Digital Public Goods for the SDGs

Emerging Insights on Sustainability, Replicability & Partnerships

FIVE CASE STUDIES

In cooperation with

digital impact alliance

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Contents

Acronyms

a2i	Aspire to Innovate
API	Application Programming Interface
AWS	Amazon Web Services
CDC	Centers for Disease Control and Prevention
COGs	Cloud Optimized GeoTIFFs
CoWIN	Winning Over COVID-19
CPIMS+	Child Protection Information Management Systems
DIVOC	Digital Infrastructure for Verifiable Open Credentialing
DHIS2	District Health Information Software 2
DIAL	Digital Impact Alliance
DPG	Digital Public Good
DPGA	Digital Public Goods Alliance
DPI	Digital Public Infrastructure
eVIN	Electronic Vaccine Intelligence Network
FOSS	Free and Open-Source Software
GBVIMS	Gender-Based Violence Information Management System
ICT	Information and Communications Technology
ICT4D	Information and Communications Technology for Development
IIIT-B	International Institute of Information Technology Bangalore
IO	Impact Observatory
ITU	International Telecommunication Union
MOU	Memorandum of Understanding
MOSIP	Modular Open-Source Identity Platform
MRMIMS+	Monitoring and Reporting Mechanism Information Management System
NISE3	The National Intelligence for Skills, Education, Employment and Entrepreneurship
OFDA	Office of Foreign Disaster Assistance
SaaS	Software as a Service
SDGs	Sustainable Development Goals
STAC	SpatioTemporal Asset Catalog
UNBL	UN Biodiversity Lab
UNEP	United Nations Environment Programme
UNICC	United Nations International Computing Centre
UNICEF	United Nations Children's Fund
WFP	World Food Programme

Overview

Digital public goods (DPGs) are crucial building blocks for enabling countries to build safe, trusted and inclusive digital public infrastructure (DPI)*, and are increasingly becoming critical levers for helping countries achieve the Sustainable Development Goals (SDGs). Unlike many one-off digital solutions — that are designed and implemented in a vacuum, and then maintained until decommissioned — DPGs by default are open for anyone to study, adapt and replicate in different contexts.

Whilst DPGs also include open data, open AI models, open standards and open content, this research is mostly focused on open-source software. More specifically, it seeks to explore the necessary ingredients for developing, implementing and replicating open-source software at scale in a sustainable way.

The report is divided into two sections:

SECTION I presents synthesized findings from five case studies. They represent distinct digital solutions that have been successfully implemented and are helping to provide society- wide benefits. Among them, MOSIP, Primero and UN Biodiversity Lab are accredited DPGs.

MOSIP	A modular and open-source identity platform that helps governments and other user organizations implement digital, foundational identity systems in a cost-effective way.
Primero™	A web app for confidential case management and incident monitoring, with family tracing and reunification tools that assist social services, humanitarian and development workers in managing protection-related data.
Co-WIN Winning Over Covid-19	The digital backbone of India's COVID-19 vaccination programme, which facilitates registration and booking of appointments for vaccination and provision of vaccination certificates for people, enabling monitoring of vaccine utilization, coverage and wastage throughout the system.
UNBiodiversity Lab	An open-source spatial data analytics platform that provides access to nature, climate change and sustainable development datasets in new ways to empower governments and stakeholders to make evidence-based decisions.
2041 a2i innovate for all	A government programme that aims to accelerate inclusive digitization of public services in Bangladesh, thereby widening access and decentralizing delivery.

SECTION II discusses overarching insights that were gleaned from the case studies, with valuable lessons that can be adopted to promote effective implementation, replication and scaling in development contexts where DPGs are not yet widely adopted. The key insights are summarized below:

1. **DPGs require strong stewardship:** DPGs that are open-source software need a core team, adequate governance and funding for long-term success. Stakeholders' understanding of DPGs and their assumptions surrounding effective stewardship of them must evolve in lockstep.

2. **Effective business models sustain and scale DPGs:** Maturing products with strong DPG potential should be actively matched with the necessary business models to secure adequate resources for their sustainability and scaling.

3. **(Re)engineering products with an intent to scale is beneficial:** Whilst DPGs are typically created to address specific problems, they must also be engineered for scalability and interoperability in order to meaningfully contribute to the evolving DPG ecosystem.

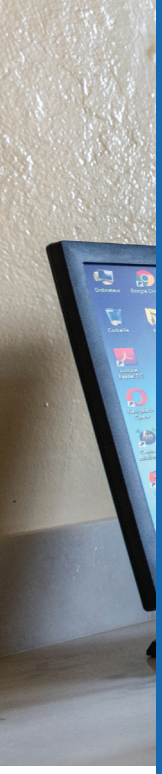
4. **Bringing local partners into the DPG ecosystem can boost replication:** Advancing DPGs to support development outcomes will require engaging with local partners.

5. **DPGs and DPI are contrasting yet complementary:** Digital public infrastructure refers to a set of digital building blocks which are interoperable, built on open standards and specifications providing access to public and private services at societal scale and are governed by enabling rules to drive innovation, inclusion, and competition in the digital economy. DPGs' openness and interoperability enable them to be plugged into a DPI. The two concepts are different, with varying purposes, investments and time horizons.

DPGs can be adapted and replicated to help countries achieve their national priorities and the SDGs. At the same time, realizing this vision requires digital cooperation and widespread knowledge sharing around DPGs to support their development, implementation and sustainability. From their technological design to the governance and resources needed for their maintenance, no two DPGs are the same. Nevertheless, the findings of this research have demonstrated that there are common threads with lessons and insights that can be harnessed within the broader DPG ecosystem to inform developing, deploying, adapting, adopting, implementing and sustaining DPGs at scale.

* DPI is an evolving approach that the Government of India is building momentum for through its G20 Presidency. GovStack defines DPI as solutions and systems that enable the effective provision of essential society-wide functions and services in the public and private sectors. At UNDP, we believe that a DPI approach should include safe and secure technology systems that are networked and enabled for public interest, where people, communities, governments and businesses can derive accelerated value and opportunities to achieve the SDGs.

Methodology note

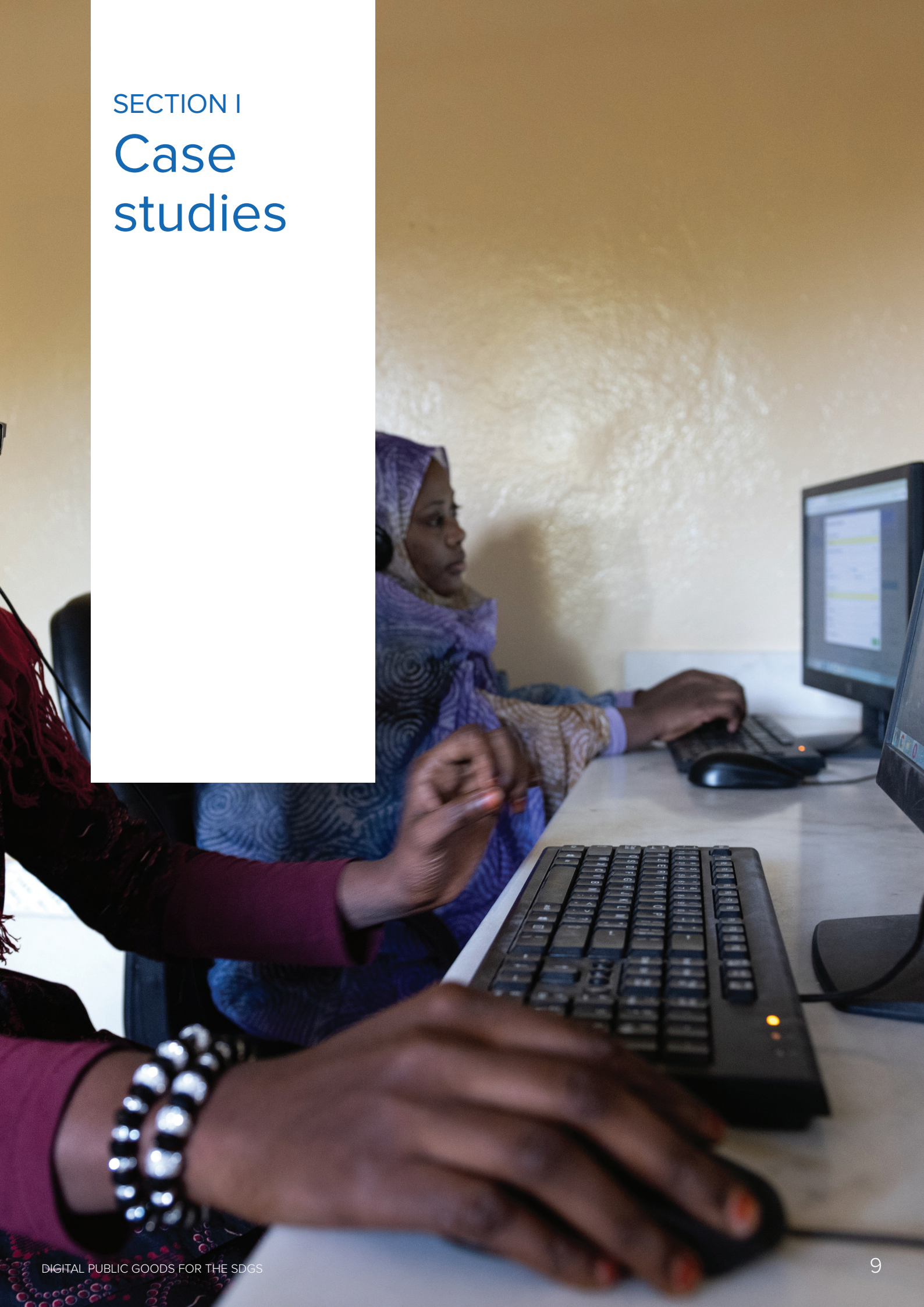


The findings of this research are based on case studies of four digital solutions that have been implemented (three of which are accredited DPGs), as well as a government programme with a digital mandate. The research relied on a qualitative suite of data collection and analysis methods, including in-depth interviews, focus group discussions with a range of experts from the respective project teams and a desk review of secondary sources.

The insights garnered from the case studies were initially reviewed by a pool of subject-matter experts from DIAL, Digital Public Goods Alliance and UNDP networks. These insights were then synthesized through a series of in-depth discussions. Except for a2i (which is unique in its form as a programme compared to the other digital solutions), the data collected from each case study was systematically evaluated based on the following categories: technical architecture, business model, organizational stewardship, community support, replication and scaling. The research was conducted throughout 2022.

SECTION I

Case studies



SECTION I

Case studies

The findings of this research are based on case studies of four digital solutions that have been implemented, and a government programme with a digital mandate. Among these five case studies, MOSIP, Primero and UN Biodiversity Lab are accredited DPGs. The research relied on a qualitative suite of data collection and analysis methods, including in-depth interviews, focus group discussions with a range of experts from the respective project teams and a desk review of secondary sources.

To fully realize this immense potential, thoughtful attention must be given to exploring what it takes to develop, implement, scale and sustain DPGs. The case studies presented here seek to uncover best practices working with DPGs at scale. They offer useful lessons and insights on technical architecture, business models, organizational stewardship, community support and partnerships.

DPGs are responsive to both their technological environments and the conditions in which they are developed. This means no two DPGs are the same — they use different technologies, have different workflows and governance, function in unique contexts and require varying types of support and resources.

As more success stories of DPGs emerge, an enabling ecosystem (comprising public-private players such as governments, funders, IT vendors, multilateral and civil society organizations) can help provide the necessary conditions for them to flourish and be replicated more easily. Gathering evidence on what makes a successful DPG and the consonant environmental conditions necessary for scaling and sustainability are therefore paramount.

Case Study
MOSIP

Case Study

MOSIP

How digital public goods can power countries' digital public infrastructure

DPI has emerged as a critical enabler for many countries, particularly in transforming their functions and service delivery. Governments that have started to build technology stacks and deploy DPI have been leveraging existing DPGs across a spectrum of use cases.

Data exchange, digital legal identity and digital payments are foundational digital systems that can drive national digital transformation.[1] MOSIP (which stands for Modular Open-Source Identity Platform) is one of the core platforms driving innovation in this area of the stack. Along with other systems like ODK, X-Road, OpenIMIS, Mifos, Mojaloop and OpenG2P,[2] MOSIP is powering government-led innovation and service delivery in India, enabling interoperability across the wider network of foundational digital systems.

A highly documented solution with a robust community of practice, MOSIP burst onto the scene in 2018. The founding of MOSIP was led by the International Institute of Information Technology Bangalore (IIIT-B), with initial financial and operational support from the Bill & Melinda Gates Foundation, Sir Ratan Tata Trust and the Omidyar Network. These organizations have continued to support MOSIP over time, with the additional support of Norad (Norwegian Agency for Development Cooperation).

MOSIP is at the forefront of current discussions regarding what constitutes a good digital ID, and in particular calls for ID systems to be established as secure and interoperable DPI. Though inspired by some of the key lessons the Indian Government learned from its implementation of Aadhar (its digital identity layer), MOSIP has gone further, by creating an open ecosystem that privileges interoperability with global solutions. It also features a vendor-agnostic digital architecture that prioritizes agency for governments of their ID data.

Case Study

MOSIP

DETAILED EVALUATION

MOSIP's centralized architecture and federated authentication of digital (legal) identities rely on the secure collection and storage of biographic and biometric data from individuals. This functionality is enabled by core modules that support data storage and validation, deduplication, the issuance of a unique ID and authentication based on that unique digital ID.[3]

Technical architecture

MOSIP was designed to be modular, meaning its core system is comprised of components that can evolve or be replaced over time. In practice, there is a certain amount of customization that will happen whenever it is deployed,[4] and that is an intentional part of the design. This is part of the reason it is being increasingly positioned as a key input to the ideal technology stack that many low- and middle-income countries might seek to adopt.

Several key protections are in place to secure the platform, including precluding direct access to data stored in the database and the use of a zero-knowledge administration principle so that data can only be accessed via Application Programming Interfaces (APIs).[5] Privacy and security are built into MOSIP's infrastructure, but will need to be assessed further as more organizations deploy it as an input to the technology stack powering governments (e.g., India[6] and Singapore[7]). By building capacity around the use of its open APIs and open standards, MOSIP demonstrates how similar solutions can enable interoperability whilst minimizing the potential for harm.[8]

Business model

Part of MOSIP's success can be attributed to its original design for scale. MOSIP benefited from the learnings of the Aadhar system (referenced above) that accelerated the development of MOSIP's architecture. Having an initial proof-of-concept that was tied to a high-profile use case (and supported by connections to some of Aadhar's original architects) positioned MOSIP's founders favourably.

This early success allowed MOSIP's developers to secure funding from Tata Trusts, Omidyar Network and others. This funding expedited the development of MOSIP and gave the team the latitude to innovate and test some of its functionality in other countries like the Philippines. The presence of high-profile, global advocates with credibility in their fields was also critical for bringing attention to the project, creating channels to demonstrate impact and raising funds.

Organizational stewardship

Academic institutions help nurture and maintain MOSIP's core platform, develop training and capacity-building activities and convene a community of practice. This is in large part due to the longstanding connections between academia and the DPG community.[9] IIIT-B, a research university with significant connections to the public and private sectors in India, took over stewardship and core support for MOSIP.

Case Study

MOSIP

IIIT-B was able to develop and launch MOSIP using a relatively small team. Its early investments and attention helped accelerate MOSIP's adoption and recognition in the global ecosystem. The early funding and development efforts of IIIT-B were bolstered by highly visible advocates—especially Nandan Nilekani, who founded Infosys and was key to the development of India's Aadhar system; and Bill Gates,[10] whose foundation funded the development of MOSIP.

Community support

Community governance is vital to MOSIP and has been supported by the academic environment in which MOSIP is housed at IIIT-B. MOSIP is strengthened by a global community of collaborators.[11] This community has mechanisms in place to contribute to and monitor the codebase, as well as approve changes. A promising feature of the MOSIP community is the Principles of Engagement designed to guide identity technologies through their rollout in low-resource contexts. This community has also endorsed the World Bank's Principles on Identification for Sustainable Development.[12] Still, it should be noted that the open nature of the MOSIP platform does not mean challenges associated with creating and enforcing an inclusive digital identity ecosystem in a way that mitigates the potential for harm are automatically bypassed.

Replication and scaling

MOSIP created a modular, open-source digital identity ecosystem at a time when few comprehensive, end-to-end solutions for digital identity existed. Securing high-profile partnerships with governments to use MOSIP as the foundation for their digital ID systems engendered confidence and strengthened advocacy efforts for its scaling.[13] [14] MOSIP signed comprehensive memorandums of understanding with governments, which included scope for technology transfer, capacity building, technology advisory services and advanced Level 3 support (that comes with the highest level of technical expertise) for the development and maintenance of the core MOSIP platform.

At the time of writing, MOSIP has signed memorandums with eight different countries: Morocco (2018), the Philippines (2019), Ethiopia (2020), Sri Lanka (2020), Guinea (2021), Togo (2021), Madagascar (2022) and Burkina Faso (2022).[15] MOSIP is supporting implementation rollouts in each of these countries except for Sri Lanka. MOSIP has had a strong presence at international, regional and multilateral fora, and has received support from reputable bodies such as the DPGA.

Case Study

MOSIP

LESSONS LEARNED

The strength of MOSIP stems from its high degree of modularity and engagement with civil society organizations, independent open-source enthusiasts, multilateral alliances and development partners. Like Aadhar, MOSIP benefits from public-private collaboration, and is anchored by an academic institution (IIIT-B). Nonetheless, it remains prominently supported by commercial partners and global actors.[16]

Whilst MOSIP has had notable success in managing a robust community and expanding its reach, implementation has not always been smooth. Despite MOSIP's contributions to the digital ID ecosystem, from a technical standpoint there remain questions about its position as a foundational building block to the technology stack.

LESSON #1

Early funding and high-profile champions boosted development, scale and credibility

MOSIP's rapid rise through national and international networks since 2018 was enabled by learnings from Aadhar. This early success reflects positively on MOSIP's value proposition, and strengthened the credibility that IIIT-B and MOSIP's initial supporters had developed through strong connections to some of Aadhar's original architects. This enabled early success in attracting core funding from the Bill & Melinda Gates Foundation, Tata Trusts and Omidyar Network that rapidly accelerated MOSIP's efforts to build a community and scale.

Case Study

MOSIP

LESSONS LEARNED

LESSON #2

A dedicated fiscal home and organizational stewardship allowed MOSIP to thrive

The success of MOSIP's stewardship by IIIT-B and others has led to the creation of an effective international community of practice, and enabled its rapid scaling and a considerable number of replications since 2019. Academia has been an ideal home for MOSIP that created a collaborative environment to support scaling and sustainability.

LESSON #3

DPGs functioning as DPI require continuous testing and support

MOSIP's country implementations are at varying levels of maturity (and therefore not ready to offer full lessons to the broader community). Nonetheless, MOSIP has positioned itself as an important part of engineering digital solutions for countries. As MOSIP continues to scale, its impact is also expected to grow. One of the benefits of MOSIP is that, despite being centralized, it is not a walled garden with restricted access. As it evolves, governments and other implementers are expected to enforce community norms of trust and help adapt it to specific needs and contexts.

LESSON #4

Privacy, security and trust are essential

The principal concerns surrounding MOSIP implementations are related to the centralization of digital identifiers, an indication that responsible data governance remains a priority. The centralized nature of its approach is not inherently problematic; it confers benefits for interoperability within the stack. However, it also means that the MOSIP framework will need to rely on the enforcement of trust frameworks (that can themselves be open to abuse).[17] Close observation of how this architecture responds in country implementations is required in order to modify the core architecture of MOSIP as needed, in addition to constructing guardrails for its safe and secure usage.

LESSON #5

Highly modular architecture grants the potential for interoperability

When considering MOSIP's support of multisectoral architecture, its recent collaboration with OpenG2P (a payment platform developed in response to the challenges COVID-19 posed to the Government of Sierra Leone) is instructive.[18] This collaboration is supported by UNDP, Mifos, the Government of Sierra Leone and a community of open-source volunteers.[19] It embodies the ethos of DPI by assembling different pieces of open-source software that are DPGs to create a product that is greater than the sum

Case Study
MOSIP

of its parts.[20] By introducing MOSIP, there is enormous potential for it to support the biometric enrollment of beneficiaries and the authorization of payments, manage flows of data, enable integration with other platforms and support OpenG2P's integrations with open-source building blocks.

MOVING FORWARD

MOSIP will need to continue promoting interoperability to enable countries to mix and match, thereby reducing the upfront costs of developing secure, identification-based infrastructure. By doing so, governments can reallocate time and funding into innovation and services that ride on top of the stack. Whilst there are always risks and vulnerabilities to such modular approaches, particularly around privacy and security, the support of partners can help strengthen the sustainability of MOSIP via responsible implementation. MOSIP continues to be an illustrative use case for how DPGs can be deployed as DPI at scale, and a practical example for development actors that are interested in investing in and supporting DPG adoption across governments.

Case Study
Primero

Case Study

Primero

How UN-led innovation allows digital public goods to replicate at scale

DPGs have become integral to the UN System's efforts to advance the SDGs, as articulated in the UN Secretary-General's Roadmap for Digital Cooperation.

UNICEF was at the forefront of the early DPGs movement. Within the UN System, UNICEF was one of the early adopters of open-source technologies, which paid dividends as Information and Communications Technology for Development (also known as ICT4D) projects began attracting significant funding. The formation of the DPGA, which was co-led and driven by UNICEF in 2018, helped unite the efforts of UN agencies working on technology and innovation. This included the International Telecommunication Union (ITU), UNICEF, World Food Programme (WFP), United Nations Development Programme (UNDP), UN Global Pulse, amongst others. The DPGA has given global actors and the UN alike a common mandate around the role of open-source innovation in global development, as well as a common language for describing, understanding and working with DPGs.

A pioneering example of how a UN agency could incubate and support DPGs was UNICEF's Primero: a web app for confidential case management and incident monitoring, with family tracing and reunification tools. Primero assists social services, humanitarian and development workers in managing protection-related data and was one of the first accredited DPGs.[21] Primero's design began in 2012 and was led by the Child Protection Programme Division at UNICEF headquarters in New York, with support from Quoin, a technology firm that worked on the prototyping of the platform.[22] Seed funding for the project and support for the initial design of the system and application was obtained from the Office of Foreign Disaster Assistance (OFDA) and the U.S. Centers for Disease Control and Prevention (CDC).[23]

The story of Primero demonstrates the UN's role as a product incubator and convenor. Given Primero's eventual scale and its adaptive approach to community governance and business sustainability, there is much to be learned from it.

Case Study

Primero

DETAILED EVALUATION

Technical architecture

The Primero platform offers three modules: CPIMS+ (Child Protection Information Management Systems), GBVIMS (Gender-Based Violence Information Management System) and MRMIMS+ (Monitoring and Reporting Mechanism Information Management System).[24] These modules provide multipurpose functionality for case workers, monitors and managers, creating a robust backend with complex workflows. Whilst the backend has mostly remained consistent throughout, the front-end has evolved over time to become more user-friendly and support a wide range of use cases. Customizations of Primero, including its core component, for specific contexts are made based on robust product reviews with specialists in the field. Since its launch, the Primero team has introduced a second version of the product and an updated web application. Further development is underway for a software-as-a-service (SaaS) package called Primero X. As Primero evolves, the range of options and possibilities may increase, but this also expands the codebase and related possibilities of failure elsewhere in the system. Constant re-evaluation and technical assessments are therefore required.

Business model

Early core funding from the OFDA and CDC helped to prototype and develop the project, so that future agile design could focus on testing and refining.[25] Funding to cover ongoing costs came from UNICEF.[26] The Primero community remains intentional about working to ensure that the platform grows responsibly and within the bounds of its existing capabilities as a project.[27]

There has been significant focus in the last several years on financial sustainability, and the Primero team has worked to create a robust business model anchored in a realistic understanding of its operational costs.[28] Primero has moved towards a subscription model to help diversify its revenue streams. However, the subscription model is constrained by some fiscal challenges in transferring money between UN agencies and partner organizations, including government and civil society users. Whilst the business model will require refinement, diversification of Primero's operations in recent years has created more pathways towards sustainability.

Organizational stewardship

Primero had a clear use case that was connected to UNICEF's goals, priorities and organizational ethos. Early proponents of Primero ensured that it was featured in the UNICEF Strategic Plan and embedded in UNICEF's work worldwide. Whilst there is tacit connections to the UNICEF brand (that strengthened institutional investment in Primero), the Primero team decided not to brand the app as fully owned by UNICEF. Instead, the team carved out a way for Primero to be quasi-independent. Primero's development is based on collaboration and sharing of best practices among UN partners, and their guidance and tools have also informed its design.

Case Study

Primero

Community support

The Primero community has shared key lessons and identified a set of goals for the platform.[29] As of April 2022, the platform has been deployed in 54 instances in 41 countries. Country-specific deployments of Primero, whether locally hosted or cloud hosted, require community support, including global technical support and local installers with the capacity to conduct training. The project's governance is rooted in good practice principles across the project planning, data collection, data storage and data sharing steps of the project lifecycle.[30]

Replication and scaling

Primero was first piloted in Sierra Leone, in response to the 2014 Ebola crisis, where it is still in use. One government official had projected that: "By 2022, we will ensure that all Ministry of Social Welfare, Gender and Children's Affairs and district council offices are using the Child Protection Information Management System, with agreed reporting, service delivery and referral systems."[31] As mentioned above, Primero has been deployed in 41 other countries since its initial pilot[32] and there are additional feasibility assessments underway in other countries. A key part of Primero's scaling approach has been to enable transfer to local ownership. The Primero team is experimenting with the option of allowing governments or other partners to host production and issue updates and patches as needed.

Case Study

Primero

LESSONS LEARNED

Much of Primero's success has been linked to the ability of the team to carve out its own identity within the innovation space, whilst making consonant strides on a sustainability plan that enables scaling. During its lifecycle, a community of practice has enabled it to mature, but that has also meant a top-down approach to maintaining the codebase and a business model focused on SaaS. Primero's product owners are beginning to invest in ways to grow the community, with the recognition that additional research may need to be done to realize the benefits of its community structure for the core platform.

LESSON #1

Core funding, strong organizational buy-in and well-established partnerships can catalyse scaling

Initial core funding allowed the Primero team to focus on rapid iteration of the platform and forming a community of practice. Additionally, UNICEF's dedicated buy-in and support connected it to a network of Country Offices that were invested in it and could ensure its future adoption and success. This enabled country partners to deploy and adapt the platform according to their needs and requirements more swiftly.

LESSON #2

Linkage to the ethos of a hosting organization fosters effective stewardship

From the outset, Primero was designed as a public good tied to the vision and mission of UNICEF — the protection of vulnerable children and survivors of violence. This provided Primero with a compelling organizational mandate and a fiscal home. The close ties between the product mission and the organizational mission demonstrate that such connective tissues can help DPGs to flourish, especially in a complex, bureaucratic environments.

Case Study

Primero

LESSONS LEARNED

Nonetheless, the case of Primero demonstrates how DPGs can build their reputations and brands distinct from their hosts.

LESSON #3

Having dedicated product owners encourages growth

UNICEF ensured Primero had dedicated product owners for the platform who could lead its growth. This support allowed Primero to engage with the community very intentionally, especially through annual community meetings. Even as Primero sought to build its unique brand identity distinct from UNICEF's, organizational support enabled the platform to explore new partnerships and business models.

LESSON #4

Strong partnerships build strong communities needed for DPGs' success

The strength of Primero's community of support and its success at scale are in part due to strong, wide-ranging partnerships. The Primero team wanted to allow partners to contribute in diverse ways besides funding. The team also wanted to be transparent and open so that partners could either adapt the open-source code or use Primero out of the box. The use of DPGs like Primero by local partners for local deployments can create efficiencies, as context-specific insights that are uncovered can inform adoption and future development based on local needs.

LESSON #5

Having a business model is important for sustainability

Whilst UNICEF invested in Primero from the outset, that funding was not sufficient to keep the project sustainable. The project aims to become financially independent in three years, and alternate financing channels (such as its subscription service) are being explored. The team is also driving costs down.[33] In its new business model, Primero is offered from UNICEF-hosted platforms as a service, with support to help set up community infrastructure and local hosting. This enables the transfer of ownership to country governments so that the Primero project team can free up resources and focus on core development.

Case Study

Primero

LESSONS LEARNED

LESSON #6

Adapting DPGs in low-resource environments requires early focus on building local capacity

The Primero team is committed to an intentional approach to sustainability, particularly around country adaptation. UNICEF handles the installation and maintenance of Primero differently, allocating staff to provide technical and programmatic support based on country requests.

LESSON #7

Maintaining a community of practice is a continuous process

Maintaining a community of practice is one of the challenges that Primero team faces. Primero demonstrated that governments and civil society working in the humanitarian and development space are welcoming new ways of working — they do not want to remain dependent on technology vendors and are seeking alternative pathways for working with UN agencies in response to local needs. The Primero team has evolved accordingly, increasingly focusing on the SaaS approach and finding a business model to support it. They are also investing in new ways to involve communities in core maintenance and developing new capacity tools and services that will yield dividends in the future.[34]

MOVING FORWARD

To continue being successful, it will be important for Primero to accrue evidence from its deployments to make a case for further institutionalization within partner countries. In addition, the team will need to put emphasis on strengthening community governance and ensuring business sustainability.

Case Study
CoWIN

Case Study

CoWIN

How UNDP helped create a public vaccine infrastructure in India

Given the recent shift towards public recognition, stewardship and maintenance of DPGs, many digital solutions are being developed, deployed and supported within local ecosystems.

One such example is CoWIN (Winning Over COVID-19)[35] — a modular, electronic vaccine intelligence platform for vaccine registration and delivery. CoWIN emerged during the COVID-19 pandemic, but its foundations are built on top of a successful system called eVIN, India's Electronic Vaccine Intelligence Network. eVIN was conceived by India's Ministry of Health and Family Welfare in 2013-2014, and UNDP began supporting its scale up in 2015 that improved the efficiency and effectiveness of the routine immunization vaccine supply chain in the country.[36] eVIN was converted to an open-source system in 2021 and supports vaccine logistics and remote temperature monitoring in vaccine supply chains,[37] leading to the growth of a public health infrastructure to support training and capacity building.

In 2020, the team at UNDP India began expanding the functionality of eVIN to support a cloud-based, end-to-end solution for delivering COVID-19 vaccines. The goal was to create a system that would also facilitate registration, immunizations, appointments and issuing certificates. UNDP India and the Government of India worked together to develop an end-to-end platform, connected by a series of modules that supports not only eVIN's functionality, but also comprehensive registration, credentialing of beneficiaries, a people-centric user interface and increased interoperability.

Since CoWIN's deployment in January 2021, more than 1.1 billion people have been vaccinated against the virus across more than 5,000 sites (where over 2.2 billion vaccine doses were administered), most of which were in rural and hard-to-reach areas.[38] An average of 3.75 million doses per day were distributed across the country from April to November 2021.[39] These figures are based on data available at the time of writing.

CoWIN succeeded in India because it emerged at the right time and the right place, building upon an existing foundational platform and public health infrastructure. It also benefitted from early investment in the community infrastructure needed to scale vaccine delivery swiftly. By improving and extending the public vaccine infrastructure that had already been developed with eVIN, CoWIN was able to support a wider range of health care outcomes and meet the requirements of the COVID-19 vaccine supply chain. CoWIN's rapid development and scaling also illustrate the importance of DPGs focusing on modularity and interoperability, as CoWIN was able to interoperate with other systems like DIVOC (Digital Infrastructure for Verifiable Open Credentialing) for credentialing vaccines. Studying CoWIN may offer timely and useful lessons for the ecosystem.

Case Study

CoWIN

DETAILED EVALUATION

Technical architecture

CoWIN is mainly based on open-source technology developed by the Government of India, but also leverages other open-source utilities, such as DIVOC. The software and codes for eVIN and CoWIN are available on GitHub and the Government of India as part of its leadership in DPI is considering open-source repository options to make their technologies easily shareable.

eVIN module: In 2015, development of eVIN began with developers seeking capabilities for vaccine delivery, remote temperature monitoring and supply chain logistics. During its deployment, there were additional upgrades based on user feedback, including from last-mile health workers. From 2015 to 2020, the Indian Government, in coordination with UNDP, trained staff in more than 29,000 health facilities on how to implement and support immunization programmes using eVIN. As a digital public health infrastructure, eVIN was already highly successful before the COVID-19 pandemic and it provided the foundation for the rapid development of the CoWIN platform in late 2020.

DIVOC: Vaccine credentialing and the ability to issue certificates were essential functions that CoWIN needed. DIVOC, an existing open-source DPG for large-scale vaccine credentialing,[40] provided this functionality. Initial integration of DIVOC's credentialling module with CoWIN proved simple, given the open standards of both platforms. This allowed for interoperability with third-party applications and rapid iteration alongside other open-source components.[41]

CoWIN module: CoWIN introduced additional open modules to the eVIN core to extend the lifecycle of the product down to the level of patient beneficiary and tracking. It also included the creation of a user-centric portal for people. Whilst eVIN was useful for tracking vaccines and managing vaccine logistics and supply chains, the introduction of additional modules also added capabilities such as: (1) beneficiary registration; (2) QR-coded certificate delivered via SMS text; (3) planning and allocating sessions for vaccination; (4) vaccinator module for one-site verification and vaccination confirmation; and (5) tracking any adverse events following immunization. These modules transformed CoWIN into an end-to-end solution over and above the delivery and management of vaccines.

Business model

CoWIN continues with support from GAVI COVID-19 Delivery Support (CDS), and India's Ministry of Health.[42] Interestingly, about 85 percent of the total budget for eVIN and CoWIN (2015-2021) was expended on operational costs, including hardware procurement, training, HR, administration and logistics, with the remaining 15 percent spent on software development and hosting infrastructure. In India alone, one million staff needed to be trained on CoWIN, and 375,000 facilities needed to be staffed and equipped. The Government of India is committed for the smooth transition of eVIN and CoWIN from external funding to domestic funds, and has offered CoWIN software to other countries, with UNDP as a potential partner to support its implementation. For this reason, the business model will need

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to address if and how UNDP and GAVI will support the Government of India on future implementations outside India in order to secure its future financial sustainability. Regardless of the approach that emerges, customized business models that are adaptive to the needs of existing national public health programmes and infrastructure will be required.

Organizational stewardship

The implementation team supported by UNDP comprises around 900 people, with additional support from the Government of India, and thousands of local health offices, including 29,000 health facilities and 375,000 local vaccine centres. This includes engagement with for example eGov Foundation, as a subcontractor to EY, for setting up secretariat at National Health Authority. The model of public-private collaboration has been tremendously successful in deploying, scaling and iterating CoWIN.

Community support

The CoWIN model has been heavily dependent on community infrastructure for training and capacity building on the CoWIN systems. The creation of a federated governance system and a trainer-of-trainers model combined with a specific focus on last-mile health solutions has reaped huge dividends in making CoWIN widely understood by community health workers across India. CoWIN has had unprecedented success and high levels of acceptance amongst people, mainly due to its user-friendly design, the ease of registration, instant certification and the ability to select convenient vaccination centres and appointment times. This continued cultivation of an active community of contributors for CoWIN. Additionally, specific targets for CoWIN were set by the Government, with the expectation from the outset in 2020 that the platform should be able to take on and manage records for one billion users. This target has been surpassed.

Replication and scaling

The CoWIN platform has not been officially deployed outside of India, though DIVOC has been deployed in four other countries. While CoWIN has been highly successful and exceeded its targets in India, questions around scalability will remain as they concern community infrastructure and capacity to manage data. Different countries will need to explore different hosting solutions to ensure interoperability with existing health and identity databases and scale delivery if demand surges. The model for replication requires further research, given how specific its deployment was in India. Other countries will need to consider how best to use a DPG like CoWIN within the constraints of their existing public infrastructure whilst creating the requisite capacity and community support.

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CoWIN

LESSONS LEARNED

CoWIN (alongside Aadhar) is one of the biggest data platforms held by the Indian Government, where it stores beneficiaries' registration and individual health ID data. Whilst the CoWIN platform was set up to meet the needs of supply chain management in a vaccine context, the broader technology architecture that underpins eVIN is well-suited to other areas of supply chain management within the health care sector. This has created the potential for other use cases. There are lessons to be learned from CoWIN on how to promote and facilitate data interoperability with other parts of the technology stack.

Whilst CoWIN is a clear success in terms of its technology and the model for scaling, its future as a DPG will depend on some strategic decisions. As CoWIN evolves, it will need to develop a supporting governance structure for replicating itself in other contexts and create new channels for others to contribute to its codebase. This will require the Government of India to develop new business models. Whilst these may be challenges, they also represent opportunities that the CoWIN project can harness to ensure its growth and sustainability.

LESSON #1

Many DPGs were originally technology-neutral

CoWIN was designed to solve a use case before it was designed as a technology solution. The project was officially 'technology neutral' that allowed its needs to determine what technology was used. This is a useful lesson of what can happen when programmatic work drives the development of technology.

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LESSONS LEARNED

LESSON #2
Scaling DPGs requires adapting to local realities

Challenges such as staff training, resourcing and the availability of electrical supply can determine the future adaptation of an open-source platform and how it is maintained and hosted. Implementations in other contexts will require both global and country-specific guidance and expertise. Final adaptation and solutions will be determined by local contexts. To avoid disproportionate investments in new technology systems, UNDP India found (with CoWIN) that it is best to invest in human capital and infrastructure initially and then strengthen digital capacity later. Ensuring capacity building for the last mile has been key for CoWIN to scale. As a digital tech platform for public health, investments in digital capacity have helped to empower the workforce close to where vaccinations have taken place. This ensured that personnel had the understanding and the flexibility required during the pandemic to update systems, standard operating procedures and policies whilst remaining focused on user friendliness for maximum adoption.

LESSON #3
The balance of costs shifts as solutions transition from proprietary to open-source platforms

The ways in which costs are distributed evolve as projects shift from proprietary to open-source technology, including whenever they scale or become institutionalized as DPGs. In the case of eVIN, the recurring costs involved in supporting proprietary systems included subscription or hosting fees and costs to vendors, so its migration to open-source systems enabled the reallocation of resources to human capacity and community infrastructure. The early migration of eVIN to an open-source model paid dividends when CoWIN was introduced, as the major costs in scaling up the additional CoWIN modules were related to AWS hosting costs.

LESSON #4
Modularity and interoperability are scale-enabling strengths of DPGs

Unlike proprietary solutions, open-source technology does not have intellectual property restraints, which makes it easier for developers to use modular components to design and scale new systems. Much of the success UNDP and the Government of India had in implementing CoWIN at such large scale was due to existent modular technologies like eVIN and DIVOC that could be combined to meet the needs of its use case. Iterating on those existing technologies rapidly and tailoring them to the needs of a local context enabled value creation for both implementers and beneficiaries. Additionally, continued interoperability between eVIN, DIVOC and the new CoWIN module has enabled those parts to function on their own whilst also summing up to something greater when combined.

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LESSONS LEARNED

LESSON #5
Government leadership of digital infrastructure is critical in driving use of DPGs at scale

Since 1985, India has enjoyed a robust universal immunization programme for children, with well-established operating protocols for vaccine management. These early investments supported technology transfer from eVIN's deployment to CoWIN's deployment, in addition to facilitating continued knowledge transfer and end-to-end support. Without eVIN's supporting infrastructure, CoWIN would have been limited in its ability to scale.

LESSON #6
Choosing which part of the product to be a DPG is critical

CoWIN's future is U-WIN: a merge between eVIN and CoWIN. It would be ideal to have a similar functionality of an end-to-end solution that other countries can leverage for managing their vaccine supply chains and tracking vaccine beneficiaries. Whilst the COVID-19 pandemic is slowly fading, vaccine platforms are looking at the future of routine immunization efforts, where platforms such as U-WIN are integrated components of national programmes for maternal and child health, HIV, tuberculosis, malaria, etc. Work is underway to modify CoWIN, which is necessary for submitting the project for official accreditation from the DPGA (at which point UNDP and the Government of India might be able to better support the deployment of CoWIN in other contexts). CoWIN is a great model of what project-led innovation within the UNDP network looks like, and how it can create the conditions for successful DPGs to emerge.

MOVING FORWARD

It is important to align stakeholders around ownership and a governance structure, as well as establish a dedicated funding pool and business model. In the case of CoWIN, being a critical public health platform, its success can be attributed to the Government stepping in and taking on ownership and funding responsibility. In providing a first-in-class model for bundling these elements together, CoWIN's technology stack and its constituent modules offer an attractive opportunity for other countries to replicate. Adaptation of the CoWIN platform to other contexts will need to consider the legal and regulatory framework for data storage, as well as alignment with existing platforms, enterprise architectures and interoperability standards.

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How the UN champions digital public goods through collaboration

UNDP and other international organizations are growing their influence in the landscape of DPGs by supporting digital innovations that can be replicated and used in different countries and contexts. Given the UN's role in convening and influencing policies, there is a case to be made for UN agencies to support data and capacity building platforms as DPGs. Whilst many open datasets exist, they are sometimes difficult for global audiences to discover and for policymakers to use and analyse. Creating global platforms that make open data sets more accessible and useable can help advance the UN's agenda on developing national capacity and supporting evidence-based decision-making.

The UN Biodiversity Lab or UNBL is a global platform which provides access to high-quality spatial data to monitor biodiversity loss and support evidence-based decisions for conservation and sustainable development. Launched in 2018 by the Secretariat of the Convention on Biological Diversity (CBD), UNDP, the UN Environment Programme (UNEP) and the UN Environment Programme World Conservation Monitoring Centre (UNDP-WCMC), UNBL provides novel ways for policymakers to interact with spatial data, aiding them in identifying and solving critical issues in biodiversity conservation, climate change and sustainable development. In October 2021, an updated UNBL 2.0 was launched as a free, open-source platform. The 2.0-release brings together 400 of the world's best global spatial data layers from more than 40 data providers for use in research, policymaking and innovative software applications.

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DETAILED EVALUATION

Technical overview

UNBL seeks to make spatial data and maps on biodiversity, climate change and sustainable development openly accessible to environment-related policymakers without requiring geographic information system expertise. The first version of UNBL was a basic tool focused on making geospatial data for biodiversity accessible to those with more limited technical capacity through a web-based platform that contained both proprietary and open-source code. The original platform was less intuitive for users and had fewer data layers and analytic capabilities. The development of UNBL 2.0 focused on increasing usability, expanding the range of data and tools, becoming fully open source, improving core functionality, enhancing the user interface and adding accessibility features.

UNBL 2.0 is now an open-source system based on technology developed by the National Geographic Society (NGS) that is currently maintained by Impact Observatory (IO), a technical partner. The development of UNBL 2.0 leveraged a multimillion-dollar investment from NGS. In its new form, the platform includes the most up-to-date open-source geospatial tools to enhance functionality and utility. The resulting platform enables users to access hundreds of global data layers and a set of metrics calculating key environmental indicators on more than 4,000 territories around the world. National policymakers and other non-commercial stakeholders can utilize UNBL workspaces to upload datasets to share insights, plan interventions and monitor changes.

The platform's data resides in the cloud, with raster data located in Microsoft Azure as Cloud Optimized GeoTIFF (COGs) on United Nations International Computing Centre (UNICC) servers. The COG file format enhances data performance in a cloud environment. A SpatioTemporal Asset Catalogue (STAC) provides a rich search interface so users can find metadata, encompassing spatial and temporal extents or by the license and provider of a dataset. STAC also contains a link to the location of each COG to support the backend of UNBL 2.0. When a user requests data for a certain region, the STAC provides a link to an open-source map tiling service, TiTiler, which pulls only the data for that region. The COG format avoids loading an entire global dataset at once. The new UNBL platform combines the best of UNBL 1.0 with next-generation open-source Geographic Information System (GIS) tools to access hundreds of global data layers and metric calculations.

Business model

The current business model for UNBL is based on project-based funding (a series of allocations that have helped to fund technical development, project management, communications and capacity building). The team envisages migration to a diversified business model that includes provision of core funding from convening partners. So far, the success of the platform and its increasing institutionalization within both UNDP and UNEP meant that UNBL has been able to sustain itself using project-level funding allocations. All parties involved are committed to ensuring that the platform is sufficiently funded.

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The UNBL team will continue to explore options for diversifying funding sources to ensure the business model and community support structures for UNBL meet demand.

Organizational stewardship

UNBL convenes a diverse coalition of partners, technical partners, data providers and donors to create sustainable impact for nature, climate and development. The UNBL convening partners, including the CBD Secretariat, UNDP, UNEP and UNEP-WCMC, jointly provide strategic direction and vision for the platform. The UNBL technical partners, including IO, Microsoft, National Aeronautics and Space Administration of the United States (NASA) and UNICC contribute key expertise to implement this vision. More than 40 different data providers and eight different donors contribute the underlying spatial data and funding essential to UNBL's success. The UNBL team consists of 10-15 people working part-time.

The open-source technology underlying UNBL 2.0 is owned by the UNBL partnership. Whilst this configuration between the four organizations has remained stable, it may need to adapt to distinguish between maintenance of the core source code and additional project management. The UNBL teams are considering how a community engagement model can support the goals of improving the functionality of the platform by responding to user needs and managing the core source code.

Community support

The UNBL platform has enjoyed rapid uptake in the community of environment-related policymakers working on biodiversity. The original UNBL documented 360 active policymakers and 55,000 visitors to the site. UNBL 1.0 led to an 81 percent increase in the number of maps in nations' reports on biodiversity to the CBD. At the time of research in mid-2022, UNBL 2.0 had 1,188 new users, 146 new requests for workspaces on the platform (109 of which have been approved based on UNBL's non-commercial use criteria) and 37,274 platform visits. In addition, the UNBL partnership organized 10 events and training sessions that have reached more than 11,000 people.

Though use of the platform is increasing, UNBL needs to expand community engagement beyond convening and technical training. One opportunity may involve accepting new features or core contributions from outside. This would allow UNBL to embrace new innovations, whilst maintaining UN stewardship which makes it a trusted platform for governments.

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UNBL

Replication and scaling

Whilst the platform previously focused on obtaining the support of national policymakers' commitments to the CBD, the platform is now open to any non-commercial users. Consequently, UNBL has not only seen increased adoption among governments, but also many requests from civil society and UN agencies to use the platform to track, monitor and demonstrate impact. UNBL workspaces, which are secure work areas in the platform where approved users can upload subnational and national data and share them with designated users, are swiftly growing in number.

Although UNBL continues to focus on making its functionality most useful for its core users (government policymakers working to deliver on commitments to the CBD), its spatial data, metrics and workspaces can support related work from academics, Indigenous peoples, NGOs, research organizations and UN agencies. UNBL plans to leverage UNEP and UNDP's combined network to drive greater adoption. This plan requires resources and capacity and, in all probability, customization of the platform.

There are widespread opportunities to use UNBL to advocate for nature-based solutions to climate change and sustainable development. Thought has been given to how a similar platform could be replicated with a focus on sustainable development. Initiatives such as UNDP's 'maps of hope' build on the spatial data available via UNBL and use systematic conservation planning to identify essential life support areas (ELSA) where protecting, managing and restoring nature can best contribute to national objectives for biodiversity, climate and human wellbeing. A proof-of-concept ELSA Tool was released on the UNBL platform in 2022 for map-coverage of Colombia, Costa Rica and South Africa through funding from the Gordon and Betty Moore Foundation, with the potential to be scaled to any country in the world. Future replications of the platform for different themes or sectors will have to ensure that data availability is robust and sufficient.

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UNBL

LESSONS LEARNED

While UNBL is one of many platforms responding to the demand for innovative data aggregation, mapping and visualization tools in the environmental sector, it is unique in its focus on collating high-quality national and global data on biodiversity. Its stewardship by UN-based actors, emphasis on the intersection between nature and nature-dependent development and focus on the CBD also serve to distinguish it among others. UNBL has succeeded on a scale where others have not because of its unique functionality, which acknowledges the importance of empowering national stakeholders to work with the best combination of data and analytics. Continued iteration and technical support will enable it to function as a DPG for global policymakers.

LESSON #1

Policymakers need new tools to use data for action

Whilst the core technology of UNBL was not revolutionary in the spatial data community, its positioning at the intersection of conservation and sustainable development sets UNBL up for success. The provision of geospatial analytics to use data and calculate metrics helps UNBL focus on a wider set of user needs. Traditionally, to extract summary statistics from geospatial data, users required technical knowledge of GIS. The UNBL platform embeds that functionality, enabling various spatial analysis that can inform critical decisions. With the release of UNBL 2.0, a new suite of touch-button metrics and an intuitive user interface evolved this functionality further. The technology underneath the platform is fully open-source, affording it the opportunity to innovate in the technology itself. The UNBL team plans to expand the metrics capabilities and add new features that support the creation of action maps using spatial optimization and enable scenario-building functions. The development of curated tools to generate intelligence from the best-available data has been critical to uptake by governments and other actors. UNBL demonstrates a clear example of the

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UNBL

LESSONS LEARNED

role DPGs can play in supporting policymakers to access and use spatial data for evidence-based decision-making.

LESSON #2

Creating open-source DPGs from scratch enables customizing functionality

The decision to fully open-source UNBL 2.0 allowed replication of the requisite functionalities from proprietary systems to serve raster and vector data and calculate metrics. With the STAC and COG architecture introduced in UNBL 2.0, the platform is now a pioneer of using open-source geospatial tools in a cloud-based environment. STAC and COG have become increasingly common and more critical. STAC increases the discoverability of geospatial data on the internet, providing broader access and more efficient data analysis workflows. The UNBL STAC provides an open and centralized place to discover, access and manage an extensive range of science-related datasets. The UNBL STAC will continue to grow as the UNBL team curates new and noteworthy environmental data and remains a valuable resource for users.

LESSON #3

DPGs can serve multiple purposes

UNBL is designed to translate data into actionable insights, which is particularly useful for policymakers and technical specialists alike. While it is principally an open-data DPG, many of its predefined metrics might also be classified as open standards. In addition, while many DPGs are initially developed as proofs-of-concept and minimum viable products then resources are sought for scaling, UNBL demonstrates that development and scaling can be pursued in tandem from the outset. Its design and varied functionalities can inform the future development of DPGs.

LESSON #4

DPGs need a defined audience and ties to recognized initiatives for success

Whilst there are many data platforms for biodiversity, UNBL distinguishes itself through robust functionality, as well as the provision of metrics that render clear value to its audiences. The audience for UNBL is clearly defined: national policymakers working to deliver on commitments to nature-dependent development through the three Rio Conventions, especially the CBD. New functionalities will be introduced in UNBL 2.0 to help make the platform directly relevant to the post-2020 global biodiversity framework of the CBD as well as the SDGs, which it only notionally supports currently. In addition to providing global datasets, UNBL actively encourages policymakers to use national data via the platform. This approach recognizes the higher resolution of national data, and the fact that it is validated

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UNBL

LESSONS LEARNED

for government use. Though many DPGs support the CBD and the 2030 Agenda in principle, the very distinct application of UNBL for policymakers, implementing commitments to international agreements, makes its efficacy more easily understood, easier to measure and strengthens engagement among governments.

LESSON #5

Collaborative governance, when well-defined, is a strength of DPGs

The collaborative model of the four organizations supporting UNBL demonstrates how the UN System can drive rapid product scaling. The teams supporting UNBL succeeded through collaboration, because different teams focused on different aspects of the project. The four convening partners lead the platform's vision and overall management, ensuring it is anchored within the UN System. By its unique ability to unite expertise in the management of environmental data, leverage on-the-ground connections to policymakers in nearly 170 countries, and tap into the CBD Secretariat's mission to support signatory nations in their commitments on biodiversity, UNBL demonstrates a breadth of expertise to meet user needs. Diverse technical partners provide support. The IO team reinforces the back-end of the platform, whilst the UNICC provides secure UN hosting. Microsoft offers the Azure cloud as well as collaboration on technical innovation through its Planetary Computer, and NASA applies platform functionalities as a decision support system through its applied sciences division. The collaboration with more than 40 data providers ensures that UNBL includes the most up-to-date version of high-quality global data on nature, carbon and human well-being. From the outset, the conditions of this partnership have been clearly defined and enable the platform to grow and flourish.

LESSON #6

Managing community engagement and inputs is critical for success as DPGs

Community engagement is critical for global platforms like UNBL. It has not yet been determined whether changes to the source code would be managed via UNBL's governance structures or through community inputs. Decisions around modifying the architecture of the codebase will require the buy-in and approval of the convening coalition. This issue will need to be addressed.

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UNBL

MOVING FORWARD

UNBL should continue upgrading and expanding its core functionality. This guarantees partner buy-in for the core offering. Future community engagement with the platform must be in alignment with its goals. It must also determine a sustainable, long-term business model. Whilst there remains some question about how UNBL will continue to scale and evolve, a collaboratively governed, hybrid platform-and-data model holds promise for the future of how policymakers and non-technical specialists think about and use DPGs in their own work. The champions of the project will need to improve the functionality of UNBL to attract a diverse range of users — especially amongst nongovernment actors. From a technical standpoint, proposed changes include improving UNBL's digital infrastructure and connections via APIs to open-source repositories — both on the UNBL public platform and within UNBL workspaces.

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a2i

Case Study

a2i

How collaborative innovation helps governments build digital public goods at scale

Governments are generally not set up to drive digital innovation in the way that start-ups and collaborative communities do. With much of their emphasis on responsible allocation and use of public funds to fulfil policy objectives, governmental operational and procurement processes tend to be hierarchical and use a waterfall approach to deploying new technology and IT systems. However, there are indications that this approach is beginning to change.

The establishment of innovation agencies within governments is part of the paradigm shift. Such agencies are often semi-autonomous with their own hierarchies and are able to bring in external resources. Today, there is growing potential for these agencies to play a key role in helping governments produce and scale DPGs, as well as procure and deploy new DPI.

One example is Aspire to Innovate (a2i) in Bangladesh, a programme of the ICT Division and Cabinet Division that is supporting the Government of Bangladesh in driving collaborative digital innovation for the public good. In practice, a2i functions mainly as a digital think tank to support the transformation of the Bangladeshi Government. Its activities are geared towards helping the country achieve the SDGs and integrating inputs from community and civil society groups into policymaking. a2i was set up in 2006 by the Prime Minister's Office, with the support of UNDP and others, as part of a joint effort called the Access to Information Programme.[43] This programme was part of the explicit mandate of the Bangladeshi Government towards e-government with funding and technical assistance being provided by UNDP and the U.S. Agency for International Development.[44]

In the past 15 years, a2i has overseen more than 50 projects. These projects focused on different aspects of digitalization, innovation or development cooperation within Bangladesh. Other projects resulted in the development of specific digital products or solutions that were leveraged by other development partners on the ground. a2i focuses on ecosystem strengthening, coordinated via the Prime Minister's Office with all ministries, districts and local government institutions in the country to support and scale up their digitalization efforts and innovation.[45]

This public innovation model provides lessons that are relevant for the DPG ecosystem. It demonstrates the kind of capacity and talents that are needed to support the adoption and maintenance of DPGs. Whilst a2i is in the process of redeveloping its open-source policy, the history of public-sector innovation in Bangladesh has already positioned a2i-supported projects to flourish as public-sector DPGs. This model may yet have lessons for how other countries steward and support the creation of effective DPI.

In 2020, the team at a2i considered converting its many products and solutions into open-source solutions and getting them recognized as DPGs. With catalytic funding from the UNDP

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DETAILED EVALUATION

Bangkok Regional Hub, a2i set out to make two products into DPGs: 1) ekShop, an e-commerce marketplace, and 2) NISE3, an online digital skills platform. The process of re-engineering and updating these two products, according to open-source requirements, was a means of testing the feasibility of a2i's digital solutions as DPGs that could be reused by the global community.

ekShop

ekShop is an e-commerce platform serving the people of Bangladesh.[46] It is designed for grassroots usage and focuses on supporting local communities and connecting e-commerce and logistical partners to consumers through last mile delivery.[47] ekShop started with the unique value proposition of government-led e-commerce. The long-term vision for a2i in Bangladesh is to create an "automated one-stop marketplace where major local e-commerce sites, delivery providers and digital transaction companies are connected."[48] ekShop initially used an inventory and shopping cart model before focusing on connecting with international shopping carts (like Amazon and Alibaba) to facilitate replication.

This change helped to transform ekShop into a significant platform for rural entrepreneurs in Bangladesh to access. In the updated model, rural entrepreneurs and local sellers can upload their products into ekShop and redistribute them to other marketplaces. It also enables inventory management between different marketplaces.

When ekShop was launched in Bangladesh, the a2i team found that the model was bringing in a substantial number of consumers, leading to requests for replication in other countries. This prompted experimentation with implementations in South Sudan, Yemen and other countries, which provided compelling insights on how the platform would be used. Consequently, the team decided to re-engineer the platform as open-source. During the re-engineering process, some capabilities in ekShop had to be rebuilt entirely and some were cut to ensure that ekShop could be scaled. The team needed to focus on interoperability and the potential for modification in other contexts.

Currently, ekShop is an open-source product that is available for public use. With in-kind support on policy and technical engineering from a local academic institution in Dhaka, the team hopes to rebuild ekShop to meet DPG standards and then focus on building out other capabilities in order to scale to other countries.

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a2i

National Intelligence for Skills, Education, Employment and Entrepreneurship (NISE3)

A mismatch between the supply and demand of relevant skills is considered to be a key reason for unemployment and inefficiencies of the labour market in Bangladesh.[49] National Intelligence for Skills, Education, Employment & Entrepreneurship (NISE) is a one-stop data platform for matching training and employment opportunities (provided by government or private skills service providers) with the young people they are designed for.[50]

Currently, NISE3 contains modules that can be scaled and reused by the Government. During the development phase, the a2i team identified many modules that were open-source and some that were not. For the ones that were not, the team decided to scrap and rebuild some of them with open licenses.

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a2i

LESSONS LEARNED

a2i has been successful at building, implementing and maintaining software for the public good in Bangladesh. It has supported capacity building and is active in supporting innovation in the capital Dhaka and other parts of the country. a2i has enjoyed a lot of success via technical rebuilds of its products in a short period of time with limited resources. Becoming a true incubator of local DPGs will require a2i to think more intentionally about sustainability and the long tail of its products as DPGs. For example, a2i might consider different permutations for its governance. According to the a2i team, there will need to be more conversations to determine how best to support business models and community innovation for DPGs, not least to manage inputs to the codebase as they scale. These arrangements do not reflect how government agencies typically resource and support projects and would therefore necessitate significant behaviour and organizational change.

LESSON #1

Technical rebuilds of existing software as DPGs will almost always require trade-offs

Many of the technical challenges a2i faced in re-engineering products as DPGs were related to 'opening' the software itself, especially related to documentation and standardization. a2i had to ensure platforms were adapted to meet open-source requirements, ready to be registered as DPGs and support an a2i-managed community codebase. The team also faced challenges ensuring regional interoperability during redevelopment with reciprocal trade-offs in software functionality. Though open sourcing its products pushed the team to focus on product maturity and interoperability, that focus ultimately made them more user-friendly, open and durable.

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a2i

LESSONS LEARNED

LESSON #2

Technical rebuilds require dedicated funding

The a2i team has not yet received dedicated financial support from the Government of Bangladesh for its DPG-focused projects. The team continues to seek expansion of core funding to cover the technical work that goes into re-engineering DPGs. The process of re-engineering both ekShop and NISE3 demonstrated that creating a business case to prioritize investments in the architecture was critical to the project becoming reusable as a DPG on a limited budget. The team requires clear buy-in from the Government to ensure it has the capacity and resources needed to maintain these products over time.

LESSON #3

Foster an innovation culture that supports DPGs

The evolution of proprietary products into DPGs requires an element of change management — changing the norms around ownership and governance of those projects and matching those norms against new funding and business models. The a2i team recognizes that open-source products might require switching to a model of training, capacity and community building that is supported by other partners, resulting in a reduced focus on direct implementation.

LESSON #4

Convening and training facilitates replication of DPGs at scale

In the past, replication of a2i products such as ekShop has been facilitated through direct relationships with government officials. a2i is increasingly interested in identifying ways for UNDP to leverage its network of Country Offices and partners to support locally adaptive deployments. The a2i team recognizes scope for the wider eco-system and international organizations like UNDP to play a larger role in supporting replications. For instance, this might mean going beyond the focus on training and capacity building to also more broadly helping to strengthen and build relationships with technical assistance providers and systems integrators within the ecosystem.

LESSON #5

Business models designed for scale are vital for the success of government-led DPGs

The a2i team is exploring how to identify appropriate business models for scaling and replicating its products, starting with ekShop. The implementation of ekShop in South Sudan works well, whilst Yemen has been more challenging given the conflict and lack of core infrastructure. The team estimates that the number of pilots it will be able to support will be dependent on the technical and financial support it receives from local systems integrators. Another model envisages

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collaborating with regional or international organizations to support local deployments through grants or working with governments directly to determine a business model conducive to replication.

MOVING FORWARD

To continue being successful, a2i will need business models geared towards long-term support, a community that actively governs its output and collaboration with governments to ensure that open-source solutions are championed nationally. a2i provides lessons on how to build and support a local innovation ecosystem, as well as how to create new models for supporting the redevelopment of existing DPG products. Whilst a2i was not founded to fulfil this role, intentional thinking about the reusability of services has strengthened local efforts and lengthened products' lifecycles. As a2i embarks on this transformative process, support from other partners in the ecosystem will be critical to guaranteeing the long-term health of these DPG investments.

SECTION II

Emerging insights from the case studies

SECTION II

Emerging insights from the case studies

The DPG ecosystem is made up of a range of public-private players who are involved in funding, developing, deploying, adapting, adopting and implementing DPGs. As highlighted in the State of the Digital Public Goods Ecosystem 2022 report, growing contributions from funders, organizations and governments are already unlocking significant value in support of the SDGs. However, there remains a need for more intentional and concerted action to further harness the manifold benefits of DPGs.

Drawing from the case studies above, this section discusses some of the overarching insights that are relevant for advancing the DPG agenda and strengthening the ecosystem.

1. DPGs require strong stewardship

2. Effective business models sustain and scale DPGs

3. (Re)engineering products with an intent to scale is beneficial

4. Bringing local partners into the DPG ecosystem can boost replication

5. DPGs and DPI are contrasting yet complementary

Insight #1

DPGs require strong stewardship

The processes of developing, implementing and maintaining open-source software is an inherently collaborative effort, requiring skills from product and software development, implementation, community management, administration to advocacy. UNDP project managers, including those who are not technologists, noted the overwhelming benefits of the open nature of DPGs. Open-source products can often be deployed easily using custom configurations and are more able to be mixed and matched for multipurpose functionality. This is beneficial and allows for others to use, innovate and deploy them, but can also lead to unclear ownership.

DPGs with strong demand can employ different strategies to ensure funding to sustain themselves, for instance charging for software as a service, or accepting training or consulting fees. Yet almost all DPGs today are still primarily dependent on grants from foundations and other outside organizations. In many cases, the organizations that funded the creation of DPGs are rarely responsible for their sustained implementation. An implementing entity will often focus efforts on localizing the replicated DPG to suit the local demand, but rarely gives back to the continued development of the original source code of the DPG. The work and coordination between funders, product developers and other stakeholders working on DPGs is generally very diffuse, which holds back replication of DPGs and thus limits their impact.

KEY LESSON:

DPGs that provide software applications need a core team, adequate governance and funding for long-term success. Stakeholders' understanding of DPGs and their assumptions surrounding effective stewardship of them must evolve in lockstep.

- **It helps to have a dedicated fiscal home and steward to nurture growth.** MOSIP's dedicated stewardship by IIIT-B has conferred an effective community of practice and international networks as well as rapid scaling in the last four years. The neutral, academic nature of IIIT-B proved an ideal home for MOSIP, providing a collaborative environment to support its scaling and sustainability.
- **Ensure that owners are dedicated, supportive and intentional.** In the case of Primero, UNICEF as a custodian was able to commit the resources to guide its growth and evolution. Even as Primero sought to build its own brand identity, organizational support guaranteed that the necessary time and funding was secured for the platform to explore new partnerships and business models.
- **Well-defined collaborative governance is a strength of DPGs.** UNBL demonstrates how collaboration drives rapid product innovation. The four project teams supporting UNBL had a lot of success through this collaborative model. The definition of roles and conditions for each party at the outset of the collaboration resulted in greater productivity.

Insight #2

Effective business models sustain and scale DPGs

The case studies revealed that much of the development and maintenance of DPGs has traditionally been performed by nonprofit and academic actors, resulting in limited business model innovation. Issues pertaining to accepting funds and entering contracts were identified among the main limitations entities face with sustaining and scaling DPGs.

It is a truism that DPGs compete against proprietary systems, the latter of which are typically more robust and well-supported. Unless DPGs become anchored to sustainable business models and can demonstrate to governments the long-term benefits of their investments — ones that can demonstrably offset higher upfront costs — the widespread adoption of DPGs in the development context will continue to face constraints.

Policy interventions can also play a role in facilitating sustainable business models. An enabling policy environment might include reformed procurement protocols to unlock the role of government as a buyer of open-source technology or to leverage in-kind contributions of open-source product development from non-governmental entities.

KEY LESSON:

Maturing products with strong DPG potential should be actively matched with the necessary business models to secure adequate resources for their sustainability and scaling.

- **Testing business models for sustainability is critical for DPGs to be successful.** UNICEF invested in Primero from the outset, but core funding was not enough to sustain the project. For this reason, Primero has been testing new business models, such as its subscription service, to reach financial sustainability.
- **The balance of costs for supporting DPGs shifts as they transition from proprietary to open source.** In the case of eVIN that digitizes information on vaccine stocks and temperatures across India (and enabled the development of CoWIN), there were recurring costs involved in supporting proprietary systems, such as subscription or hosting fees and costs to vendors. Its migration to open-source systems freed up those resources, which were redirected to building human capacity and community infrastructure. The early migration of eVIN to open-source paid dividends when CoWIN was introduced, as new vendor costs could be avoided.

Insight #3

(Re)engineering products with an intent to scale is beneficial

Open-source software grants others the right to use, study, change and replicate it. Yet, merely open sourcing a solution is rarely enough for others to reapply it in a new context, especially if the solution is geared towards social impact.[51] The digital project leads who were interviewed as part of this research acknowledged that the current innovation culture still needs to evolve from its focus on single-instance software implementations to a more scalable approach.

In most cases, the first implementation of an open-source product includes unique elements to match the specific demands and workflows, for example an implementation that is carried out in the context of a government agency. However, open-source projects that are intent on becoming DPGs must be engineered (or re-engineered) with scaling in mind. Such re-engineering may mean, in part, removing and neutralizing the source code from the first implementation so that sensitivities are not openly exposed, keeping the system design modular and interoperable for replications.

KEY LESSON:

Whilst DPGs are typically created to address specific problems, they must be engineered for scalability and interoperability in order to meaningfully contribute to the evolving DPG ecosystem.

- **Highly modular architecture confers interoperability.** Some DPGs are helping to build foundational DPI as key inputs into a 'technology stack' — which many governments use to deliver public services — and they are highly modular and supported by shared standards. With MOSIP, its modular design has enabled it to promote a more open ecosystem and explore integration with other global solutions developed outside of India, including DPGs like OpenG2P,[52] Mifos[53] and Mojaloop.[54]
- **Successful DPGs were developed using a technology-neutral lens, accelerating new deployments.** Applying a 'technology-neutral' lens allows the needs of the project to dictate what technology is used. In the case of CoWIN, being technology-neutral enables third-party developers to integrate into their own applications and platforms, enabling the solution to quickly evolve to meet requirements and exchange data in new countries.
- **Creating open-source DPGs from scratch improves upon proprietary systems.** For UNBL 2.0, the project's partners boldly decided to create the technology to combine and overlay datasets. Consequently, the team was able to consider not only how to replicate the functionality of Google Earth Engine in an open-source environment, but also how to improve the platform's performance in terms of how data is pulled.

Insight #4

Bringing local partners into the DPG ecosystem can boost replication

One way to boost replication of successful DPGs is to raise awareness of their existence (for example through repositories such as the DPGA registry). Greater awareness of existing DPGs and other solutions can help governments and local communities avoid duplication. Several interviewees who participated in this research described cases where money was spent on proprietary software and systems, despite the fact that free and open-source software alternatives that perform similar tasks are available .

Local partners can tap into the DPG and free and open-source software ecosystems to enhance their knowledge about existing solutions, contribute local solutions and use their contextual knowledge to assess what solutions are appropriate to be replicated in local contexts. In this way, local partners can act as network nodes, where information and knowledge about replicable digital solutions, as well as insights on what may be required for effective implementation on the ground can be exchanged.

KEY LESSON:

Advancing DPGs for development will require engaging with local partners.

- **Scaling DPGs requires adapting to local realities.** For CoWIN, the UNDP India team found it important to invest in human capital and digital infrastructure before deploying any new functionality. Digital capacity building for public health workers to adopt and use a digital system like CoWIN at scale is an added layer on top of existing health system capacity.
- **Convene and train to support scaling of DPGs.** In the case of a2i, replication of a2i products like ekShop in other countries has been facilitated through direct relationships with government. a2i is interested in identifying ways for UNDP to leverage its network of Country Offices and partners to support locally adaptive deployments. The a2i team sees scope for strong players in the DPG ecosystem to play a larger role in supporting replications. Such support may go beyond training and capacity building to more broadly include ecosystem strengthening and building relationships with technical assistance providers.

Insight #5

DPGs and DPI are contrasting yet complementary

With DPGs providing software for others to study and replicate, DPI is the underlying infrastructure that allows DPGs, and other software and data to interact. DPI marries inclusive, rights-based approaches with open, interoperable standards, and the minimum needed technical components that allow for public and private IT systems to communicate across a population. This is seen in countries where there is a uniform way for people to open a bank account with just a digital ID, or sending and recieving money via their mobile phone securely and efficiently, or for public entities to exchange digital information safely.

DPI involves both technological and non-technological aspects, such as strong regulation and governance. Openness is required for both public and private actors to integrate and share data with a national DPI in order to layer new applications and services. Interoperability between digital applications are achieved through shared standards and protocols, needed for users to have a seamless experience no matter which organization is building on top of the DPI.

These distinctions between DPGs and DPI result in fundamentally distinct functions, different time horizons for implementation, and varied budget requirements and strategies for scale. In a well-functioning ecosystem, DPGs that respond to niche needs can often be deployed in a matter of weeks, generating obvious efficiencies. DPI, conversely, is a multi-year effort with a concomitant effect on cost. This is especially true if the DPI is foundational (such as providing digital ID, digital payments or data exchanges between public entities).

Countries such as Ukraine, India and Estonia that have engaged in these multi-year commitments have enjoyed startling payoffs. As the World Bank explained: “When built using open design principles, open interfaces and open standards, [DPI] not only foster new public sector applications but also provide a foundation to catalyse private sector innovation and new markets.”[55]

Within the ‘digital for development’ space, foundational DPI is often considered as digital ID, digital payments and data exchanges. Yet there are other types of DPI — for example sectoral DPI in areas of climate, education and justice. These sectors have unique challenges and could benefit from a DPI approach, but addressing the challenges requires more than just the technology itself. In addition, there needs to be adequate regulations, governance and ecosystem innovation.

With digital health, there is a range of open and interoperable DPGs that de facto function as a sectoral DPI, delivering effective and widely used digital services to support health care. One example is the transfer of patients’ personal data between care units, insurance providers and researchers, where common security protocols must be followed. This can be supported by DPGs and other open-source software that work together. Another example is in the climate sector, where there are complex, multistakeholder processes for accrediting

and trading carbon credits between climate projects, private companies and state agencies. In such instances, carbon verifying entities may need to follow a number of digitally-mediated steps. Neither example can be accomplished with just one digital product.

DPGs and DPI complement each other. A strong ecosystem of DPGs multiplies the number of options to integrate and layer upon DPI. Once a shared digital infrastructure exists, the more high-quality, well-funded, open-source DPGs are there for others to study, configure and reuse, breeding a self-fueling model of innovation.

KEY LESSON:

DPI is a multifaceted policy, regulatory and technological approach to create uniform ways in which digital tasks take place. Given their reusability, openness and interoperability, DPGs can be plugged into a DPI to accelerate innovation and impact. The two concepts are different, with varying purposes, investments and time horizons.

- **DPGs as inputs into DPI require continuous testing and support at scale.** Whilst MOSIP's country implementations are at varying levels of maturity (and therefore not ready to offer full lessons to the broader community), the continued integration of MOSIP has undoubtedly positioned it as a critical part of the technology stack. One of the benefits of MOSIP is that despite being highly centralized, it is not a walled garden with restrictions that would prevent it from integrating with other applications. The hope is that governments who are supporting MOSIP's implementation will enforce community norms of trust and help adapt it to specific needs and contexts.

Concluding thoughts

Concluding thoughts

The old order of technology governance was generally steered by the private sector. It gave rise to incentives for single ownership of technologies, and access to them were often mediated through licenses and fees. This limited their ability to scale and deliver meaningful social impact. However, in recent years, there has been greater understanding and alignment on the importance of open-source software, open data, open AI models, open standards and open content as DPGs.

Importantly, moving away from the old operating models is critical for the development, implementation and sustainability of DPGs. This shift is already happening, but more remains to be done. There must be a concerted effort by governments, the private sector, civil society and donors to identify and nurture DPGs that can contribute to building inclusive and rights-based DPI that can scale in emerging markets. Beyond the tech, DPGs must be considered within a governance framework that includes legal, regulatory and policy dimensions centred on people.

If the necessary rights and safeguards are intentionally built in, governments will be able to effectively leverage DPGs to advance public interest and contribute to the SDGs. Leveraging multi-stakeholder bodies such as the DPGA, and forums like the DPG Charter, GovStack and others, development actors must align with national priorities to determine how and where DPGs can be useful.

This research highlights some of the challenges DPGs have encountered in the development context, and the successes some DPGs have had in overcoming them. As the DPG ecosystem expands, more insights are expected to emerge. The salutary lessons presented in this research are intended to help governments and digital development practitioners identify and scale DPGs towards delivering services at population scale.

UNDP is committed to the development and implementation of DPGs, anchored in an inclusive and rights-based approach that is centred on human agency and human development. We welcome partners to join us in this effort.

Glossary

Building blocks
Software code, platforms and applications that are interoperable, provide a basic digital service at scale and can be reused for multiple use cases and contexts. (GovStack/DPGA)

Digital
An ever-evolving range of technologies (like mobile technologies, artificial intelligence, machine learning, blockchain, internet of things and robotics to name a few) that impact nearly all aspects of our world. It is also a mindset, which translates into a new way of working that enables people and institutions to innovate with technology. (UNDP)

Digitalization
Defined in the development context, it is the process of using digital (technology, tools, processes, solutions) for greater operational impact, as well as for the internal transformation of an organization. (UNDP)

Digital ecosystem
A complex and dynamic interconnected network of actors and systems, all of which function as a unit to create an enabling environment for digital to advance economic and societal efforts. (UNDP)

Digitally-enabled
Embedding digital technologies and approaches into the design, implementation and deployment of projects and programmes at the national, regional and global levels. (UNDP)

Digital public goods (DPGs)
Open-source software, open data, open AI models, open standards and open content that adhere to privacy and other applicable laws and best practices, do no harm by design and help attain the Sustainable Development Goals (SDGs). (GovStack/DPGA)

Digital public infrastructure (DPI)
A set of digital solutions which are interoperable, built on open standards and specifications providing access to public and private services at societal scale and are governed by enabling rules to drive innovation, inclusion, and competition. (UNDP)

Digital solution
A solution that incorporates the use of digital technology to solve a problem. (UNDP)

Digital technology
Systems, hardware and processes that use digital data or signals to achieve defined outcomes. (UNDP)

Digital transformation
The integration of digital technology into all areas of business, fundamentally changing how economic and social activities are

Glossary

enacted. It is also a social change process that is purposeful rather than unregulated and should be intentionally planned and executed. (UNDP)

Fiscal home
A host entity to hold intellectual property, execute legal contracts and receive funding. This legal entity must be able to meet the audit requirements of multilateral donors, a bar that can be far higher than what many small nonprofits typically encounter. (Digital Impact Alliance)

Free and open-source software
Free and open-source software allows users and programmers to edit, modify or reuse the software's source code. This gives developers the opportunity to improve programme functionality by modifying it. The term "free" indicates that the software does not have constraints on copyrights. The term "open-source" indicates the software is in its project form, enabling easy software development from expert developers, collaborating worldwide without any need for reverse engineering. (Techopedia)

Inclusion
An approach that puts people at the center of digital transformation efforts to ensure a more open, transparent and accessible process. This approach helps create a society in which all people have the right to affordable technologies and have reasonably priced broadband to access the digital realm. (UNDP)

Interoperability
The ability of computer systems or software to exchange and make use of information. (UNDP)

Modularity
The degree to which a system's components may be separated and recombined, often with the benefit of flexibility and variety in use. (Wikipedia)

Proprietary system
A system that relies on software and equipment that is licensed from a copyright holder. (EasyTechJunkie)

Scaling
Mainstreaming adoption of proven digital approaches. This could include geographic expansion, scaling impact at the policy level or scaling the incentive structures for the long-term. (UNDP)

Software product
A software that has been developed and maintained for the benefit of a user base and often to satisfy a need in the market.

Sustainable Development Goals (SDGs)
The Sustainable Development Goals, also known as the Global Goals, were adopted by the United Nations in 2015 as a universal call to action to end poverty, protect the planet and ensure that by 2030 all people enjoy peace and prosperity. (UNDP)

Glossary

Technology stack
A full technology stack includes all aspects of IT infrastructure required to deploy and manage applications and services: hardware and software components, databases, middleware, storage and networking. (TechTarget)

Walled garden
A network or service that either restricts or makes it difficult for users to obtain applications or content from external sources. (PCMag)

Endnotes

Section I: Case studies

[1] https://digitalpublicgoods.net/blog/unpacking-concepts-definitions-digital-public-infrastructure-building-blocks-and-their-relation-to-digital-public-goods/

[2] https://mifos.org/blog/mifos-mosip-openg2p/

[3] https://documents1.worldbank.org/curated/en/672901582561140400/pdf/Open-Source-for-Global-Public-Goods.pdf

[4] https://timesofindia.indiatimes.com/blogs/digital-mehta/what-is-mosip/

[5] https://privacyinternational.org/case-study/4657/id-systems-analysed-mosip

[6] https://indiastack.org/

[7] https://www.tech.gov.sg/products-and-services/singapore-government-tech-stack/

[8] https://opendigitalecosystems.net/pdf/04_MOSIP-Case-Study_vF.pdf

[9] https://digitalpublicgoods.net/blog/the-transformative-role-of-academia-digital-public-goods/

[10] https://www.mosip.io/news-events/bill-gates-cites-mosip-as-pathway-and-enabler-of-digital-financial-inclusion-in-interview-with-cnbctv18

[11] https://privacyinternational.org/case-study/4657/id-systems-analysed-mosip

[12] https://opendigitalecosystems.net/pdf/04_MOSIP-Case-Study_vF.pdf

[13] https://medium.com/omidyar-network/the-growing-demand-for-digital-public-infrastructure-requires-coordinated-global-investment-and-an-8ce1a22e4d6c

[14] https://www.brookings.edu/blog/future-development/2022/03/18/aid-effectiveness-scaling-and-digital-public-goods/

[15] https://www.mosip.io/news-events/the-government-of-the-togolese-republic-sign-an-mou-with-iiit-b-on-mosip

[16] https://identityreview.com/mosip-open-source-national-id-system-gains-momentum-in-africa-and-asia/#:~:text=MOSIP%20is%20essentially%20a%20modular,identity%20solutions%20to%20their%20citizens

[17] https://privacyinternational.org/case-study/4657/id-systems-analysed-mosip

[18] https://openg2p.org/

[19] https://mosip.io/news-events/digital-public-goods-mosip-and-openg2p-announce-collaboration

[20] The existing software solutions that OpenG2P uses include Mifos for the payments and vouchers layer; Odoo for the enterprise resource planning (ERF) layer; Elastisearch for deduplication and search; and ODK for perimeters; as well as Apache Fineract and Mojaloop (another prominent open-source payment system).

[21] https://www.unicef.org/innovation/stories/open-source-app-primero-protect-displaced-children

[22] https://www.unicefusa.org/stories/unicef-microsoft-leverage-tech-protect-vulnerable-children/37820

[23] https://www.unicef.org/evaluation/media/946/file/Primero.pdf

[24] https://www.cpims.org/; https://www.gbvims.com/primero/; http://www.gbvims.com/wp/wp-content/uploads/9-Primero-Glossaryv2.pdf/

[25] https://www.unicef.org/evaluation/media/946/file/Primero.pdf

[26] Ibid.

[27] https://drive.google.com/file/d/1d0vBC0s66XNSxhT1LbQfeMuJgHvyo3Vr/view

[28] Note: The Digital Impact Alliance, one of the lead authors of this report, provided business consulting services to Primero in 2019 through its Open Source Center (OSC).

[29] https://sites.google.com/view/primeroannualmeeting/home

[30] https://drive.google.com/file/d/1uA19XlEYHFWPwKXYf01Kebc67IHjSZ1q/view

[31] From the Second Regular Session of the UNICEF Executive Board, the representative for Sierra Leone states (at min 47:25) from http://webtv.un.org/search/part-2-3rd-meeting-unicef-executive-board-second-regular-session-2019-11-13-september/6085743029001/?term=unicef%20executive&lan=english&cat=Meetings/Events&sort=date

[32] These countries include: Afghanistan, Bangladesh, Brazil, Burkina Faso, Cambodia, Central African Republic, Colombia, Democratic Republic of Congo, Gaza, Germany, Ghana, Guatemala, Ethiopia, India, Indonesia, Iraq, Jordan, Kenya (Kakuma and Dadaab), Kyrgyzstan, Lebanon, Libya, Mali, Myanmar, Niger, Nigeria, Papua New Guinea, the Philippines, Qatar, Sierra Leone, Somaliland, Somalia, South Sudan, Sudan, NE Syria, Tajikistan, Tanzania, Thailand, Turkey (Syria cross-border), Uganda, Uzbekistan, West Bank and Yemen.

[33] https://drive.google.com/file/d/1d0vBC0s66XNSxhT1LbQfeMuJgHvyo3Vr/view

[34] https://drive.google.com/file/d/1d0vBC0s66XNSxhT1LbQfeMuJgHvyo3Vr/view

[35] https://www.cowin.gov.in/

[36] https://www.nhp.gov.in/electronic-vaccine-intelligence-network(evin)_pg#:~:text=According%20to%20PIB%2C%2003%20August,99%25%20in%20most%20health%20centers

[37] Ibid.

[38] Ibid.

[39] Ibid.

[40] https://digitalpublicgoods.net/registry/divoc.html

[41] Note: The full DIVOC platform actually has six modules that focus on various activities, ranging from analytics to the issuance and verification of certificates, but the workflows in DIVOC are simpler than those of CoWIN, as there is less disaggregation across the full suite of data and the credentialing module is one of the most robust.

Endnotes

[42] https://www.in.undp.org/content/india/en/home/projects/Winning_Over_COVID_Co-WIN.html

[43] https://blogs.lse.ac.uk/southasia/2017/02/06/how-a2i-is-using-empathy-to-foster-innovation-in-bangladesh/

[44] https://innovation.brac.net/images/pdf/A2i-141204.pdf

[45] Ibid.

[46] https://info.undp.org/docs/pdc/Documents/BGD/UNDP%20a2i-II%20closing%20report_Final.pdf

[47] Ibid.

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[48] Ibid.

[49] https://a2i.gov.bd/a2i-missions/future-of-work/

[50] https://digitalx.undp.org/nise_1.html

[51] According to the DPG Standard (https://digitalpublicgoods.net/standard/), DPGs must be designed and developed to advance the SDGs and demonstrate such by providing links/documentation that support their relevance. Accreditation as DPG requires additional elements as well.

[52] OpenG2P stands for open government to person payments, and provides the tools needed to digitise large scale cash transfers with open-source building blocks (see: https://digitalpublicgoods.net/registry/).

[53] Mifos is a platform for delivering the complete range of financial services needed for an effective financial inclusion solutions (see: https://mifos.org/). A suite of Mifos applications has been built on top of the Mifos X platform for web, Androided, etc. — each of which has been accreditated as a DPG in itself (see: https://digitalpublicgoods.net/registry/).

[54] Mojaloop is an open-source software for creating payment platforms that will help unbanked people access digital financial services (see: https://digitalpublicgoods.net/registry/).

[55] https://documents1.worldbank.org/curated/en/099755004072288910/pdf/P1715921edb5991b14e63149d61b83e137f756213782.pdf

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