exposed to the southern edge of the eyewall, and Newport Pass located about 25 km to the south (Figure 7.7).
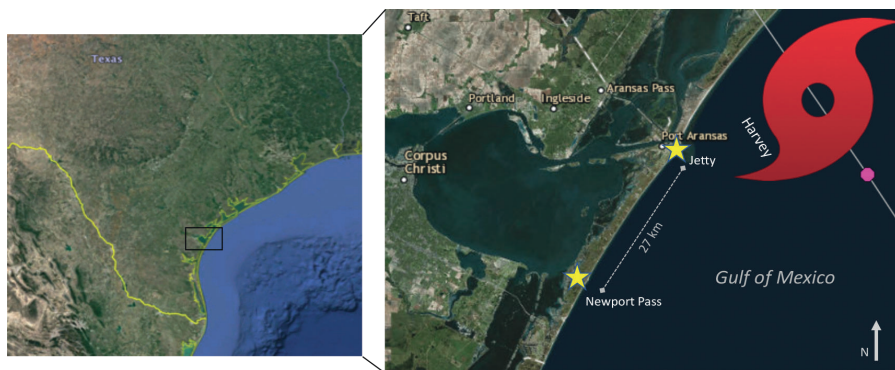

FIGURE 7.7
Hurricane Harvey Mustang Island, TX study sites

Change at the beach locations was distinguished by comparing post-hurricane UAS survey data with pre-storm airborne lidar data collected by the United States Army Corps of Engineers (USACE) National Coastal Mapping Program. The USACE airborne lidar survey was conducted in August-October 2016. The MANTIS lab collected post-impact UAS data in September-October 2017. Newport Pass study site was surveyed using a rotary DJI Phantom 4 Pro (Figure 7.1a), and Port Aransas study site was surveyed using a fixed-wing SenseFly eBee. Both systems were integrated with 20 MP RGB cameras. Ground control targets were used to ensure high-accuracy geo-referencing and to tie the data to a vertical datum. All UAS imagery were processed using SfM to generate orthomosaics and DSMs. Because the UAS DSM raster cell values were referenced to a vertical datum for elevation, they represent elevation of the exposed ground and landcover and are referred to herein as DEMs.

Figure 7.8a is a traditional aerial image acquired prior to the hurricane at the Port Aransas South Jetty site, and Figure 7.8b shows a high resolution (3 cm) UAS orthomosaic produced from a survey a few weeks after the hurricane.

Results show that the most noticeable change was the beach erosion and scouring near the jetty and along the roadway where as much as 4 m was de-voured by the large wave action and storm surge. The UAS-derived mapping products provided up-to-date information to the County to aid damage assessment of the jetty and guide their recovery efforts. At Newport Pass, there was perhaps the most noticeable change where a previously weakened dune blowout (Figures 7.9a and c) was completely breached by the storm surge during the hurricane and a temporary inlet to Corpus Christi Bay was formed (Figures 7.9b and d). This resulted in elevation changes upwards of 4 m losses where the channel cut through the dune, and gains where the flooded bay wa-

FIGURE 7.8

These images depict storm-related changes to the Port Aransas South Jetty site. (a) Google Earth aerial image from south of the Aransas Pass jetty before Hurricane Harvey; (b) High resolution UAS imagery from south of the Aransas Pass jetty after Hurricane Harvey.

ters and strong northwest winds from the southern eyewall pushed sediment and water against the backside (bayside) of the dune (Figure 7.9e).

In support of a different initiative related to Harvey, UAS surveys were conducted over a heavily damaged inland neighborhood near Rockport, TX where some of the strongest wind fields were observed during the storm. The effort was conducted as part of a volunteer emergency response effort in collaboration with engineers from the University of Notre Dame and the United States National Science Foundation (NSF) Geotechnical Extreme Events Reconnaissance (GEER) project. The purpose of the NSF GEER effort is to collect high-resolution remote sensing data along with information on structural damage recorded by reconnaissance teams on the ground to evaluate performance of structures during disaster events. Figures 7.10a and 7.10b show aerial images of the neighborhood prior to Hurricane Harvey and Figures 7.10c and 7.10d show parts of a UAS orthomosaic of the same area generated after the storm. Figure 7.10e is an oblique UAS image of six houses before the storm and Figure 7.10f is an oblique image of a 3D point cloud constructed from the UAS imagery using SfM. The collected UAS information from Harvey and other storms are being used by engineers to improve structural design and refine building codes for reducing impacts from hurricanes and other natural disasters. This effort will lead to more sustainable development and in return, more resilient coasts.
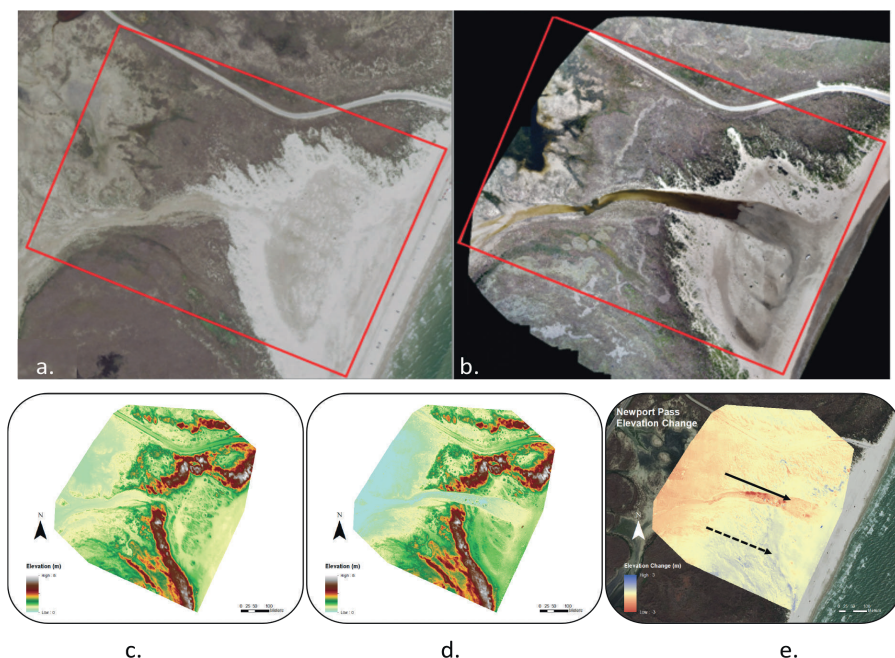
FIGURE 7.9

These images depict storm-related changes to the Newport Pass study site.
(a) Aerial image south of Newport Pass before Hurricane Harvey; (b) UAS
imagery of Newport Pass after Hurricane Harvey; (c) DEM of Newport Pass
created from a 2016 USACE airborne lidar survey before Hurricane Harvey;
(d) DEM of Newport Pass created from a UAS survey after Hurricane Harvey;
(e) Computed elevation change of Newport Pass due to Hurricane Harvey
(before DEM surface subtracted from after DEM surface). Solid arrow shows
zone of large erosion stemming from the breach. Dashed arrow shows zone of
deposition.

7.6   Conclusion

Engineering and scientific solutions for sustainable development of cities and
communities requires updated geospatial information. For communities re-
siding within the highly dynamic and vulnerable coastal zone, accurate and
timely geospatial data is critical to aid disaster response, mitigate risks to
coastal hazards, and plan for more sustainable and resilient infrastructure.
UAS is transforming our ability to map and monitor our evolving world at
unprecedented detail. As UAS technology continues to rapidly evolve, so will
the speed at which we can attain increasingly accurate and detailed spatial

FIGURE 7.10

These images depict storm-related changes to a neighborhood near Rockport, TX: (a) Traditional aerial imagery of a Rockport neighborhood before Hurricane Harvey from Google Earth; (b) Zoomed in view of the aerial image showing the house before Hurricane Harvey; (c) UAS imagery of a Rockport neighborhood after Hurricane Harvey; (d) Zoomed in view of UAS imagery showing damage to the same house after Hurricane Harvey shown in the aerial image above; e) oblique imagery of a Rockport house before hurricane Harvey; (f) oblique view of a SfM derived 3D point cloud of the same house after hurricane Harvey.

information. With increasing reliance upon geospatial technology and data to inform our decisions, it becomes ever more important to understand the applications and limitations with such measurements and how to effectively apply

them to better navigate our future world. It becomes ever more important to understand the accuracies associated with such measurements and how to effectively apply them to better navigate our future world.

Bibliography

[1] Designing the image acquisition plan, article 202557459, May 2018.

[2] United nations atlas of the oceans, October 2018.

[3] Jonathan L Carrivick, Mark W Smith, and Duncan J Quincey. *Structure from Motion in the Geosciences*. John Wiley & Sons, 2016.

[4] Ismael Colomina and Pere Molina. Unmanned aerial systems for photogrammetry and remote sensing: A review. *ISPRS Journal of photogrammetry and remote sensing*, 92:79–97, 2014.

[5] National Research Council et al. Disaster resilience: A national imperative, 2012.

[6] F Greenwood. How to make maps with drones. *Drones and aerial observation, July*, pages 355–47, 2015.

[7] Richard JT Klein, Marion J Smit, Hasse Goosen, and Cornelis H Hulsbergen. Resilience and vulnerability: coastal dynamics or dutch dikes? *Geographical Journal*, pages 259–268, 1998.

[8] Richard Slocum and Christopher Parrish. Simulated imagery rendering workflow for uas-based photogrammetric 3d reconstruction accuracy assessments. *Remote Sensing*, 9(4):396, 2017.

[9] Michael J Starek, Thomas Davis, Dan Prouty, and Jacob Berryhill. Small-scale uas for geoinformatics applications on an island campus. In *2014 Ubiquitous Positioning Indoor Navigation and Location Based Service (UPINLBS)*, pages 120–127. IEEE, 2014.

[10] Darren Turner, Arko Lucieer, and Christopher Watson. An automated technique for generating georectified mosaics from ultra-high resolution unmanned aerial vehicle (uav) imagery, based on structure from motion (sfm) point clouds. *Remote sensing*, 4(5):1392–1410, 2012.

[11] Geert Jan Van Oldenborgh, Karin Van Der Wiel, Antonia Sebastian, Roop Singh, Julie Arrighi, Friederike Otto, Karsten Haustein, Sihan Li, Gabriel Vecchi, and Heidi Cullen. Attribution of extreme rainfall from hurricane harvey, august 2017. *Environmental Research Letters*, 12(12):124009, 2017.

[12] AS Woodget, PE Carbonneau, Fleur Visser, and IP Maddock. Quantifying submerged fluvial topography using hyperspatial resolution uas imagery and structure from motion photogrammetry. *Earth Surface Processes and Landforms*, 40(1):47–64, 2015.

Part III

Supporting SDGs: Legal, Policies and Institutional Components and Capacity Building

8

Legal and Policy Paths for Effective Sustainable Development

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This chapter begins by reviewing basic economic and legal principles that have been used effectively by governments in supporting the marketplace in regard to traditional economic resources such as land, labor and capital. Because information and knowledge can and often do replace the need for traditional resources in contemporary societies, the chapter focuses as well on policies and laws promoting the growth of information economies to support SDGs implementation.

8.1 Introduction

Many of the UN Sustainable Development Goals (SDGs) are likely to be achieved most efficiently and effectively under legal and policy frameworks possessing certain basic legal and policy principles and frameworks [6]. If not already in place, recommended long-term principles and frameworks may be pursued concurrently or in tandem with short-term policy and legal adaptations that may be needed to address more immediate and pressing short-term SDG needs. Among SDGs that are unlikely to be addressed successfully without stable and well-reasoned long-term legal and policy frameworks in place include:

- **Goal 8.** Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all.

- **Goal 10.** Reduce inequality within and among countries.

- **Goal 16.** Promote peaceful and inclusive societies for sustainable devel-

opment, provide access to justice for all and build effective, accountable and inclusive institutions at all levels.

Most societies across the globe recognize the extreme importance of a vibrant marketplace as a prerequisite to sustainable development. They further recognize the strong role of government in creating appropriate legal bounds within which competitive markets in goods and services may thrive while concurrently providing safety-net services for the disadvantaged. That is, a nation with few natural resources but with a highly educated and innovative workforce may achieve a robust economy and sustainable development through primarily the development of information infrastructure and the provisioning of digital products and services. Yet, digital economies come as well with their own set of legal and policy challenges.

8.2   Fundamental Economic Policies Germane to Traditional Resources

Adam Smith, in his 1776 treatise on the Wealth of Nations, postulated that the ideal private good has the characteristics of *excludability, rivalry,* and *transparency.* Land, labor and capital exhibit these ideal marketplace characteristics but only fully through enforcement of appropriate laws.

In exploring these characteristics and the role of law in their support, we may use the illustrative and familiar example of land. *Excludability* in land is achieved by granting owners the ability to keep others from using or trespassing on their private property through action by government, typically through the judiciary and police enforcement. Land owners also have the legal right typically to exclude others using physical means, such as through the use of fences, buildings and other barriers.

Rivalry is the concept whereby my use of a resource deprives or affects your use of the same resource. If I use land to build a house on it, you can't build your house on it. Thus, land is far more rivalrous than a resource like digital information. Millions can benefit from an information resource without degrading or depriving anyone else's use of the same resource but this is not typical for land.

Transparency is achieved when a buyer has the ability to see the quality and prices of all competing goods in the marketplace. In land markets, our legal systems often support this characteristic by mandating that all land ownership records are publicly and readily accessible to all and an operational system is supported that guarantees or insures the validity of the title rights acquired.

Because land has the characteristics of a private good, the sale and trade of land parcels through the open marketplace has worked well and can con-

tinue to work well in creating wealth both for individuals and for national populations as a whole. The same holds true for other traditional economic resources possessing the classic characteristics of private goods. Information system goods and services, on the other hand, lack some of these characteristics and therefore must typically be transformed through action of law to exhibit the classic characteristics of private goods.

8.3   Role of Legal Controls

What then is the role of law in marketplace contexts? What should be the role of law in transitioning from least technologically developed cities and nations to smart cities and economically vibrant nations? Most western culture legal scholars, policy makers and economists argue that the priority of controls in society, in order, should be: (1) the marketplace, (2) private arrangements and (3) the law. Laws should be used only as a last resort in managing society's affairs. If the marketplace is truly free and open, the market itself is a far better means for setting prices and controlling quality than any state-imposed guesses enacted into law. If equally sophisticated private parties can work out pricing and quality issues for themselves through individualized contracts, that negotiation will give far more efficient results than conditions imposed by government through the law.

Thus, new laws are often NOT the best solution in addressing many societal challenges. When competitive markets exist, market forces are often a far better choice in establishing relations between parties than are detailed legal regulations. In Western culture, we often argue that the law should step in to regulate only where the free and open marketplace isn't working. In these instances, the primary role of the law should then be to:

(a) correct the marketplace to return it to being open, free, and competitive, and/or

(b) construct means to provide important goods and services desired by society that will not otherwise be produced by the marketplace.

In the latter case, lack of a marketplace to produce goods is due often to the inherent characteristics of the goods. That is, highly desirable goods such as street lighting or military defense are non-rivalrous and the benefits once supplied are difficult to exclude from others. It is inefficient for the marketplace to supply them. Thus, in these instances, governments often step in to produce the goods directly. Alternatively, government might convert a good by action of law such that the good then possesses rivalry and excludability. By example, copyright law, and its enforceable sanctions if violated, make creative works excludable. Copyright law provides an incentive to authors to

make their knowledge, ideas, discoveries, and creative works widely available to the benefit of all in society. With the production and dissemination of the works of millions of authors and artists available in the marketplace, science and the useful arts are advanced. Without protection making the works legally excludable, such works often would be readily and widely distributed to millions with no compensation to the creators. This creates a strong disincentive for the sharing and distribution of creative works by authors and would make their sale, licensing and distribution far more burdensome.

While government by itself or through its agents would be unable to create the variety and extent of valuable goods and services provided by the marketplace, governments serve a strong role in establishing conditions to allow the marketplace to thrive. Among areas in which the law has a likely justifiable role in supporting both established and emerging economies include settling disputes, protecting citizens against excessive or unfair private power, protecting citizens against excessive or unfair government power, ensuring people an opportunity to enjoy the minimum decencies of life, and maintaining order.

8.4   Policies and Laws Germane to Digital Economy Resources

When appropriately bounded by laws to control negative behavior within the marketplace by private and even government parties, the marketplace has been very efficient and effective in promoting economic growth. However, economies falter when laws preventing skewing of the market and protecting human rights fail to be enacted and enforced. Because information technology advances and the digital resources they create continue to advance rapidly, it is very difficult for governments to respond quickly and effectively through government executive actions, legislation, and constitutional amendments to dampen or eliminate their adverse effects. A burgeoning information economy and developing cyberinfrastructure inevitably raise conflicts and legal challenges related to:

- intellectual property rights such as those involving copyright, patent, trademark, trade secret, and sui generis data laws,

- privacy rights supporting the ability of individuals to control the collection, dissemination and use of information about themselves and to prevent overly intrusive behavior by others,

- security, encryption, and data management practices,

- hacking and other cybercrimes,

- citizen access to government data, records, and online services,

- control of private power such as through anti-trust and anti-competition law,

- licensing and contract self-help mechanisms,

- liability in the provisioning of data and online services, and

- jurisdiction over disputes.

In many countries, resolving new conflicts within the context of digital economies are being left largely to emerge through processes carried out primarily in the private marketplace by competing business, consumer, and public interests. Government intervenes with new laws often only when technology and changed societal conditions have advanced to the point where problems and inequities have become clearly evident through the process of litigation in the courts. In other nations, government is far more proactive. Regardless of the timing of government intervention, there exist numerous conflict areas in which government may be justified in stepping in to resolve digital economy disruption, particularly in regard to failure of the market to achieve equitable results or protect human rights. The following paragraphs provide examples of illustrative instances.

8.4.1 Settling Disputes

Digital Tracking: Numerous disputes have arisen in modern contexts in the tracking of objects, humans, transactions by individuals, and interactions among individuals and their surroundings. These conflicts are continuing to grow as digital tracking becomes more pervasive. Tracked data, if stored somewhere, is subject to misuse and hacking. Law is often the best means of determining who should bear the costs of harms in such instances. For example, a breaching party such as a hacker may be inaccessible or unable to pay. The law might step in to establish rules for placing the damage burden on either victims, system developers, private operators, or government, or settle the dispute by distributing the burden among some or all of them.

Technology Gone Wrong: Assume that software in an autonomous vehicle in an emergency situation opts to hit three adult pedestrians in a crosswalk rather than one child and two pets located to the side of the travel lane. Laws enacted by elected representative government and enforced by the courts may be the best means for weighing and balancing the reasonableness of software algorithmic implementations and artificial intelligence decision-making, forcing corrections of technologies, and distributing the costs of harms.

8.4.2 Protecting People Against Excessive or Unfair Private Power

Actual Monopolies: Many areas across the globe have only a single supplier of Internet services because a sufficient market fails to exist to support more

than one. Assume that the single digital service exists with non-negotiable conditions on a take-it or leave-it basis. The law might justifiably regulate such a service provider as a public utility to create a level playing field for all citizens within the jurisdiction. Alternatively, legislative action might be taken in appropriate cases to break up a monopolist into multiple smaller companies to create competitive choices for consumers.

Natural Monopolies: The information system with the greatest number of users often has the greatest utility which in turn attracts even more users. Assume that the corporate owner of a dominant information service offers the service on take-it or leave-it terms, such as giving up personal privacy or doing without the service. Because a competitive market fails to exist, the law may justifiably force a policy change or impose an alternative solution to restore an open, transparent, and competitive market. By example, it has been argued that Amazon dwarfs all private natural monopolies of the past and should be broken into at least two pieces through the action of anti-trust law. One company would operate its retail operation while a second separate company would operate its e-commerce operation which provides order and delivery services for thousands of companies [5].

Unfair Private Practices: Assume that consumers buy robots for answering questions and doing mobile chores around the home such as vacuuming floors. However, the company switches its privacy policy after capturing a large market share. That is, perhaps under the new policy the robot now records all voices all the time and photo documents all items in the home when no humans are present. A competitive market fails to exist due to sunk costs and thus the law is justified in stepping in to correct any unfair practices.

8.4.3 Protecting Citizens Against Excessive or Unfair Government Power

Controlling Government Collection: If government does not have access to certain aspects of your life, it can't control those aspects. Law is often used to ban data collection on citizens by government agencies in order to temper the power of the State. Thus, many governments have bans on domestic surveillance of citizens without first obtaining search warrants authorized by the courts under tightly controlled criteria and circumstances. However, if similar strong laws are not imposed on the commercial sector, technology has advanced to the point where personal data is able to be massively collected, retained, and exchanged by businesses and thereby also becomes much more accessible to the State.

Monopolistic Information: Because it can force the gathering of certain data by action of law, government often collects information to which only government has access and provides services that only government can provide. Open access and equal access laws are often enacted so that citizens can readily know what government is up to. In many democratic nations, citizens have a right to know what personal information about them is being

held in government records, the right to inspect the records, and the right to make corrections or add explanations to those records. Numerous narrowly drawn exceptions to accessing government records also typically exist. These provisions typically might enable government agents to decline requests for information and data relating to police investigations, the national defense, confidential employee records, and similar matters that, if exposed to the general public, might have strong negative consequences for citizen rights or national interests.

8.4.4 Ensuring People an Opportunity to Enjoy the Minimum Decencies of Life

The education of young children and ensuring that they have enough to eat are viewed almost universally by governments as minimum decencies of life that all governments are justified in supplying and morally mandated to supply when needed. Although many taxpayers don't have children of their own, they benefit as well when they help support such societal needs. The investment supports the creation of a citizenry that is better able to take care of themselves and their families, engage in the future in the workforce, contribute to the economic wellbeing of society, participate actively in the functioning of government, and contribute to the advancement of knowledge, science, and innovations in society. Government support of at least a minimum education also diminishes the need for welfare services and generally strengthens the social fabric of the nation. Thus, government is often justified in passing laws that promote minimum standards of living for all.

In the digital age, the use of information technologies and growth of digital economies has become so prolific throughout the globe that those without access to at least a minimal level for communications, learning, and transactions are at a distinct disadvantage compared to others that do have this access. Yet, an estimated 4 billion people around the globe currently lack access to the internet [8]. Similar to rural electrification programs of the past and present, programs to provide access to information infrastructure and digital devices is viewed by many governments as a justifiable goal in meeting the minimum decencies of life for all citizens. Thus, if the marketplace is not adequately supplying such services, the government justifiably has a strong role to play in either addressing the issue directly or incentivizing the market to provide minimal equitable access to all.

8.5 Maintaining Order

Another justifiable role for government in passing new laws is for maintaining order within a nation. Typically, one might think of government relying pri-

marily on the police and courts for maintaining order. In day-to-day dealing with cybercrimes or resolving digital economy conflicts among businesses, attorneys, police and the courts are indeed on the frontlines in processing and resolving such disruptions. In the case of a major cyberattack or persistent cyberattacks against a country, the defense and military branches of government likely also become involved. However, when the societal conditions of a nation are substantially disrupted such as by technological advancements or by radically changed global business models, legislative bodies may need to enact new laws in order to maintain order.

Across large sectors of the globe, spanning from very poor to very wealthy countries, economic inequality is growing. Large segments of the global population are being left behind by today's economies. Automation, robotics, and artificial intelligence supporting algorithmic decision-making are expanding and rapidly displacing many workers [3, 8]. Corporate business models have shifted radically by decentralizing many functions such that contractors at diverse locations compete with each other to supply parts, products, and services *just in time* using part-time employees that receive few benefits. These societal shifts are resulting in concentrated economic growth in each nation primarily where wealth is already concentrated. Discontent is growing among the poor and middle classes where job opportunities at reasonable pay are rapidly dwindling. The results to date of expanding digital economies are deepening dissatisfaction by large segments of populations in many countries. The inability of a nation's political and economic systems to address fundamental problems angers many, creates widespread mistrust in democratic institutions, and makes civil disobedience more likely. This is resulting in growing risks for democracies and challenges to the functioning of government.

A justifiable role of government in maintaining order under these circumstances, in addition to maintaining civil control through police and the courts, is to pass new laws creating more just and equitable distributions of the benefits arising from technological progress among the population. Such laws create a stronger societal and economic foundation for all and thereby advance the nation as a whole.

8.6   Open Access to Domestic Government Data

One policy area that has been particularly problematic for many nations has been with government agencies competing with private businesses in the marketplace. Laws are justified in preventing government agents from doing so. If a nation desires to grow a strong digital economy, it should not allow the government to claim intellectual property rights in domestic government data and then use those rights to compete with private businesses in providing goods and services to its population. Government should collect or create data, in-

formation, and records to meet its legislatively mandated purposes and then make these government works openly and freely available to all businesses and individuals as digital public goods. Government should not compete in data sales or services with the private sector. Rather, open access government data provides a public asset that all industries may mine and use in competing against each other in providing better services and products for citizens as well as increasing personal and corporate taxable income benefitting the nation.

Collective experience across the globe shows that the open use and sharing of scientific and technical data, stimulates economic growth, enhances accountability, and accelerates scientific discoveries [2]. Subject to a few narrowly drawn exceptions, such as those frequently set forth in national freedom of information acts, the recommendation to enact laws providing open access to government data applies to all domestic government data at all levels.

8.7 Correcting Unjust Laws and Policies Within Growing Information Economies

The wealthiest nations on Earth have begun creating an *information civilization* for the globe which is currently characterized by inestimable numbers of smart phones and personal digital devices, massively distributed sensors, rapid growth of automation in manufacturing and service industries, institutionalization of ubiquitous surveillance by the corporate and government sectors, pervasive data mining, machine learning, predictive analytics, algorithmic decision-making through artificial intelligence techniques, emerging deployment of autonomous vehicles, and burgeoning robot applications [10]. The spread of technological advancements and applications globally shows little sign of slowing down. This technological tsunami over the past few decades has resulted in untold benefits in increasing business and government efficiencies and delivering products and services at much lower costs to constituencies, clients, and consumers.

These information economy advancements have also caused massive problems within wealthy nations. In the United States, during a recent three-decade period of mind-boggling technological advancements, the average pre-tax income of the lower half of Americans when adjusted for inflation has remained virtually unchanged at just over $16,000 annually. Meanwhile, the average pre-tax income of the top one percent of the population has more than tripled up to $1.3 million in 2014 and increased more than sevenfold for the top .001 percent up to $122 million per year in 2014 [4].

The disparities have only increased since. Job creation and wages favor the high and low ends of the pay scale with middle class opportunities continuing to wane. Startups of small businesses have precipitously declined, severely

narrowing long-standing paths to reach the middle class. While in the U.S. currently there may be sufficient numbers of jobs resulting in low unemployment, most of the emerging jobs are insufficient to provide a living wage, even for many college-educated citizens. "The system in America and around the world has been organized to siphon the gains from innovation upward such that the fortunes of the world's billionaires now grow at more than double the pace of everyone else's" [4]. The top ten percent of humanity now controls 90 percent of the planet's wealth [4].

A fundamental research question of our time is how information societies might correct or adapt to enable rich opportunities for all humans to more equitably share in the benefits of information technology advancements rather than funneling the benefits primarily upwards towards those individuals with greatest existing wealth [7]. Much of the problem appears to be with the inability of governments across the globe to effectively utilize the mechanisms described in the previous section.

A wide range of legislative actions have been proposed for addressing inequitable human and societal conditions brought about by technological advancements and digital economies. Many have already been tested in various forms, particularly in more affluent nations across the globe. Among the approaches for more equitable distribution of benefits have included universal health care, widespread implementation of paid family and parental leave, remunerating work of value to society that may not currently be credited in monetary terms such as for parenting, volunteering and mentoring, creating citizen accounts able to accrue the value of such contributions outside of jobs, as well as many additional similar approaches depending on national circumstances [8]. The list of suggested methods for paying for such programs, most of which would also need to be deployed through legislative action, is very long as well.

While numerous solutions have been proposed, their widespread implementation has been severely lacking to date. A combination of approaches for ensuring sustained worker income and benefits as well as government approaches for generating revenues to pay for them are likely to be enacted as societal disruption becomes more pronounced and governments are forced to respond.

The types of remedies just raised, however, will not be achieved or will fall far short in achieving objectives if foundational constitutional or other controlling governmental framework principles are misaligned with supporting core democratic principles. Foundational principles at the highest level may need to be adapted to current and emerging circumstances due to the vastly changed global landscape brought about by information technologies.

Many nations, including those that are wealthy, likely need to increase their focus on political reforms to strengthen democratic processes, provide equal voices for ordinary citizens, and reduce polarization in politics. Among foundational-shifting law-making actions suggested in higher wealth nations have included decreasing misalignments among population and representa-

tion in governmental bodies, instituting substantive campaign finance reform to lessen the effects of moneyed interests in elections, making the process of redrawing election districts less susceptible to political maneuvering, lessening political polarization through actions such as implementing widespread ranked-choice voting and requiring all citizens to vote such that even less politically fervent citizens vote, and strengthening, broadening and enforcing anti-trust law to protect citizens and businesses from the deleterious economic and political effects of historically large and national boundary crossing monopolies.

Leading legal scholars also have long argued that there is a fundamental need to strengthen the rights of individuals such that humans would have much stronger rights compared to the competing rights of corporations [9, 1]. Stronger human rights would enable humans to be much better able to control information exposure about themselves and potentially place them in a position to directly share in revenue streams partially based on use of their private personal data by businesses and other parties.

8.8   Conclusions

All nations struggle with selecting and constantly revising legal and policy paths that will allow the social, economic, and political well-being of their citizens to thrive and that will achieve long-term sustainability for the nation as a whole. Open competitive private markets within and among nations have key roles to play in generating wealth for each nation as well as for its' citizens. Governments have a major role to play in ensuring that markets provide a level playing field by passing and enforcing laws that keep them open, free, and competitive. Governments also have a role to play in providing important goods and service strongly desired or needed by society that that will not be produced otherwise by society. As a general proposition, particularly in response to continually emerging technological advancements, governments across the globe need to do a much better job of revising laws to enable more equitable spreading of economic benefits across far broader and much larger swaths of the population.

Bibliography

[1] Charles Lund Black. *A New Birth of Freedom: Human Rights, Named and Unnamed.* Yale University Press, 1997.

[2] Catherine Doldirina, Anita Eisenstadt, Harlan Onsrud, and Paul Uhlir. Legal approaches for open access to research data. *LawArXiv*, 2018.

[3] Hannah Fry. *Hello World: Being Human in the Age of Algorithms.* W. W. Norton Company, 2018.

[4] Anand Giridharadas. *Winners Take All: The Elite Charade of Changing the World.* Knopf; First Edition, First Printing edition (August 28, 2018), 2018.

[5] Stacy. Mitchell. Amazon doesn't just want to dominate the market – it wants to become the market. The Nation, 2018.

[6] United Nations. Sustainable development goals, 2015.

[7] Cathy O'Neil. *Weapons of Math Destruction: How Big Data Increases Inequality and Threatens Democracy.* Crown; 1 edition (September 6, 2016), 2016.

[8] Darrell M West. *The future of work: robots, AI, and automation.* Brookings Institution Press, 2018.

[9] Alan F Westin. Privacy and freedom. *Washington and Lee Law Review*, 25(1):166, 1968.

[10] Shoshana Zuboff. *The age of surveillance capitalism: the fight for the future at the new frontier of power.* Profile Books, 2019.

9

Developing a Framework for National Institutional Arrangements in Geospatial Information Management

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Strong national institutional arrangements in geospatial information management are essential for successful implementation of the Sustainable Development Goals. This chapter presents a comprehensive framework based on a set of core instruments that has been developed to assist stakeholders. Examples of good practices in member states were collected for each instrument, enabling stakeholders to apply the framework in their decision making processes.

9.1   Introduction

The strategic importance of national institutional arrangements in geospatial information management was recognized by the United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM) at its third session in July 2013 when it identified the need for countries to examine institutional arrangements in geospatial information management, and thereby provide governments with options on how best to create national geospatial entities [12]. This need arose from earlier discussions at its second session in August 2012, when the Committee of Experts considered an inventory of issues that should be addressed in the coming years.

At its third session, the Committee of Experts further agreed that there was an urgent need to identify good practices related to national institutional arrangements for geospatial information management. A small Working Group

on National Institutional Arrangements (WG-NIA) was established to continue the work with Member States and regional and international entities. WG-NIA aims to examine national institutional arrangements (NIAs) that support geospatial information management. The output of the WG-NIA identifies good practices of institutional arrangements in Member States to provide national governments with principles and guidelines for institutionalizing geospatial information management. Relevant institutional arrangements contribute to the strengthening of geospatial information management taking into account (technological) issues related to digitalization, geo-referencing, standardization, fundamental geospatial datasets. Moreover, new aspects such as volunteered geographic information and open data are also taken into account.

At its fourth session in August 2014, the Committee of Experts reiterated the strategic importance of national institutional arrangements, noting that Member States are at different stages of geospatial development, and that institutional and policy frameworks are dependent on these legal, fiscal arrangements and governance models, which are quite different across the globe [13]. At this session the WG-NIA proposed the following definition for institutional arrangements: "National Institutional Arrangements (NIA) for Geospatial Information Management (GIM) may be defined as formal and informal cooperation structures that supports and links public and private institutions and/or organizations and which are used to establish the legal, organizational and productive frameworks to allow for sustainable management of geospatial information, inclusive of its creation, updating and dissemination, thereby providing an authoritative, reliable and sustainable geospatial information base for all users."

At its fifth session in August 2015, the WG-NIA presented to the Committee of Experts an extensive analysis of the results of a set of questionnaires from Member States which provided evidence to the importance and complexity of national institutional arrangements, and which generated a valuable source of information to be used in the future [14]. The Committee, in its decisions, provided guidance on how the WG-NIA might evaluate the status of efforts on progress in national institutional arrangements, including providing additional clarity on the process and on the conclusions drafted.

At its sixth session in August 2016, the Committee of Experts recognized the complex and broad scope of the work that the WG-NIA was undertaking, noting that there is no single universal solution or model that fits all countries [15]. Reiterating the need to provide Member States with options on how best to create robust national geospatial institutional structures, the Committee encouraged the WG-NIA to continue its work and, in order to give the work greater focus, to report on its progress to the UN-GGIM Bureau prior to presenting it to the Committee at its next session.

Subsequent to the sixth session, the WG-NIA made presentations at two UN-GGIM regional meetings. Based on discussions coming out of these meetings and interventions from Member States representatives and the Bureau, it was agreed that the WG-NIA should focus on generic elements that provide

Member States with guidelines and principles with which to make decisions on their national institutional arrangements, and not delve into technical methods and detail.

The next step was the execution of a small project "To develop a framework and guidelines in support of national institutional arrangements in geospatial information management for Member States". The purpose of this small project was to support the WG-NIA by evaluating the work done to date, package, develop and deliver outputs that will satisfy the objectives of the Committee of Experts under the agenda item "trends in national institutional arrangements in global geospatial information management." The project was executed from the end of February until the beginning of June 2017. The results were presented by the chair of the Working Group and approved by the experts during the seventh session (August 2017) [16].

The approved framework consisting of NIA-instruments forms the foundation for the current WG-NIA activities focusing on the development of a Foundational Guide to NIA-instruments for Geospatial Information Management.

Before the development of the framework, key documents were reviewed, such as UN Economic and Social Council (2013; 2014; 2015; 2016) and WG-NIA meeting reports, and discussions with key persons of WG-NIA took place.

Important work has been carried out by WG-NIA providing a strong grounding in the mechanisms of many parts of national geospatial information management. For the purposes of supporting the WG-NIA's objectives, a method to better identify how various mechanisms combine to deliver effective geospatial information management was required. There was scope to consider those institutional arrangements related to setting direction(s) through prioritisation and decision making, and monitoring performance, compliance and progress against agreed-on direction and objectives. Consequently, strong case studies were welcomed so that a set of key examples of good practices of institutional arrangements in context could be identified.

The development of the NIA-framework would benefit from drawing from existing governance and/or institutionalization disciplinary expertise and literature dealing with relevant governance structures and business models. These generally provide frameworks for allocating tasks and resources and/or taking into account appropriate instruments for collaboration, regulation and/or market forces which extend to the various levels of government. Such frameworks also take into account the distribution of powers and responsibilities within the Member States (e.g. partnership building, legal frameworks, market regulations).

As a means to assist the WG-NIA and enable it to have a renewed and greater focus, it was strongly recommended to develop a relevant, specific and comprehensive framework for national institutional arrangements based on a set of core instruments, while taking into consideration that no single universal approach exists which fits all Member States of the United Nations. Such a framework needs to be able to logically generate generic elements

and/or improving on the national institutional arrangements. In this context, the challenge was to develop a framework that is simple and straightforward in design, so that the key examples of good practices are logically borne out of the application. Another final challenge was that the framework had to be able to simply aggregate the findings at a global level while remaining relevant for individual Member States. The framework developed forms the foundation for identifying key examples of good practices of institutional arrangements.

This chapter is divided in five sections. This introductory section 1 included the review of the achievements of WG-NIA. The next section 2 "Framework development" introduces the framework for national institutional arrangements based on a set of core NIA-instruments followed by section 3 "Framework application" in which the followed application approach is presented. Section 4 'Key examples' presents the descriptions of key examples of good NIA-instrument practices. The reports ends with a short section presenting the main lessons learnt.

9.2   Framework Development

9.2.1   Introduction

To assist the WG-NIA, the development of a relevant overarching framework for NIAs based on a set of core instruments was recommended. While taking into consideration that no single universal approach exists which will fit all Member States of the United Nations, such a framework nonetheless needs to be able to generate generic elements that support delivery and/or improvement on current NIAs. There are two key challenges inherent to the development of a framework. First, the design should be simple and straightforward to enable key examples of good practices to be logically borne out of the application. Second, to support the ability to aggregate elements to be applicable at a more global level while remaining relevant for individual Member States.

9.2.2   Concepts

In this context, institutionalization is considered to be a process of creating 'appropriate' routines that become habitualized or internalized as legitimate behavior, and institutional arrangements provide instruments that governments can use to facilitate this (policy) process within and/or between organizations or programs. Institutionalization here refers to formal and informal structures that aim to enhance, frame or regulate the voluntary or forced alignment of tasks and efforts of organizations in the pursuit of geospatial information management. These instruments are used to create greater coher-

ence and to reduce redundancy, lacunae and contradictions with and between policies, implementation or management [5].

Three mechanisms underpinning institutional arrangements (in the public sector) – with an emphasis on coordination – can be distinguished: hierarchies, markets and networks. Each of these mechanisms has something to contribute to understanding the causes of problems experienced in institutional arrangements, the gains to be achieved through institutional arrangements, and the mechanisms through which better institutional arrangements can be achieved. The distinction between hierarchies, markets and networks of institutional arrangements in social life is widely accepted [11].

In hierarchy-based institutional arrangements, patterns of interaction have two main drivers: authority, operationalized in administrative orders, rules and planning on the one hand, and dominance and authority as the basic control system on the other. Market-based institutional arrangements are based on competition, bargaining and exchange between actors. The price mechanism, incentives and self-interest of actors steer activities of different actors by creating an 'invisible hand'. Network-based institutional arrangements take the form of cooperation between actors, where inter-organizational relations are ruled by the acknowledgement of mutual interdependencies, trust and the responsibilities of each actor [5].

Each of these mechanisms illuminate different aspects of institutional arrangements, but each also has some important explanatory deficiencies. Although these mechanisms are introduced as alternatives to one another, in reality many attempts on the part of government to enhance institutional arrangements will involve more than one of these forms. Under certain circumstances, attempts to impose direct hierarchical control over an organization or set of organizations will work better if the institutional 'arrangers' can build a more cooperative network among the organizations involved or among lower-level employees in those organizations. On the other hand, attempts to embed institutional arrangements that are more bottom up will work better if hierarchy casts a deep, dark shadow on the participants. As well as providing an intellectual understanding of policy making and evaluation, these mechanisms are also closely related to a set of instruments that can be leveraged to deliver national institutional arrangements.

9.2.3   Instruments

The three mechanisms for institutional arrangements presented above are of a more general and abstract level. They refer to the basic processes which may underpin institutional arrangements (authority, price and competition or trust and solidarity) in a sustainability context. In turn, institutional arrangements rely on certain instruments, i.e. specific activities or structures, which may themselves refer to specific operational mechanisms.

Instruments can be either structural or managerial. Institutional arrangements may be realized by creating new or changing existing structures or

TABLE 9.1

Classification of NIA-instruments into structural and managerial instruments

Structural	Managerial
- S1. Establishment of coordinating functions or entities	- M1. Strategic planning
- S2. Reshuffling division of competences	- M2. Financial management: input-oriented
- S3. Establishment of a legal framework	- M3. Financial management: performance-oriented
- S4. Regulated markets	- M4. Financial management: joined up working and cooperation
- S5. Systems for information exchange and sharing	- M5. Inter-organizational culture and knowledge management
- S6. Entities for collective decision-making	- M6. Capacity building
- S7. Partnerships	

management forms within the government. Managerial instruments refer to procedures, incentives and values which plan, monitor and evaluate the use of resources (HRM, finance) or the implementation of policies. Relevant structural instruments in the context of NIA are: S1. Establishment of coordinating functions and entities, S2. Reshuffling of competencies, S3. Establishment of a legal framework, S4. Regulated markets, S5. Systems for information exchange and sharing, S6. Entities for collective decision-making, and S7. Partnerships. Relevant managerial instruments are: M1, Strategic planning, M2. Financial management: input-oriented, M3. Financial management: performance-oriented, M4. Financial management fostering joined up working and cooperation between public organizations, M5. Inter-organizational culture, knowledge management, and M6. Capacity building. Table 9.1 presents the classification of NIA-instruments into structural and managerial instruments types. Each of these instrument will be briefly introduced below.

S1. Establishment of coordinating functions or entities.   This   structural NIA-instrument refers to the creation of influencing lines of control with the establishment of new functions or entities (e.g. coordination body) with clearly allocated roles, or responsibility tasks. In this context, a coordinator, respectively an individual or unit whose only or main function is to coordinate the geospatial information management activities of the different organizations in an inter-organizational system, and a lead organization which has besides its coordinating function, some operational line functions. The exact position of the coordinating entity vis-à-vis other organizations may determine to what extent hierarchical authority and power as resource is available. Most common coordinating functions or entities within the public sector imply some hierarchical difference between coordinator and the coordinated organizations. Moreover, their coordinating power is mostly stipulated and enforced by laws

and statutes. Their task is often to streamline, monitor and control the implementation of a centrally decided specific objective, goal or policy [5].

S2. Reshuffling of competencies. This structural NIA instrument contributes to new or changing structures and institutional forms in the context of the management of geospatial information. A well-known example is the reshuffling of competencies between ministries or departments in response to changing contextual pressures. NIA is enhanced by bringing related activities together by merging organizations or by separating them from other organizations with completely different activities. In addition, this instrument also takes into account the issue of (de)centralizing activities.

S3. Establishment of a legal framework. This structural NIA-instrument refers to the construction and adoption of a regulatory framework(s) for geospatial information management at different administrative levels and the associated legal conditions. Such a legal framework consists of a broad set of rules and regulations, aiming to organize a particular element in society (in this case the management of geospatial information). These rules and regulations are not necessarily developed specifically for a particular subject, but may have been created for other purposes in society and are now applied to the management of basic reference datasets. This can include legislation that deals with (digital) information, (open) data, standards or content, such as freedom of information, intellectual property rights or the protection of personal data. It can also involve legislation and policy with an even broader scope, such as tort liability and contract law, which apply to any kind of actor, situation or object falling within the field of application [6].

S4. Regulated markets. Another set of structural NIA instruments relates to the creation of regulated markets in order to create stimuli and sanctions that induce appropriate behavior by public organizations. The institutional arrangement of tasks and activities by different organizations is done through mechanisms of price and competition, offer and demand. Money and incentives are crucial. Providers of geospatial information are mainly funded through sales to their customers and purchasers, and their demand determines the activities of these providers. Such markets are generally created by government and, depending on the kind and number of users and providers, the kind and level of competition and the level of regulation, the market can be internal or external [5].

S5. Systems for information exchange and sharing. Applying the creation and maintenance of this structural NIA-instrument may induce organizations to take into account the actions of other organizations through processes of mutual adjustment. Through new or re-oriented flows and systems of information, decision-making organizations can be better informed about the latest developments and activities in line with those of organizations [9]. Through systems and arrangements for information exchange, information flows and exchange can be better organized. For example, the development of national geoportals as a key element of geospatial data infrastructures – which are web portals used to effectively find and access geospatial information and associ-

ated geospatial services (e.g. display, editing, analysis), are a good example of this instrument in the context of geospatial information management [3]. Information from various organizations can also be integrated in a government-wide information system, giving a strategic overview of government activities. The focus would be on both technical ICT systems as a basis for making information accessible as well as on the content of the information systems.

S6. Entities for collective decision-making. This structural NIA-instrument refers to entities that can make binding decisions [1] affecting multiple actors. Strategic decision-making boards are established consisting of senior officials of different organizations belonging to the policy domain of geospatial information management in order to collectively set out strategy and control the implementation of it. Such joint decision-making bodies enable joint planning and joint working more easily than weaker forms of cooperation.

S7. Partnerships. The most extreme form of cooperation is the creation of a partnership between two or more organizations leading to a common organization controlled by the different 'parent' organizations. This enables the achievement of which these organizations are collectively responsible for, or simply perform joint tasks. Applying this structural NIA-instrument obviously stimulates ownership and creativity, but also assumes substantial autonomy, a common vision, and sufficient goodwill and capacity at organizational level to make collaboration possible. Public partnership can take myriad forms, but can be broadly categorised into: government to government partnerships (G2G); government to business (G2B); and government to community or citizen (G2C).

M1. Strategic planning. This management NIA-instrument refers to the existence, implementation status and political support of strategy plans regarding geospatial information management in which activities of public organizations are aligned to a system of interconnected levels of plans, objectives and targets. NIA is fostered by giving individual organizations clear objectives and targets within a framework of broader inter-organizational or even government-wide goals. These different levels of plans are linked to one another to avoid duplication, gaps and to enhance the pursuit of overarching goals. These plans are monitored and evaluated, after which plans can be adjusted and fine-tuned.

M2. Financial management: input-oriented. This is the first NIA-instrument related to financial management system encompassing processes and instruments of budgeting, accounting and auditing. The set of instruments may entail budgetary guidelines, framework letters. Expenditure review committees, bilateral negotiations and conflict resolution processes, budgetary advice at the centre, formats, systems and provisions for accounting and audits [8, 5]. The hierarchical, input-oriented budget process defines clearly what resources related to geospatial information management should be spent on, and in great detail. There is not much autonomy for organizations to spend the budget as they see fit. Making savings are expressed as a multilateral demand, to which

all organizations have to comply. Through the budget, policy priorities are set and communicated downwards.

M3. Financial management: performance-oriented. This second financial management NIA-instrument is result-oriented, with a heavy emphasis on organizational incentives for performance. The focus of the management system is on providing incentives to organizational units to improve their performance. The budget is linked to the expected or past performance (price times quantity: p*Q) of the organizations, and financial sanctions in case of underperformance are possible. Such budgeting is a pre-condition of creating (quasi)markets.

M4. Financial management fostering joined up working and cooperation. This third financial managerial instrument aims to join-up working and cooperation between public organizations. In such a perspective, the focus of the financial management system is on the consolidation of financial and performance information across organizations and policy fields. The emphasis is on information consolidation and exchange, new budget formats, geared towards horizontal policies (for example, outcome- or program-based budgets related to geospatial information management), as well as joined and exchangeable budgets in order to achieve cross-cutting objectives [9, 1, 5]. If organizational or individual incentives for collaboration are present in financial management systems, they are heavily geared towards joined-up activities and cooperation. Such financial management systems oriented towards collaboration will usually include great flexibilities for budget shifts between organizations and years, a limitation of input controls, as well as longer time-span.

M5. Inter-organizational culture and knowledge management. Another NIA-instrument relates more to human resources as an important resource. This managerial instrument aims to enhance institutional arrangements by fostering shared visions, values, norms and knowledge between organizations. As such, this set of NIA-instruments fosters the creation and growth of inter-organizational networks [7] and hence is predominantly linked to the network mechanism to institutional arrangement. This could be achieved by means of the development of cross-cutting skills among staff; common education or common training; management development; mobility of staff between organizations; and the creation of systems for inter-organizational career management [9]. The introduction of behavioral and ethical codes for relevant staff members may be another vehicle for creating and cultivating such common values and norms.

M6. Capacity building. Capacity building or development is defined by United Nations Development Program as the process by which individuals, organizations, institutions and societies develop abilities to perform functions, solve problems and set and achieve objectives [20]. Applied to the geospatial information management context, this means establishing effective strategies for capacity assessment, development, and promoting geospatial advocacy and awareness. For example, the development of a competency framework to articulate the skillsets and knowledge required to function in the geospatial

TABLE 9.2

Classification of NIA-instruments into structural and managerial instruments

Instruments	Hierarchy	Market	Network
Structural	S1. Establishment of coordinating functions or entities S2. Reshuffling division of competencies S3. Legal framework	S4. Regulated markets	S5. Systems for information exchange and sharing S6. Entities for collective decision-making S7. Partnerships
Managerial	M1. Strategic planning M2. Financial management: input-oriented	M3. Financial management: performance-oriented	M4. Financial management: joined up working and cooperation M5. Inter-organizational culture and knowledge management M6. Capacity building

industry could serve as a basis for capacity assessment and development. Facilitating education and skills training at all levels, from building basic awareness to the development of specialist skills could help to ensure a sustainable pipeline of talent for the geospatial information workforce.

The structural and managerial NIA instruments can be clustered into the underlying mechanisms allowing to guide the application of the key instruments for strengthening a specific NIA-mechanism (see table 9.2). The instruments clustered can be considered as complementary to each other and it is up to the decision-maker (and policy makers) which one and/or how to apply.

Being aware that no single universal NIA approach exists which will fit all Member States of the United Nations, it is important to note that some NIA-instruments may appear more relevant than others in a specific national context. It is up to the decision-makers (and policy makers) to decide which NIA-instrument is more relevant, feasible, efficient and/or effective.

9.3 Framework Application

9.3.1 Introduction

In order to apply the identified NIA-instruments in the context of geospatial information management, existing good practices in Member States were collected for each NIA-instrument and described in a standardized template. To better understand how these instruments can be used effectively to support geospatial information management in practice, examples of good practices of these instruments were sought mainly through WG-NIA members.

The notion of a 'good' practice is highly subjective: it is a consequence of any number of variables including political stability, resource commitment, effective governance and management structures, application of guiding principles for geospatial information management [19], etc. Therefore, instead of imposing a definition of what constitutes a 'good' practice of a national institutional arrangement, we have left the selection of examples up to the WG-NIA members (deemed as experts) and assumed that the reported practice represents an example of a 'good' practice because it demonstrates outputs or outcomes that facilitate geospatial information management in that country. A field in the standardized template for describing the good practices ('Good Practice Motivation') aims to provide justification to its selection for readers. All the completed templates were reviewed by the WG-NIA members as a validation process.

This contextual assessment implies that what might be a good practice for one country may not necessarily be transferable to another country. This underscores the UN-GGIM's initial statement that there will not be a one-size-fits-all solution. To overcome this specificity, section 5 will draw out key lessons based on the recurrence of these themes across the examples to develop generalized principles and guidelines.

The instruments of the overarching framework for NIAs are applied to Member States with geographical representations of the UN-GGIM's five regions (UN-GGIM Africa, UN-GGIM Americas, UN-GGIM Arab States UN-GGIM Asia-Pacific, UN-GGIM Europe) to present good practices for each NIA-instrument and to derive principles and guidelines from these practice presentations.

9.3.2 Application Approach

The structural and managerial instruments of the overarching framework for NIAs were applied to Member States to: 1) identify and describe good practice examples of institutional arrangements; and 2) elicit generic elements and lessons learnt, making partial use of the previous works executed by WG-NIA. In section 4 the key examples of each NIA-instrument are briefly presented.

The first steps in the identification of good practices for each type of NIA-

instrument were the intensive reviews of existing key source materials and documents, as well as provision of good practices by members of WG-NIA. The Key source materials used were:

- Detailed answers of two questionnaires executed by WG-NIA Task Groups (TG) 1, 2 and 3 (2015) [18]. Questionnaire 1 was a shared questionnaire of the three TGs (TG1: Geospatial Reference Information production systems analysis; TG2: Geospatial Reference Information (GRI) funding structures, dissemination systems and data policy models; TG3 Role of Volunteered Geographic Information). Questionnaire 2, from TG3, was on the Structure of Geospatial Management Organization (2015) [17].

- Documents stored in the UN-GGIM Knowledge Base with descriptions of National Spatial Data Infrastructures (2015-2016), examples of geospatial information laws/directives/regulatory practices (2015-2016), Case studies/best practices (2013-2014), country reports (2011-2016), and Country profiles (2014-2016).

- INSPIRE Member States Reports[1] (2010-2016) [10].

- INSPIRE State of Play reports[2] [2].

The objective of the application was to collect a minimum of three good practices for each type of NIA-instrument. The collection criteria were the following: 1) Relevance of the practice example clearly showcasing the meaning of the application of the NIA-instrument; 2) Availability of information from reliable sources (e.g. policy documents, official websites, documents stored in the UN-GGIM Knowledge Base, etc.); 3) Currency – practices older than 10 years were considered to be outdated except those that very clearly showcase the meaning of the instrument; 4) Geographical representation of all the good practices as per the UN-GGIM's five regions; 5) Submissions of good practices provided by members of WG-NIA.

The collected examples of good practices were mainly described by members of the WG-NIA. Some practice descriptions include contributions of representatives of UN Member States who had detailed knowledge about a specific good practice (Brazil, Canada, Chile, Ecuador, Slovenia, Sweden). In total, 61 key examples of good practices of NIA-instruments were identified and described of which twenty are from the UN-GGIM region Europe, sixteen from Asia-Pacific, seventeen from Americas, five from the Africa, and three from Arab States.

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[1]According to Article 21 of EU INSPIRE Directive, EU Member States shall send a report about the implementation progress of the directive every 3 years including issues related to institutional arrangements.

[2]These studies were executed by the Spatial Applications Division of KU Leuven on the status of national spatial data infrastructures across Europe. The studies began in 2002, and the reports were updated every year up to 2007. Further studies were carried out using the same approach in 2010 and 2011. These studies also referred to institutional arrangements of geospatial information management in the countries

The descriptions were based on a standardized template. This template was designed so that those who have an interest in good practices of NIA-instruments would find the content accessible and easily understood. The template contained the following topics: Title, Country, Type of NIA-instrument, Aim, NIA-instrument description, Background, Use, Good practice motivation, a visualization illustrating the NIA-instrument practice, and Reference. These topics together introduce a good practice of a specific NIA-instrument in one of the Member States. The applicability of the template was tested and approved by members of the WG-NIA.

9.4 Key Examples

9.4.1 Introduction

The instruments of the overarching framework for NIAs were applied for Member States to identify good practices of each type of NIA-instrument in Member States. This application was presented in the previous section 3.

The objective of this section 4 is to showcase key examples of good practices for each NIA-instrument. Based on the input of members of WG-NIA, a list of minimum three key practice examples per NIA-instrument was compiled reflecting the meaning and the applicability of each instrument.

9.4.2 Description of Key Practice Examples

Table 9.3 below presents an overview of all described key examples of good practices for each NIA-instrument as introduced in section 2 "Framework Development" followed by country and title of the good NIA-instrument practice. Annex 3 of the consultancy report [4] presents the full descriptions of all the collected key examples of good practices for each NIA-instrument. The descriptions are based on the standardized template as introduced in section 3 "Framework application"

TABLE 9.3: Overview of all described key examples of good practices for each NIA-instrument

NIA-Instrument	Country	Title
S1	Mexico	Coordination of the National Information System Statistical and Geographic
	New Zealand	A Clear Geospatial Governance Framework
	Panama	Coordinating structure of the National Spatial Data Infrastructure of Panama

	Spain	SIGPAC Coordination Board
S2	Belgium	Reshuffling of agencies in the Belgian region of Flanders
	Czech Republic	Governmental role clarification and the development of an SDI Coordination Structure
	Portugal	Reshuffling division of competences in the Portuguese Spatial Data Infrastructure within the broader governmental reform context
S3	Mexico	Legal Framework of the National Information System for Statistics and Geography
	The Netherlands	Legal Framework of the National Information System for Statistics and Geography
	Russia	Law on geodesy, cartography and spatial data
S4	Denmark	Open Standard Licensing
	Rwanda	Rwanda Open Data Policy
S4 + S5	United Kingdom	Open data platform data.gov.uk
S5	Canada	Federal Geospatial Platform
	Ecuador	Spatial data infrastructure facilitating emergency response in case of earthquakes
	France	National geoportal of the French administration
	Indonesia	Coordinating Data Sharing Through Indonesia's National Geospatial Information Networks
	Kenya	National land information management system
	Mexico	Digital Map of Mexico
	Morocco	Development of governmental geoportals
	New Zealand	LINZ Data Service
	Republic of Korea	Integrated Approach Towards Data Sharing through NIIS
	Rwanda	SpIDeRR: Spatial Information and Data Portal for Disaster Risk Reduction
	Singapore	Sharing Data, Delivering Services and Building Communities in GeoPlatforms

	Spain	Cadastral Electronic Site (SEC)
S6	Fiji	Fiji Geospatial Information Council
	Singapore	Joint decision-making committee with multiple Government agencies to drive geospatial development
	Slovenia	Slovenian coordination mechanism for infrastructure for spatial information
S7	Australia	Building National Datasets Through Intergovernmental Partnerships in PSMA Australia Limited
	Canada	Canadian Ocean Mapping Research and Educational Network (COMREN)
	Japan	GSI Maps Partner Network
	Mexico	National and international arrangement signed by INEGI
	Spain	Public Agreements of the Spanish National Plan for Land Observation (PNOT)
	Sweden	Data sharing model – The Swedish Geodata Cooperation Agreement
Combined S1 S2 S3	Ghana	Land administration project and subsequent reforms of the National Institutional Arrangements
M1	Australia	The Consultative Approach of Australia's 2026 Spatial Industry Transformation and Growth Agenda
	Brazil	Action Plan for the Implementation of INDE
	Denmark	Good Basic Data Everyone – A driver for growth and efficiency
	Former Yugoslav Republic of Macedonia	Strategy for National Spatial Data Infrastructure of the Former Yugoslav Republic of Macedonia
	Mexico	Programs of the National System of Statistical and Geographic Information (SNIEG or System)
	Namibia	Namibia National Spatial Data Infrastructure (NSDI): Strategy and Action plan 2015-2020
	Singapore	The Comprehensive Scope of the Singapore Geospatial Master Plan
	United Kingdom	Place matters: the Location Strategy for the United Kingdom

M2	Bahrein	Government Investment in Bahrein Spatial Data Infrastructure
	China	Financial investments in Chinese geospatial information Management
	India	NSDI Financial Strategy and Funding Models
	Mexico	Cadastral Modernization Program
M3	Germany	Automated performance procedure for German SDI Monitoring
	United Arab Emirates	Geomaturity Assessment of Abu Dhabi Spatial Data Infrastructure
	USA	Geospatial Maturity Assessment
M4	Australia/New Zealand	Australia and New Zealand Cooperative Research Centre for Spatial Information
	The Netherlands	Geonovum
	Norway	Digital Norway (NSDI) shared financing of basis geodata
M5	Canada	Federal Committee on Geomatics and Earth Observations (FCGEO) and Canadian Committee on Geomatics (CCOG) – Public Sector Geomatics Cooperation in Canada
	Canada	The Canadian Geomatics Community Roundtable and GeoAlliance Canada
	Japan	Enhanced cooperation among relevant stakeholders of geospatial information applications and services at local level
	Poland	Training cycle on INSPIRE Directive implementation
	USA	The COGO Report
M6	Brazil	Capacity Building in the National Spatial Data Infrastructure of Brazil (INDE)
	Chile	Regional training workshops for managing the National System on Territorial Information (SNIT)
	Singapore	Strengthening geospatial information capacity and the use of Geospatial Information, Science & Technology

In total, 61 key examples of good practices of NIA-instruments have been identified and described of which twenty are from the UN-GGIM region Eu-

rope, seventeen from Americas, sixteen from Asia-Pacific, five from the Africa, and three from Arab States.

Examples of good practices of NIA-instruments from 38 UN Member States were collected: Australia, Bahrein, Belgium, Brazil, Canada, Chile, China, Czech Republic, Denmark, Ecuador, Fiji, France, Germany, Ghana, India, Indonesia, Japan, Kenya, Republic of Korea, Former Yugoslav Republic of Macedonia, Mexico, Morocco, Namibia, New Zealand, The Netherlands, Norway, Panama, Poland, Portugal, Russia, Rwanda, Singapore, Slovenia, Spain, Sweden, United Arab Emirates, United Kingdom, and USA. These examples reflect practice across a range of UN Member States. More than one good practice is described for 13 UN Member States.

The collected examples demonstrate that some NIA instruments are fairly easy to identify and describe. This is seen in the diversity of practice applications for the structural NIA-instrument, S5. "Systems for information exchange and sharing", and the managerial NIA-instrument, M1. "Strategic Planning".

Conversely, it was difficult to obtain good practice examples of some NIA instruments such as S2. "Reshuffling division of competences" and M5.

"Inter-organizational culture and knowledge management". This is not necessarily an indication of an absence of these practices, rather an absence of available information on these practices as NIA-instruments.

9.5   Lessons Learnt

Some lessons learnt can be derived from the collected examples.

Emergence of a common model. The examples show there exists an array of institutional strategies to achieve good geospatial information management, but there are also commonalities. These commonalities have been abstracted and are shown as a possible roadmap for institutional design in Figure 1. This should not be read as the ideal model for implementing the NIA instruments, but simply as a way to support a user's understanding of how to commence use and implementation of the instruments. This needs to be done with sensitivity to contextual variables in the country (e.g. sources of legitimacy for decision-making, resources, number of agencies involved, pre-existing inter-organizational relationships, etc.).

Figure 1. Proposed model of function and relationship of NIA instruments

Clear trends. Examples from Member States demonstrate some clear trends: that geospatial information is now considered a national asset; that the publishing and sharing of geospatial information has socioeconomic benefits and as such, is gaining characteristics of a public good; that this represents challenges in terms of operations and funding structures.

The need for an integrated change process. Governments are cog-

nizant of these emerging and/or established characteristics and are seeking to legislate to establish the appropriate facilitative governance structures. However, the examples also demonstrate that it often falls to managers to negotiate the operational challenges that these structural changes bring. Therefore, it is important that these NIA-instruments are considered in an integrated way as much as possible, and not perceived as a hierarchical change process.

The importance of a strategic plan. Many countries had an element of strategic planning, that was conducted as a first step to identify the vision, mission, aim and objectives of the geospatial information management initiative. This provided the direction for selecting the appropriate instrument for instigating a new structure. Whether this was more hierarchy- (S3) or networks-based (S7), is really a function of a contextual variables like where authority comes from, previous initiatives that may have worked or failed, resource flows, existing successful relationships, etc.

Catalysing institutional change. Legal frameworks were also often used to catalyse an institutional change process as it represents a coercive force and demands a mandatory shift in mental models and culture. Often the benefit of legislation is the provision of enforcement mechanisms to ensure that organisations comply with changes. However, the example from the Netherlands also shows that a consolidated legal framework is also a strategic mechanism that aligns the development, use and management of geospatial data with sustainable development principles – a strategy that can enhance the legitimacy for change.

The need for clarity. Regardless of the coordinating mechanism, it was apparent that in a multi-organisational, and multi-sectoral collaboration, clarity over who did what was necessary. This is reflected in the link to S2. S1 and S6 can be seen as potential outcomes of S2, and its operationalisation into a governance structure. For managers on the ground, the change trajectory marked by S1. Establishment of coordinating functions and entities, and S2. Reshuffling division of competencies needs to be considered carefully as this has implications for M5. Inter-organizational culture and knowledge management and M6. Capacity building.

Being open to 'open' data. It is strongly recommended that governments explore the possibilities of open data policies by making use of Creative Commons licenses as open standard licenses allowing providers of public sector (geospatial) data to publish their data without the need to develop and update custom licenses. However, issues related to accountability, transparency and sustainable financing need to be also taken into account. In order to have a strong regulated market, the main guideline is to establish a consistent pricing policy regarding the use of geospatial data and services.

Diverse business models. The three financial management NIA-instruments (M2. Input-oriented, M3. Performance-oriented, M4. Joined up working and cooperation) represent funding and business model options. Each have their own benefits and limitations, but it is evident that an initial injection of funds is necessary for getting an large-scale geospatial system up

and running. There is a growing tension between the cost of geospatial data production and maintenance and the diffused economic benefits that accrue from facilitating its use and reuse. Norway provides a good example of the use of obligatory co-financing of basic data to manage this financial tension.

The challenge of culture and capacity. NIA-instruments M5. Inter-organizational culture and knowledge management and M6. Capacity building can be difficult instruments to apply in practice. The normal approaches, as seen in the examples, tend to be trainings and workshops. While these should not be discounted, they do not necessarily translate to the types of culture change and capacity building that is required to sustain new ways of working. Singapore's example of multiple approaches at different demographics provides a good example of an approach.

Acknowledgements

Bibliography

[1] Perri 6. Joined-up government in the western world in comparative perspective: A preliminary literature review and exploration. *Journal of Public Administration Research and Theory: J-PART*, pages 103–138, 2004.

[2] European Commission. Spatial data infrastructures in europe: State of play, 2002-2007, 2010-11.

[3] Joep Crompvoets. Geoportals. *International Encyclopedia of Geography: People, the Earth, Environment and Technology: People, the Earth, Environment and Technology*, pages 1–6, 2016.

[4] Joep Crompvoets and Serene Ho. To develop a framework and guidelines in support of national institutional arrangements in geospatial informa-

tion management for member states. united nations committee of experts on global geospatial information management. 2017.

[5] Koen Verhoest Geert Bouckaert, B. Guy Peters. *The Coordination of Public Sector Organizations: Shifting Patterns of Public Management.* Palgrave Macmillan; 2010 edition (February 24, 2010), 2010.

[6] Katleen Janssen and Joep Crompvoets. *Geographic data and the law: defining new challenges.* Leuven University Press, 2012.

[7] Erik-Hans Klijn and Joop FM Koppenjan. Public management and policy networks: foundations of a network approach to governance. *Public Management an International Journal of Research and Theory*, 2(2):135–158, 2000.

[8] 1999 OECD. *Integrating financial management and performance management*, volume PUMA/SBO (99)4 Final. Organisation for Economic Co-operation and Development, 1999.

[9] Christopher Pollitt. Joined-up government: a survey. *Political studies review*, 1(1):34–49, 2003.

[10] European Commission INSPIRE Member States Reports. Monitoring and reporting, 2010, 2013, 2016.

[11] Grahame Thompson. *Markets, hierarchies and networks: the coordination of social life.* Sage, 1991.

[12] UN. Trends in national institutional arrangements in global geospatial information management. *United Nations Economic and Social Council, E/C.20/2014/5/Add.1*, 2013.

[13] UN. Trends in national institutional arrangements in global geospatial information management, report on the third session. *United Nations Committee of Experts on Global Geospatial Information Management, Economic and Social Council, E/2013/46-E/C.20/2013/17*, 2014.

[14] UN. Trends in national institutional arrangements in global geospatial information management. *United Nations Economic and Social Council, E/2015/46-E/C.20/2015/17*, 2015.

[15] UN. Trends in national institutional arrangements in global geospatial information management. *United Nations Committee of Experts on Global Geospatial Information Management, Economic and Social Council E/C.20/2016/6*, 2016.

[16] UN. Trends in national institutional arrangements in global geospatial information management. *United Nations Committee of Experts on Global Geospatial Information Management, Economic and Social Council E/2017/46-E/C.20/2017/18*, 2017.

[17] UN-GGIM. Working group on trends in national institutional arrangements, questionnaire on structure of geospatial management organization. task group 3, 2015.

[18] UN-GGIM. Working group on trends in national institutional arrangements, questionnaires to inform the work of nia task groups 1, 2 and 3, 2015.

[19] UN-GGM. The statement of shared guiding principles for geospatial information management, 2015.

[20] A UNDP Primer United Nations Development Programme. Capacity development, 2009.

10

Considerations for Institutional Interconnectivity

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This chapter opens by acknowledging the framing of sustainable development as a 'wicked' problem before overviewing the concept of institutions. The institutional challenges around coordination and collaboration in the public sector are then reviewed, first in the context of wicked problems followed by geospatial data management and spatial enablement. Finally, the chapter closes with a summary and a brief discussion on potential strategies for progressing the issue.

10.1 Introduction

There is growing recognition of the importance of geospatial data for the implementation and measurement of progress of the goals and targets identified under the United Nations (UN) 2030 Agenda for Sustainable Development [38]. With an orientation towards spatial enablement, much of this book is focused on addressing the challenge of SDG connectivity from a technical perspective, which is a significant challenge.

There are, however, also significant non-technical challenges. The SDGs seek to improve outcomes, often relating directly to the lives of the most vulnerable, whose agency in contributing and collecting data is almost always compromised. Bringing together data about their lived experiences in a way that is useful and truthful is not straightforward, as can be seen from the lack of prescribed methodologies for numerous targets and indicators. Bringing such data together also requires recognition of ethical data collection and integration, and is contingent upon different public, private and non-government organizations being able to collaborate and coordinate their efforts. Such scenarios may invite new ways of working together, inferring the need to develop

and shape inter- and intra-organizational relationships which may or may not have precedence.

These non-technical challenges are often subsumed under the broad umbrella of 'institutional' considerations. Addressing these challenges is important and central to the progression of the SDGs [41]. But what exactly are institutions? The UN's own guidance note suggests that the word is used interchangeably with organizations, while the economist, Douglass North, famously espoused institutions as 'rules of the game' [31]. Regardless, the only consistency is that 'institutions' is a fuzzy word and can mean different things to different people - sometimes even to those within the same discipline.

This chapter therefore seeks to provide a general overview - a sort of primer - on institutional considerations for those who may be involved in attempting to drive coordination and collaboration to integrate geospatial data (with other administrative or statistical data) for SDG-related activities. As it is governments who have explicitly undersigned commitment to the SDGs, and who mostly still hold custodian roles over these data types, this chapter is oriented to the behavior of the public sector. This is not to say though that the discussion will not be relevant to other non-government stakeholders equally active in pursuing sustainable development. Accordingly, this chapter dips into literature from multiple domains such as public administration, sociology, economics, management and innovation studies to provide breadth, rather than depth, of coverage.

10.2   SDGs as a 'Wicked' Problem

The challenge of sustainable development is now broadly understood and accepted as a 'wicked' problem. The general concept of 'wicked' problems is attributed to Rittel and Webber's seminal work on design thinking to deal with the limitations they saw in (then) approaches to deal with complex planning problems. They defined a list of ten properties of wicked problems, invoked a non-linear, non-rational approach to designing which challenged the prevailing approach of the time, and inextricably and explicitly linked designer/design with the political context [36]. This theory has since been expanded upon in the design sphere, where wicked problems are now commonly characterized by the presence of fuzzy problem boundaries, unclear responsibilities, and a plurality (and contesting) of values, drivers, contexts, solutions, connectedness, and legitimacy [8, 21, 17].

Peters (2017) proposes that the term 'wicked' problem has become somewhat indiscriminately used, broadly cast to describe any difficult problem. He argues that, "*few problems facing governments in 2015 and thereafter are actually wicked problems in the full conceptual meaning of the term*" ([33],p.386). Indeed, we live in an age where complexity and complicatedness is the new

normal and many problems facing governments these days are unlikely to be definitively resolved. Perceptions of progress are instead likely to be contingent on, and a consequence of, how outcomes are framed to stakeholders vis-á-vis context [5, 17]. Alford and Head (2017) argue that a loose application of the term has promulgated a "totalizing" ([3],p.399) perspective, whereby the problem is not fully analyzed as the sum of its constituent parts but instead attempts to solve the problem in its cumulative form . This enables a tendency towards problem avoidance (we cannot develop a strategy if we cannot distinguish a starting point), or conversely pressure to define the 'right' solution that is immediately implementable, and conveys (perhaps unintendedly) an implicit expectation that success is largely difficult to achieve.

Nonetheless, the notion of wickedness is still useful and latter studies have focused on drawing out more nuanced conceptualizations. Using examples from natural resource management, Nie, (2003) offers a dualistic perspective: wickedness in policy problems can be **by nature** or **by design** whereby "*the very nature and context of some cases and issues essentially promise political conflict – they are wicked by nature. But they are also wicked by design in that political actors, institutions and decision making processes compound them*" ([30],p. 308-309). Newman and Head (2017) show how assumptions of 'wickedness' can be epistemological: here, problems that are technical in nature are assumed to be more amenable to traditional problem-solving approaches, while social problems are viewed as more intractable, thereby demanding non-traditional approaches [29]. Alford and Head (2017) developed a typology of 'wickedness' to help analysts think through problem structure, and hence potential solutions [3].

By various definitions, it appears that there is broad agreement that the challenge of sustainable development is a wicked problem [34, 18, 43]. In part, this is attributed to the fact that sustainable development as an outcome is the sum of resolving a multitude of other wicked problems like climate change, which also occupy highly contested spaces that inhibits agreement and action. Subsequently, this infers that many networks of stakeholders need to be enrolled in problem-solving, which has led to a growing interest in a system-of-systems approach to address sustainable development challenges [28]. This is further complicated by the fact that in our knowledge economy, data is power - information sharing within government, and across public sector organizational boundaries, is recognized as a longstanding chronic challenge even if such activity advances organizational or public benefit [40]. For governments who have committed to the SDGs, this indicates challenges in terms of both public administration and public policy.

10.3   Institutions

In any situation, the way we behave will be consciously or unconsciously influenced by any number of rules and practices that prescribe how to act appropriately. These rules and practices are relatively stable and resilient to change, and are simultaneously being produced and changed by the social structures that we are embedded within.

These social structures that produce regular patterns of behaviour are what we refer to as **institutions** in this chapter: they evolve from local customs and beliefs, strengthening to form normative rule-based structures (both formal and informal) that prescribe or preclude behaviours in actions at all levels of society, and hence are instrumental in political order [32]. Core to the discourse of institutions is the assumption that institutions reduce risks and uncertainty (thus lowering transaction costs) by creating expectations around order and predictability of how others might behave in certain situations, i.e. propagating a logic of appropriateness [25, 47, 4]. Such behaviour is accepted and expected as optimal ways of acting.

We focus here on three main types of institutions as defined by Scott (2001): *regulative*, which is legally sanctioned; *normative*, which is morally governed; and *cultural-cognitive*, which is culturally supported [39]. These three types of institutions exert pressure to conform to expected behaviour in different ways: regulative institutions exert coercive pressure, i.e. we feel compelled (i.e. no choice) to act often with the threat of sanction; normative institutions exert normative pressure, i.e. we feel that we ought to act due to social pressure; cultural-cognitive institutions exert mimetic pressure, i.e. we imitate behaviour without necessarily having a conscious understanding of motivation [12].

There is often an assumption that stable institutions persist simply because they are right and a sense of 'historical efficiency' becomes associated with it [25]. However, institutions can often be less than appropriate not only because they are difficult things to change, but also because the cost of enacting change may be greater than the benefits that change might bring [11].

10.4   Wicked Problems and Institutional Challenges for Coordination and Collaboration in the Public Sector

The public policy and political science literature is rife with many examples of challenges posed to the administrative capacity of governments to coordinate action. As Bouckaert, Peters, and Verhoest (2010) note, "*Coordination is one*

of the oldest problems facing the public sector" ([14],p.13). Institutions, as described above, play an important role in coordination and collaboration. Here, we briefly emphasize three common challenges related to wicked problems.

Multiple stakeholders. Coordination and collaboration is thought to be the most effective way of addressing transboundary problems that involve an array of stakeholders [17]. However, this attracts risks of under- or over-coordination. With many stakeholders involved, directing and forming a solution could be compromised if the problem does not fall within the explicit responsibility of any one organization to direct and coordinate; on the other hand, if too many stakeholders want to lead, then it becomes difficult to formulate a coherent approach [22]. In this context, institutions can be useful or limiting in the sense that social rules and practices directly structure opportunities and access to resources for actors that enhance or constrain participation [37].

Mechanisms for coordination. The Weberian view of bureaucracy has embedded a hierarchical approach to coordination as convention [45]. This has been an effective mechanism for vertical coordination enabled by regulative pressure, and therefore important functions of government (e.g. planning, budgets) remain effectively hierarchical. However, such rigidity can limit flexibility or access resources to facilitate coordination. With the increasing presence of non-government stakeholders in public service delivery more generally but also in tackling wicked problems, other mechanisms for coordination have become pertinent, primarily networked approaches, where collaboration is voluntary and fostered by shared values [20, 7]. In networks, coordination tends to be more horizontal, and is a consequence of negotiation amongst network members, which requires a culture of social trust to be established (Peters 1998; Considine 2005). Therefore challenges for coordination here may be cultural, but also related to communication, i.e. expressing and agreeing on rules and practices [2].

Institutional legacy of public sector reform. For many governments around the world, efficient and effective public service delivery is contingent on standardized, routinized models - and this is directly oppositional to the nature of wicked problems. The ability of the public sector to contend with such problems is compounded by public sector reforms in the 1980s and 1990s under the banner of New Public Management (NPM). This resulted in a shift away from coordinated, multi-purpose organizations towards streamlined, specialized units with more explicitly defined service objectives, which incentivized competition rather than collaboration [14]. Consequently, the negative - albeit unintended - impact these reforms had on overall public administration motivated another wave of changes in the 2000s that sought to redress fragmentation through an emphasis on 'joining up' government agencies for the delivery of public services [16, 6].

10.5   Challenges of Coordination for Spatial Enablement

The challenge of coordination related to spatial enablement could be seen as having parallels with the experiences of implementing spatial data infrastructures (SDI). SDIs are commonly expressed as collection of technology, data, policies and standards to facilitate access and sharing of geospatial data across a network of custodians and users [35]. The push for SDIs coincided with the second wave of reforms around joined-up government and this is likely to have positively impacted the take-up of the concept.

However, the implementation of SDIs in reality have often been troubled. The collection and provision of statistically significant geospatial data is often a central government task as this includes fundamental information for governing including cadastral data, addresses, physical planning, topographic information, etc. Indeed, many governments define foundational geospatial layers, e.g. in Australia, there are ten such layers[1] prescribed that are pronounced to be 'trusted' base datasets - i.e. collected and managed by government custodians. Early research demonstrated a range of institutional challenges including lack of incentives to encourage the development of new practices for sharing data [9], or an alternative perspective is that the opening up of data threatened existing power relationships [13]. Additionally, many SDI initiatives also have governance arrangements that are legacies of their origins stemming from specialist national mapping agencies, which were subsequently found to be inappropriate for delivering on the larger scale objectives of whole-of-government spatial enablement [27].

In response, SDIs appeared to move from a hierarchical mode towards a more networked mode of coordination [23, 44]. However, a recent study of institutional arrangements of SDIs across 37 UN Member States revealed that in reality, a hybrid approach seems to prevail where hierarchical structures still play an important role in coordinating SDIs but that a shift towards a networked approach also existed, especially at inter-organizational boundaries [10]. Additionally, issues of access and coordination have also been, to some extent, mitigated where strong open public sector information policies have been enacted and 'open by default' positions on government data have eased access to government spatial datasets [42].

There are also similar challenges confronting land administration systems (LAS). LAS are commonly framed as an institutional framework since it comprises structures defined by both social aspects (e.g. regulation and policies) and technology. Although LAS are defined as a core part of SDIs due to their administration of cadastral data [46], they are often tackled as distinct entities. This should perhaps not be surprising as in many parts of the world, geospatial data is not managed within the same government organization as

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[1]Foundation Spatial Data Framework (see https://www.anzlic.gov.au/resources/foundation-spatial-data-framework).

cadastral data. Multiple ways of organizing this exists, commonly through multiple agencies (e.g. Greece, Spain) or distributed across different levels of government (e.g. Poland).

Consequently, issues such as overlapping administrative authority (e.g. Philippines), lack of harmonised legislation, and mandatory submission to extensive formal processes to effect change can all conspire to constrain efforts to coordinate and collaborate [19].

In line with shifts in public management approaches around the world, there is also a trend to modernize LAS. LAS have traditionally been focused on regulated data processes and hence, facilitated more of a transactional relationship between actors (e.g. regulator, data producer, user, etc.). This has tended to effect a more bilateral, authority-based type of governance.

Presently, given the emphasis on the knowledge economy and inhabiting a digital milieu, there are corollary impacts for LAS where data processes can now be construed as knowledge processes supporting the development of social capital, i.e. LAS are becoming knowledge-intensive industries. In these scenarios, trust becomes paramount as a public management strategy and multilateral governance becomes a more appropriate form of coordination [15, 1].

10.6   Institutional Considerations: Moving Forward

This chapter sought to provide an overview of institutional considerations for those who may be involved in attempting to drive coordination and collaboration of geospatial data for SDG-related activities. While oriented towards the public sector, the emergent lessons are equally valuable for stakeholders from other sectors who may be similarly involved.

Institutions, those social structures constituted of stable and resilient rules and practices that influence behavior, are central to any political structure. In the case of wicked problems like sustainable development, where numerous governmental and non-governmental organizations are involved, it becomes important to consider what impact existing institutions have, as these help to establish the appropriate structures for facilitating coordination (e.g. when a group of stakeholders do not always interact in a consistent way) and collaboration (e.g. when new relationships are required).

It also becomes important to consider the impact of existing institutions as these directly structure opportunities and access to resources, which can influence or limit the ability of stakeholders to participate. As such, institutions are also mechanisms for coordination, but many governments operate under a vertical (hierarchical) structure, whereas open, transboundary challenges like sustainable development often requires a more horizontal (networked) structure that is cultivated less by directives, and more through ongoing negotiation

amongst stakeholders. This however, requires time and insightful strategizing to establish a culture of trust.

Shifting modes of governance is also a challenge experienced in the context of spatial enablement. Experiences over the last few decades of SDI implementation have revealed the limitations of institutional arrangements initially established to drive SDIs under the mandate of national mapping agencies. Similar to the findings in public management literature, it was thought that a networked approach would be a more appropriate mode of coordination but recent studies have shown that in fact, a hybrid arrangement seems to prevail. In reality though, it seems many governments are beginning to move towards a more hybrid approach.

For example, in Rwanda, institutional arrangements such as overarching policies, legal and regulatory framework and financing and capacity building programs are used as hierarchical instruments of vertical coordination. Their Open Data Policy helps to ensure that agencies follow consistent rules on data release, privacy safeguards, and use of an "open" license and technical standards. As well, departments are mandated to follow a directive to make available all for-public-consumption data online without charge. At lower levels though, network-type instruments are used such as partnerships for training and the establishment of a portal to facilitate exchange of information. Rwanda's use of such hierarchical instruments are fairly typical (e.g. strategic plan, coordinating government body, etc.), but there is increasing presence of both network arrangements, largely through partnerships (both formal and informal) or other collective decision-making model, and market arrangements (e.g. user-pay models).

Finally, at a time when wicked problems seem like the new normal, the legacy of previous public sector reforms that sought to create specialized functions of governments have left unintended consequences. Whilst these reforms achieved more efficient services, it also inadvertently resulted in the fragmentation of governments which has negatively impacted on their ability to collaborate. There is now a need to consider how to enact the necessary structural and cultural changes to mitigate and reverse the impact of these reforms. This however, might lie beyond the mandate of most geospatial and land organizations.

Albeit brief, the overview presented in this chapter has illustrated a variety of institutional considerations for how a public sector organization might approach and facilitate coordination to deliver the types of interconnected administrative response to wicked problems, such as those represented by sustainable development and advancing of the SDGs. An institutionalist perspective, which argues that action is driven by a logic of appropriateness (versus consequence, i.e. actors more motivated by rationality and self-interest), indicates that coordination is not simply a product of designing the right structural arrangements in terms of economic rationality; it also requires the cultivation of a common culture where norms and values are shared - a fundamental premise for success [24, 26]. This often requires strategies that tap

into normative or mimetic pressures to encourage the requisite collective be-haviour. However, these are not easy strategies to develop and requires that attention be paid on how the problem is legitimized to design the appropriate incentive structures to attract buy-in and resources.

The reviewed literature also emphasizes that wicked problems are a sum of many parts, and instead of tackling the problem in its entirety, it may be more productive to attempt to better understand the structure of the problem since this will help identify the type of organizational structure, and hence institu-tional arrangements, best required to enable more effective coordination and collaboration, i.e. institutional connectivity. This will improve both response and implementation of solutions and support progression of the SDGs.

Bibliography

[1] Paul S Adler and Seok-Woo Kwon. Social capital: Prospects for a new concept. *Academy of management review*, 27(1):17–40, 2002.

[2] E. Alexander. *How Organizations Act Together: Interorganizational Co-ordination in Theory and Practice*. Routledge; 1 edition (December 3, 1995), 1995.

[3] John Alford and Brian W Head. Wicked and less wicked problems: a typology and a contingency framework. *Policy and Society*, 2017.

[4] Jens Beckert. Agency, entrepreneurs, and institutional change. the role of strategic choice and institutionalized practices in organizations. *Orga-nization studies*, 20(5):777–799, 1999.

[5] Pam Carter. Policy as palimpsest. *Policy & Politics*, 40(3):423–443, 2012.

[6] Tom Christensen and Per Lægreid. The whole-of-government approach to public sector reform. *Public administration review*, 67(6):1059–1066, 2007.

[7] Mark Considine. *Making public policy: institutions, actors, strategies*. Polity, 2005.

[8] Richard Coyne. Wicked problems revisited. *Design studies*, 26(1):5–17, 2005.

[9] W. J. Craig. Why can't we share data: institutional inertia, 1995. pp. 107-118.

[10] Joep Crompvoets and Serene Ho. To develop a framework and guidelines in support of national institutional arrangements in geospatial information management for member states. united nations committee of experts on global geospatial information management. 2017.

[11] P. Dimaggio and W. Powell. The new institutionalism in organizational analysis. The International Encyclopedia of Organization Studies: 144–145, 1991.

[12] Paul J DiMaggio and Walter W Powell. The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. *American sociological review*, pages 147–160, 1983.

[13] WH Erik de Man. Understanding sdi; complexity and institutionalization. *International Journal of Geographical Information Science*, 20(3):329–343, 2006.

[14] Koen Verhoest Geert Bouckaert, B. Guy Peters. *The Coordination of Public Sector Organizations: Shifting Patterns of Public Management.* Palgrave Macmillan; 2010 edition (February 24, 2010), 2010.

[15] Sumantra Ghoshal and Peter Moran. Bad for practice: A critique of the transaction cost theory. *Academy of management Review*, 21(1):13–47, 1996.

[16] John Halligan, Fiona Buick, and Janine O'Flynn. Experiments with joined-up, horizontal and whole-of-government in anglophone countries. *International handbook on civil service systems*, pages 74–99, 2011.

[17] Brian W Head and John Alford. Wicked problems: Implications for public policy and management. *Administration & society*, 47(6):711–739, 2015.

[18] Peder Hjorth and Ali Bagheri. Navigating towards sustainable development: A system dynamics approach. *Futures*, 38(1):74–92, 2006.

[19] Serene Ho, Abbas Rajabifard, Jantien Stoter, and Mohsen Kalantari. Legal barriers to 3d cadastre implementation: What is the issue? *Land Use Policy*, 35:379–387, 2013.

[20] Jan Kooiman. Governance. a social-political perspective. In *Participatory governance*, pages 71–96. Springer, 2002.

[21] Marshall W Kreuter, Christopher De Rosa, Elizabeth H Howze, and Grant T Baldwin. Understanding wicked problems: a key to advancing environmental health promotion. *Health education & behavior*, 31(4):441–454, 2004.

[22] Per Lagreid and Lise H Rykkja. Organizing for "wicked problems"– analyzing coordination arrangements in two policy areas: Internal security and the welfare administration. *International journal of public sector management*, 28(6):475–493, 2015.

[23] Bastiaan Loenen. *Developing geographic information infrastructures: The role of information policies.* IOS Press, 2006.

[24] James G March. *Primer on decision making: How decisions happen.* Simon and Schuster, 1994.

[25] James G March and Johan P Olsen. The logic of appropriateness. In *The Oxford handbook of political science.* 2004.

[26] James G March and Johan P Olsen. *Rediscovering institutions.* Simon and Schuster, 2010.

[27] Ian Masser, Abbas Rajabifard, and Ian Williamson. Spatially enabling governments through sdi implementation. *International Journal of Geographical Information Science*, 22(1):5–20, 2008.

[28] Scott M Meentemeyer, Brian Sauser, and John Boardman. Analysing a system of systems characterisation to define system of systems engineering practices. *International Journal of System of Systems Engineering*, 1(3):329–346, 2009.

[29] Joshua Newman and Brian W Head. Wicked tendencies in policy problems: Rethinking the distinction between social and technical problems. *Policy and Society*, 36(3):414–429, 2017.

[30] Martin Nie. Drivers of natural resource-based political conflict. *Policy sciences*, 36(3-4):307–341, 2003.

[31] Douglass C North. Institutions. *Journal of economic perspectives*, 5(1):97–112, 1991.

[32] Elinor Ostrom. *Understanding institutional diversity.* Princeton university press, 2009.

[33] B Guy Peters. What is so wicked about wicked problems? a conceptual analysis and a research program. *Policy and Society*, 36(3):385–396, 2017.

[34] Jonathan Pryshlakivsky and Cory Searcy. Sustainable development as a wicked problem. In *Managing and engineering in complex situations*, pages 109–128. Springer, 2013.

[35] Abbas Rajabifard, Mary-Ellen F Feeney, and Ian P Williamson. Future directions for sdi development. *International Journal of Applied Earth Observation and Geoinformation*, 4(1):11–22, 2002.

[36] Horst WJ Rittel and Melvin M Webber. Dilemmas in a general theory of planning. *Policy sciences*, 4(2):155–169, 1973.

[37] Fritz W Scharpf. *Games real actors could play: actor centered institutionalism.* Westview Press; 1 edition (September 5, 1997), 1997.

[38] Greg Scott and Abbas Rajabifard. Sustainable development and geospatial information: a strategic framework for integrating a global policy agenda into national geospatial capabilities. *Geo-spatial Information Science*, 20(2):59–76, 2017.

[39] W Richard Scott. *Institutions and organizations: Ideas and interests.* Sage, 2008.

[40] A.L. Stinchcombe. *Information and organizations.* Berkeley, CA: University of California Press., 2000.

[41] UNDP. Institutional and coordination mechanisms: guidance note on facilitating integration and coherence for sdg implementation, 2017.

[42] Bastiaan Van Loenen and MJM Grothe. Inspire empowers re-use of public sector information. *International Journal of Spatial Data Infrastructures Research, 9, 2014*, 2014.

[43] Annemarie van Zeijl-Rozema, Ron Cörvers, René Kemp, and Pim Martens. Governance for sustainable development: a framework. *Sustainable Development*, 16(6):410–421, 2008.

[44] Danny Vandenbroucke, Joep Crompvoets, Glenn Vancauwenberghe, Ezra Dessers, and Jos Van Orshoven. A network perspective on spatial data infrastructures: Application to the sub-national sdi of flanders (belgium). *Transactions in GIS*, 13:105–122, 2009.

[45] Max Weber. *The theory of social and economic organization.* Simon and Schuster, 2009.

[46] Ian Williamson, Stig Enemark, Jude Wallace, and Abbas Rajabifard. *Land administration for sustainable development.* Citeseer, 2010.

[47] Oliver E Williamson. The institutions of governance. *The American Economic Review*, 88(2):75–79, 1998.

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Implementing SDGs in Smart Cities Beyond Digital Tools

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The chapter aims to establish the theoretical framework by exploring the key components of smart city to observe the implementable structure and action of SDGs at the city level, particularly, the key components of smart city beyond digital tools towards SDGs.

11.1 Introduction

The process of smart transformation of cities is complicated and full of challenges, for example, the challenges of unprecedented demographic growth being projected to 9.8 billion as well as the continuous growth of urbanization reaching 68 percent by 2050 [86], which drives global cities to the limited capacity regarding sustainable economy, society and environment [10]. In the face of such challenges, smart cities establish the agglomeration hubs in terms of intelligent inhabitants, dense trade and business, interconnected chain industry, advanced technology and knowledge, positive policy and etc., which keeps reshaping the cities' mobility, growth pattern and ecological system. In fact, the complex future of smart cities is not foreseeable. The crucial doubt is its maintenance of sustainable development. Recently, the advancement of technological tools generates the possibility of capacity building in smart cities, which is expected to alleviate urban problems such as urban sprawl, waste control, air pollution, traffic congestion and etc. towards sustainability through the harness of digital tools and information.

With such background, the UN General Assembly issued the resolution A/RES/70/1 "Transforming our world: the 2030 Agenda for Sustainable De-

velopment" [87], which calls for the global attention of 17 Sustainable Development Goals (SDGs), covering the issues of elimination of hunger and poverty, life and prosperity, work and living conditions, social justice and partnership, environment and industry in the face of global challenges.

In fact, SDGs are to be implemented at the city level to reach the goals of global sustainability. Particularly, the goals are implementable in smart cities, such as G7, G8, G11 and G12. In addition, G16 and G17 point out that technology-driven framework of cities is essential in that regard, which coincides with the digital facilitation in smart cities. Therefore, the focus of implementing SDGs in smart cities is essentially on the focus of the facilitation of digital tools.

However, as the concern of smart city and its sustainability raises, people start to discuss that implementing SDGs in smart cities not only needs the enablement of technologies but also requires further strengthening the institutional frameworks. In another word, sustainable development requires a long-term transformation during which the enhancement of digital capacity is crucial [10], but the holistic smart city framework of implementing SDGs is still unknown.

The following sections are described as follows. The chapter starts by discussing the SDGs and means of implementation in smart cities. In this first section, the research focus is the SDGs and its implementation framework, including the general framework and implementable data and indicators. The second section is the smart city context. In this section, the research analyzes the smart city context by proposing the argument of smart city and sustainability, the measures of making cities smart and sustainable and the needs of digital tools and living labs. The third section is the key components beyond digital tools. In this section, the research proposes the key components beyond digital tools, particularly, networked infrastructure, knowledgeable community and intelligent governance. The fourth section is action agenda of smart city towards SDGs beyond digital tools. The research proposes the action agenda at the city level consisted of the integration of innovation capacity, transformation of smart growth, and evolvement of socio-economic ecosystem. And the last section is the discussion and conclusion. In this section, the research discusses and reviews the smart city frameworks of SDGs beyond digital tools. The research contribution is the establishment of holistic smart city frameworks of the implementation of SDGs beyond digital tools.

11.2 SDGs and Means of Implementation in Smart Cities

11.2.1 Three-Tier SDGs

The Sustainable Development Goals (SDGs) have been advocated by the UN since 2015 at the UN Conference on Sustainable Development in Rio de Janeiro [87, 86]. The general aim is to build up the global sustainable capacity in the face of uncertainties regarding economic, social, environmental and political challenges by 2030. Apart from Millennium Development Goals (MDGs), SDGs specially highlight the adoption of data and digital tool, thus SDGs are the call for the "data revolution" [68].

The SDGs consist of 17 goals and 169 sub-targets, that are, Goal 1 (G1)-no poverty, G2-zero hunger, G3-good health and well-being, G4-quality education, G5-gender equality, G6-clean water and sanitation, G7-affordable and clean energy, G8-decent work and economic growth, G9-industry, innovation and infrastructure, G10-reduced inequalities, G11-sustainable cities and communities, G12-responsible consumption and production, G13-climate action, G14-life below water, G15-life on land, G16-peace, justice and strong institutions, and G17-partnerships for the goals. The research finds that the 17 goals can be grouped into three tiers in one hierarchy, that are, fundamental tier, i.e. ecological balance and well-being goals (including G1, G2, G3, G4, G5, G6, G7, G10, G14 and G15), middle tier, i.e. industrialization goals (including G8, G9, G11 and G12) and top tier, i.e. higher-level targets (including G13, G16 and G17). The middle tier, the goals to be accomplished in cities, is the column bone supporting whole hierarchy, connecting higher-level targets with the fundamental tier (Figure 11.1). Therefore, the means of implementing SDGs in cities are crucial regarding the realization of SDGs.

11.2.2 Means of Implementation-Framework

Among the goals in the middle tier, the four goals, G8, G9, G11, and G12, form the implementation frame of implementing SDGs in smart cities in general, covering the interactions and connections of stakeholders in the process of city development moving towards more inclusive, resilient, harmonized, innovative, informative, technological, industrialized and sustainable future.

G11 is the most frequently mentioned in Urban Sustainable Development Goals (USDGs) aiming to ensure cities are "inclusive, safe, resilient and sustainable". It includes 7 sub-targets, covering the living conditions, environment, disaster, equalities of urban residents, determining to leave no one behind. Besides G11, the overall aim of G9 "Industry, Innovation and Infrastructure" is to build resilient infrastructure, promote sustainable industrialization and to foster innovation as the strong infrastructure provides the cornerstone of sustainable industrial development, supporting the technolog-