization of federally developed technology. Through MTC, NGA will engage with partners in the greater St. Louis region to drive innovation in geospatial technology through collaboration and a transfer of technology and subject matter expertise. In 2021, NGA will sponsor two accelerators that will be open to small or early stage companies. Accelerator activities will develop participating companies and prepare them to support the NGA mission.

National Geospatial Advisory Committee, PPP Use Case

Use Case 7: TomTom Data Maintenance Pilots With U.S. States

Piloting Public-Private Partnerships: Cooperative Geospatial Data Collection and Maintenance

Background

States, counties, and cities around America have a vital need to have ready access to geospatial data about their jurisdictions. Geospatial data about roads, rail, property, addresses, elevation, soil types, and other data are essential in the delivery of sanitation, postal and other services, assurance of public safety / 911 operations, urban / community planning, land use and ownership, fair taxation, and other services. Geospatial data also underpins a rapidly expanding range of industry provided location services used broadly by government, businesses and citizens to support an array of other uses such as mobile navigation, logistics & transport, real estate development, and business site planning.

In many cases, industry accesses openly available government geospatial data and adds additional information and capabilities to offer "value added" products and services to the marketplace. To avoid costly duplication of data collection and maintenance, Public-Private Partnerships (P3s) are emerging that leverage the capabilities of both the government and private sector to collect, maintain, and apply geospatial data for a range of public and private sector interests.

TomTom Data Maintenance Pilots with U.S. States

TomTom is an international company focused on delivery of high-quality navigation, transportation logistics, mapping data, and location-based services.

One of several such companies, TomTom has initiated a series of pilot projects with U.S. States to identify areas of mutual interest in the creation and maintenance of geospatial data related to roads. TomTom's objective is summarized by TomTom's Senior Partnership Development Manager Robert Hoyler:

"Our overall objective is to develop a collaborative approach involving TomTom and State governments, with the aim to achieve a mutually beneficial GIS database maintenance process; whereby strategic efficiency & quality gains can be realized by all participants."

How Does It Work?

While TomTom has their own proprietary process for highly accurate capture of road information for commercial uses, they see potential value in collaboration directly with States that are also collecting and maintaining road data to support a wide range of State service provision and public safety programs. They have established partnership pilots with the State of Utah and others to identify areas of potential value to all parties. Through these pilots, TomTom has identified that their processes to identify new road centerline information (essentially the delineation of a road) can be more current and accurate than existing State-maintained databases. States benefit from receiving these updated or new road delineations to validate their databases.

States on the other hand tend to have more detailed descriptions of road characteristics that can be provided in return for the road delineations provided by TomTom. Access to State attribution information about roads is of value to TomTom in reducing the impact to the company of requiring alternative means of collection of this data (research, field verification), which shortens the timeline to achieve end-user benefits. With pilots underway in Utah, TomTom is in discussion with other States including Alabama, Arkansas, Indiana, New Jersey, and New York regarding potential pilots with those States.

Why Does It Work?

The P3 piloting approach that TomTom has taken in partnership with Utah works because it allows public and private sector partners to work together informally and cooperatively to identify, test, and validate approaches and discover areas of mutual benefit before making formal commitments. Piloting also enables stakeholders to test organizational agreements, resourcing, and governance methods that would need to be in place to operationalize P3 arrangements for the long term. Furthermore, pilots provide opportunity for stakeholders to better understand and address the potential implications to their business models, intellectual property rights ownership, etc.

Lessons Learned

One of the major challenges expressed by TomTom as a result of these pilots is great sensitivity regarding potential impacts to the private sector business model when such collaboration occurs. Will such arrangements negatively impact markets or profits? What are the implications to intellectual property? These are understandable concerns for any private sector organization. However, through pilot projects stakeholders can better understand potential areas of risk and reward that can help inform decisions and shape approaches to operationalizing activities in partnerships.

Conclusions

This case study illustrates the significant value of pilot initiatives as a collaborative method to prototype and test approaches and reveal outcomes that provide mutual benefit to public and private sector stakeholders. The limited scope of these initiatives is an incentive to test approaches before committing to long term operations through more formal partnership agreements. This case study also identifies the potential for P3s to be established based largely on mutual benefit, with minimal additional resource / funding investment needed to provide benefit to all parties.

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