**United Nations Committee of Experts on
Global Geospatial Information Management**

National Institutional Arrangements:
Instruments, Principles and Guidelines

National Institutional Arrangement Instruments

Concepts

1.   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 coherence and to reduce redundancy, lacunae and contradictions with and between policies, implementation or management[1].

2.   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 accepted2.

3.   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 actor3.

4.   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.

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[1] See Bouckaert, G, B.G. Peters & K. Verhoest (2010). The coordination of public sector organisations – Shifting patterns of public management. Palgrave Macmillan.
[2] See Thompson, G., J. Frances. R. Levacic & J. Mitchell (1991), Markets, Hierarchies and Networks: The coordination of Social Life. London: Sage; O'Toole, L., (1997). Treating networks seriously: Practical and Research-Based Agendas. Public Administration Review, 57(1): 45-52.
[3] See Bouckaert, G, B.G. Peters & K. Verhoest (2010). The coordination of public sector organizations – Shifting patterns of public management. Palgrave Macmillan.

Instruments

5.   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.

6.   Instruments can be either **structural or managerial**. Institutional arrangements may be realized by creating new or changing existing structures or management forms within the government. Managerial instruments refer to procedures, incentives and values which plan, monitor and evaluate the use of resources (Human Resource Management, finance) or the implementation of policies.

7.   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 1, below presents the classification of NIA-instruments into structural and managerial instruments types. Each instrument will be briefly introduced below.

Table 1.   Classification of NIA-instruments into structural and managerial instruments

Structural	Managerial
- **S1. Establishment of coordinating functions or entities** - **S2. Reshuffling division of competences** - **S3. Establishment of a legal framework** - **S4. Regulated markets** - **S5. Systems for information exchange and sharing** - **S6. Entities for collective decision-making** - **S7. Partnerships**	- 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

8.   Structural Instruments

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[4].

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[5].

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[6].

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[7]. 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

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[4] idem

[5] Janssen, K. and J. Crompvoets (eds.) (2012). Geographic data and the law: defining new challenges. Leuven: Leuven University Press.

[6] idem

[7] Pollitt, C. (2003). 'Joined-up government: A survey', Political studies review, 1(1): 34-49.

to effectively find and access geospatial information and associated geospatial services (e.g. display, editing, analysis), are a good example of this instrument in the context of geospatial information management.[8] 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[9] 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).

9.   Managerial Instruments

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 [10] [11]. The hierarchical, input-oriented

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[8] Crompvoets, J. (2016). Geoportals. In: D. Richardson, N. Castree, M. Goodchild, W. Liu, A. Kobayashi, & R. Marston (Eds.), The International Encyclopedia of Geography: People, the Earth, Environment, and Technology. Hoboken, NJ: Wiley/Association of American Geographers.

[9] 6, P. (2004). 'Joined-up government in the Western world in comparative perspective: a preliminary literature review and exploration', Journal of Public Administration Research and Theory, 14, 103-38.

[10] Organization for Economic Cooperation and Development (OECD) (1999). Integrating financial management and performance management, PUMA/SBO (99)4 Final.

[11] Bouckaert, G, B.G. Peters & K. Verhoest (2010). The coordination of public sector organizations – Shifting patterns of public management. Palgrave Macmillan.

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 should 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[12] [13] [14]. 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 [15] 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[16]. 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[17]. Applied to the geospatial information management context, this means establishing effective strategies for capacity

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[12] Pollitt, C. (2003). 'Joined-up government: A survey', Political studies review, 1(1): 34-49.

[13] 6, P. (2004). 'Joined-up government in the Western world in comparative perspective: a preliminary literature review and exploration', Journal of Public Administration Research and Theory, 14, 103-38.

[14] Bouckaert, G, B.G. Peters & K. Verhoest (2010). The coordination of public sector organizations – Shifting patterns of public management. Palgrave Macmillan.

[15] Klijn, E.H. and J.F.M. Koppenjan (2000). 'Public management and policy networks: Foundations for a network approach to governance', Public Management, 2(2): 135-58

[16] Pollitt, C. (2003). 'Joined-up government: A survey', Political studies review, 1(1): 34-49.

[17] United Nations Development Programme, 2009. Capacity Development: A UNDP Primer, New York.

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 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.

10.   These NIA-instruments have been linked with the indicators previously developed by the NIA Working Group. Table 2. presents the relationship between NIA-instruments and indicators previously proposed by NIA Working Group. Some NIA-instruments directly link with specific NIA Working Group indicators. Some NIA Working Group indicators have less strong relationships with the NIA-instruments.

Table 2.   Link between NIA-instruments and proposed NIA Working Group indicators

NIA-instruments	NIA Working Group indicators	
Structural	Strongly related	Weakly related
S1. Establishment of coordinating functions or entities	35	16
S2. Reshuffling division of competences		
S3. Establishment of a legal framework	26, 27, 28	29, 30, 31, 36
S4. Regulated markets		13, 31
S5. Systems for information exchange and sharing	17, 19, 20, 22	18, 21, 25, 42, 49
S6. Entities for collective decision-making		33, 34, 35
S7. Partnerships	9	2, 37
Managerial		
M1. Strategic planning	32	
M2. Financial management: input-oriented	8, 10	11, 14, 15
M3. Financial management: performance-oriented	8, 12	10, 11
M4. Financial management: joined up working and cooperation	8, 15	4, 10, 11, 14
M5. Inter-organizational culture and knowledge management	39	
M6. Capacity building		23, 24, 37, 43, 48

11.   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 3)[18]. 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.

Table 3. Clusters of NIA-instruments strongly based on work of Verhoest and Bouckaert (2005)

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[18] Verhoest, K., and G. Bouckaert (2005). 'Machinery of government and policy capacity: The effects of specialization and coordination', in M. Painter and J. Pierre (eds.) Policy capacity. Basingstoke: Palgrave.

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

12.   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.

To apply these NIA-instruments in the context of geospatial information management, to identify good practices of (national) institutional arrangements in Member States as well as to provide the general principles and guidelines, existing good practices in Member States are collected for each NIA-instrument. These are provided in the document "*Compendium of Good Practices*."
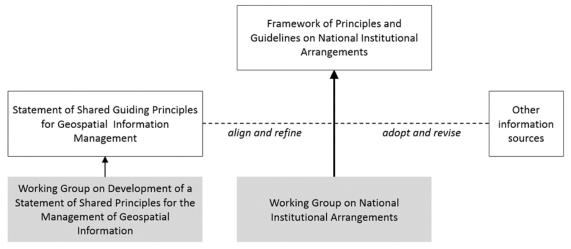
Principles and Guidelines

1.   This section presents general principles and guidelines on NIAs for geospatial information management to be used by Member States based on the lessons learnt from the key examples of good practices of NIA-instruments presented in background document "Compendium of Good Practices."

2.   In the context of WG-NIA, the following definitions for principles and guidelines are applicable:

- Principles are the fundamental beliefs that frame and structure the entire set of NIA instruments and what they seek to achieve.
- Guidelines are then specific directions on the implementation of each NIA instrument (or several NIA instruments, especially where overlaps occur).

3.   The presented principles provide key concepts for assisting governments in dealing with the barriers and challenges in implementing the NIAs in the context of geospatial information management.

4.   The presented principles are formulated using several key inputs. First, there is strong alignment with the UNGGIM's *Statement of Shared Guiding Principles for Geospatial Information Management*[19]. However, when viewed through the lens of the needs of NIAs, there are opportunities to refine and further add to these principles. Input derived from the results of the previous reports of WG-NIA, discussions with members of WG-NIA and experts in NIAs, internet browsing, and relevant academic and grey literature[20] have been pertinent. These inputs and the development process are shown in Figure 1.

Figure 1: Inputs into the development of the framework of principles and guidelines on national institutional arrangements.

5.   The objectives of the principles are:

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[19] UN-GGIM Secretariat – Statistics Division (2015). The Statement of Shared Guiding Principles for Geospatial Information Management.

[20] Examples of reviewed literature: Bouckaert, G., peters, B.G, and Verhoest, K. (2010). The Coordination of Public Sector Organizations – Shifting Patterns of Public Management. Palgrave MacMillan; Organisation for Economic Co-operation and Development (2007). OECD Principles and Guidelines for Access to Research Data from Public Finding. OECD; United Nations Development Program (2011). Chapter 8: Governance Principles, Institutional Capacity, and Quality. In: Towards Human Resilience: Sustaining MDG Progress in an Age of Economic Uncertainty.

- to highlight the need to consider NIA-regulations and coordinating practices in the formation of relevant Member States' policies and programs to underpin the generation of high quality geospatial information that meets Member States' criteria for evidence-based analysis and informed policy decision-making;
- to cultivate trust in the authoritativeness and reliability of public sector geospatial information;
- to direct the institutional frameworks that govern geospatial information organizations and ensure there is 1) commitment to its adoption and 2) understanding of its objectives at all political levels and by stakeholders in national authorities;
- to stimulate the exchange of good practices in NIAs in the context of geospatial information management; and
- to foster knowledge and cooperation within and among UN Member States predicated on a culture of openness and transparency.

6.   The following principles are considered as applicable for NIAs in the context of UN-GGIM: Geospatial Advocacy, Coordination, Collaboration, Agility and Adaptiveness, Performance, Open Data, use of and adherence to geospatial standards, Adherence to law, Accountability, Transparency, Respect and confidentiality, Standards of Service, Expertise, Participation and Inclusion. Each principle will be briefly introduced.

Principles

i.   **Geospatial Advocacy**: is reinforced by steadfast advocates promoting the use of high quality geospatial information critical for evidence-based analysis and informed policy decision-making in support of sustainable development, economic growth, poverty eradication, peace and security, disaster risk reduction, and climate change adaption.

ii.   **Coordination:** enhance the voluntary or forced alignment of tasks and efforts of relevant geospatial information organizations within a national institutional setting.

iii.   **Collaboration:** encourage (inter)national collaborations among key geospatial information organizations fundamental to the facilitation of improvements in the development, management, use and exchange of geospatial information, as well as the integration of statistical data and other information, to create new knowledge and supply products and services meeting user needs.

iv.   **Agility and Adaptiveness**: address and take advantage of institutional, technological and other advancements in support of the development and delivery of products and services. This flexibility requires considering the rapid and often unpredictable changes in information technologies, geospatial information management approaches, financial resources, legal systems and cultures of each Member State. Specific national, social, economic, and regulatory implications need to be considered when organizations develop NIAs, and when governments develop policies to promote NIAs and review the implementations.

v.   **Performance:** improve the overall efficiency of geospatial information management to avoid the expensive and unnecessary duplication of data collection efforts, and to promote further costs effectiveness by describing good practices in geospatial information management. NIAs need to cover the development of new reward structures and the adaptation of existing ones, including recognition of geospatial

information management activities in tenure and promotion review in order to address the possible problems of insufficient incentives for stakeholders or lessening efforts by geospatial data producers on relevant activities.

vi. **Open Data:** where feasible adopt policies that maximize access to and use of open and unrestrictive geospatial information at the lowest possible cost for innovation, efficient and effective decision-making and a spatially enabled society. NIAs need to provide a suitable environment for allowing open access to geospatial information in an easy, timely, user-friendly way, and preferably via the Internet.

vii. **Use of and adherence to geospatial standards**: embrace the development of, adherence to, and use of nationally and internationally recognized geospatial standards and interoperable geo-processing technologies. Utilization of standards and interoperable technologies will facilitate the effective and efficient creation, sharing, exchange and use of geospatial data, the open transfer of data among organizations, platforms and applications, and encourage innovation, reduce transaction costs, increase transparency, allow (inter)national compatibility and cooperation within the market place. In this interoperability context, NIAs need to cover to pay due attention to the relevant international geospatial standards. Member States and key institutions should cooperate with international organizations charged with developing new standards,

viii. **Adherence to law:** observe laws, regulations and administrative practices of the Member States, within which they operate, as well as international laws and conventions, avoid conflict of interest and make stakeholders aware of those laws and conventions, which govern and are related to operations. The national security as well as intellectual property of geospatial data creators and providers are to be acknowledged and protected. The NIAs should facilitate, institutionalize and respect the legal rights and legitimate interest of all relevant stakeholders.

ix. **Accountability:** facilitate trust amongst geospatial data creators, providers and users, create a clear understanding of geospatial data through the publication of metadata, including information on ownership and intellectual property rights, access and usage conditions and technical specifications (in particular currency, data models, quality and accuracy definitions). This will support informed and fit for purpose use and interpretation of geospatial data. Data creators and providers are responsible for compliance to the specifications of geospatial datasets made available for consumption and use. NIAs need to tackle this data accountability issue and allocate responsible institutions.

x. **Transparency:** identify sources and the processes that are used to create and provide official geospatial data. Information on geospatial data-producing organizations, documentation on the geospatial data (metadata) as well as processes and specifications of conditions attached to the use of these data needs to be available in a transparent way, ideally through the Internet.

xi. **Respect and confidentiality**: exhibit high levels of responsibility and consideration to stakeholders in the execution of daily operations. Particular care is to be exercised to protect the confidentiality of geospatial information that may adversely impact an individual, community and/or Member State. Personal data is to be especially respected and protected. NIAs should promote explicit, formal practices such as the development of rules and regulations, regarding the responsibilities of the various parties involved in the geospatial information management activities. These practices could pertain to authorship, producer credits, ownership, dissemination, usage

restrictions, financial arrangements, ethical rules, licensing terms, liability, and sustainable archiving. Specific attention needs to be devoted to supporting the use of techniques to guarantee the integrity and security of geospatial information.

xii. **Standards of Service**: employ good practices of NIAs and solutions, and pursue excellence in the delivery of geospatial data and services. Appropriate access, fairness and equity are to be accorded to all stakeholders. Equality addresses power inequalities (be they political, economic, legal, or cultural) and requires the extension of development gains to the most excluded groups and individuals. Institutions that ensure non-discrimination and equality can mitigate the burden of possible geospatial information management actions on the most vulnerable.

xiii. **Expertise:** institutionalize to arrange value of national expertise in geospatial information knowledge and expertise in order to, where appropriate, comment on and validate the quality of geospatial datasets covering national territory, seeking their overall consistency, in order to advise on matters of application, interpretation and use of geospatial information. The associated NIAs need to be based on the relevant professional standards and values embodied in the codes of conduct of the communities involved.

xiv. **Participation and Inclusion:** empower through representation in government and through other (e.g. administrative and local) mechanisms facilitating free, active and meaningful participation in decision-making processes making use of geospatial information. Meaningful and free participation of citizens and stakeholders in decision-making processes could contribute to the overall adaptability and stability of institutions and promotes innovative policy dialogues.

Guidelines

7.   The presented guidelines are more specific to NIAs. Governments can use them as specific directions on the implementation of instruments to strengthen the national institutionalization of geospatial information management of their country. These directions as guidelines refer to the implementation of instruments that can be either structural or managerial. Institutional arrangements may be realized by creating new or changing existing structures or management forms within the government.

8.   The guidelines can directly be linked to the implementation of the seven structural instruments in the context of NIA, which are: S1. Establishment of coordinating functions and entities; S2. Reshuffling division 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, or linked to the implementation of the six managerial instruments: M1. Strategic planning; M2. Financial management: input-oriented; M3. Financial management: performance-oriented; M4. Financial management fostering joined up working and cooperation; M5. Inter-organizational culture and knowledge management, and M6. Capacity building.

9.   Most of principles mentioned above (page 10) can be directly linked to the implementation of the NIA-instruments. Table 4 clearly presents the relevance of the principles for the implementation of the NIA-instruments; "**X**" means very relevant and "x" means relevant. The table illustrates the very strong link between the principles and NIA-instruments. NIA-instruments S1., S3., S5., M1., M5. and M6. apply all the principles, in particular for S3., S5., M1. and M5. are the principles very relevant.

Principle "Geospatial Advocacy" is very relevant for all thirteen NIA-instruments. Most principles are relevant for the implementation of all NIA-instruments – in particular principles "Collaboration", "Accountability", "Transparency" and "Standards of Service" are very relevant for several NIA-instruments. Although not relevant for all the NIA-instruments, principle Open Data appears to be very relevant for several NIA-instruments.

Table 4. Relevance of the NIA-principles for the implementation of the NIA-instruments.

Principles	NIA-instruments												
	S1	S2	S3	S4	S5	S6	S7	M1	M2	M3	M4	M5	M6
Geospatial Advocacy	X	X	X	X	X	X	X	X	X	X	X	X	X
Coordination	X	x	x	x	x	x	x	x	x	x	x	x	x
Collaboration	x	x	x	x	X	X	X	x	x	x	X	X	x
Agility/Adaptiveness	x	X	x	x	x	x	x	X	x	x	x	x	x
Performance	x	x	x	x	x	x	x	x	x	X	x	x	x
Open Data	x		X	X	X			X				x	x
geospatial standards	x		x	x	X		x	x			x	x	x
Adherence to law	x	x	X	X	x	x	x	X	x			x	x
Accountability	x		X	X	X	x	x	x	X	x	x	x	x
Transparency	x	x	x	x	X	x	x	X	X	x	x	X	x
Respect/Confidentiality	x	x	X	x	x	x	x	x	x	x	x	X	x
Standards of Service	x	x	X	x	X	x	x	X	x	x	x	X	x
Expertise	x	x	x	x	x	x	x	X	x	x	x	X	X
Participation/Inclusion	x		x		x	X	x	X	x		x	X	x

Legend: "**X**" means very relevant and "x" means relevant.

10.   Table 4 indicates that NIA-Instruments S3. Legal Framework, M1. Strategic Planning, S5. Systems for information exchange and sharing, and M5. Inter-organizational culture and knowledge management needs the most attention when implementing the NIA-instruments in the context of UN-GGIM. Serious attention needs also to be given to NIA-instruments S1. Establishment of coordinating functions and entities, S4. Market regulation, and M6 Capacity building.

11.   On the basis of the examples as presented "*The Compendium of Good Practices*", lessons for each NIA instrument were elicited, as indicated in Table 5. These "lessons on what to do" can be considered as guidelines as they provide directions on the implementation of the instruments.

Table 5. Overview of the lessons on what to do for each NIA-instrument type

NIA-Instrument	Country	Title	Lessons on what to do
S1. Establishment of coordinating functions and entities	Mexico	Coordination of the National Information System Statistical and Geographic	• Legislation forces the establishment of cooperation links that contribute to institutional coordination, and structures the required policies, plans and strategies It also represents endorsement at the highest level of government, which cultivates the legitimacy changes required for coordination. • Establish a strong governance structure with clear allocated roles, tasks, and responsibilities of the participants as well as financial resources for the participants. • Clear and visible leadership through a clear 'problem owner' provides a focal point for engagement with stakeholders – the external face of the consequence of coordination. This also ensures that coordination is enforced.
	New Zealand	A Clear Geospatial Governance Framework	
	Panama	Coordinating structure of the National Spatial Data Infrastructure of Panama	
	Spain	SIGPAC Coordination Board	
S2. Reshuffling division of competencies	Belgium	Reshuffling of agencies in the Belgian region of Flanders	• Establishment of a strong governance structure with clear allocated roles, responsibilities, and tasks of the participants. • Addressing the issues related to agility and adaptiveness and take advantage of institutional, technological and other advancements in support of the development and delivery of relevant data, products and services • Invest in good practices demonstrating the added-value of reshuffling the division of competences. • Exploring the integration of geospatial information management competences into a larger e-government framework that involves the exchange of digital (geo-)information, authentic sources, interoperability, service integration and user focused services. • The reshuffling division of competences need to be backed up in national legislation and/or part of a national policy program.
	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. Establishment of a legal framework	Mexico	Legal Framework of the National Information System for Statistics and Geography	• Legislation should consider strategic objectives (e.g. sustainable development), desired operational functions, existing vertical and horizontal relationships between government organizations and how this might need to change, and whether regulatory efficiencies can be gained to improve the efficiency and effectiveness of policy-making (e.g. a consolidated legal framework). • Issues related to open data, national security, intellectual property rights, accountability, confidentiality, fairness and equity need somehow be included in the legal framework.
	The Netherlands	Integrated legal framework concerning planning and the environment	
	Russia	Law on geodesy, cartography and spatial data	

NIA-Instrument	Country	Title	Lessons on what to do
S4. Regulated markets	Denmark	Open Standard Licensing	• Apply 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. • Set up strong open data policies embedded in national legislation with references to issues related to leadership, accountability, transparency, sustainable financing. • Have a consistent pricing policy regarding the use of geospatial data and services.
	Rwanda	Rwanda Open Data Policy	
S4. Regulated markets + S5. System for information exchange and sharing	United Kingdom	Open data platform data.gov.uk	
S5. Systems for information exchange and sharing	Canada	Federal Geospatial Platform	• Easing systems usability should be prioritized e.g. provision of a range of query/analysis tools, provision of guides and a user forum,, etc. • Strengthen collaborations among key geospatial information organizations in order to supply data, products and services meeting user needs • Transparent and updated assessment of the usage of the systems e.g. provision of usage statistics in a meaningful way, system 'openness', etc. • Adopt and implement an open data license framework (e.g. Creative Commons) as this will massively stimulate re-use and value-add of the data. • Any information sharing system should be spearheaded by national commitment – e.g. see S1-S3. • Adopt internationally recognized geospatial standards as the utilization of these standards will facilitate the effective and efficient exchange, sharing and use of geospatial information. • Understand that these systems are not just data infrastructures but also operate as communication channels between data suppliers and users (not just between government agencies, but also between government and citizens).
	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)	
	Fiji	Fiji Geospatial Information Council	

NIA-Instrument	Country	Title	Lessons on what to do
S6. Entities for collective decision-making	Singapore	Joint decision-making committee with multiple Government agencies to drive geospatial development	• Such an entity is often aimed at developing strategies to operationalize coordination of geospatial information across whole-of-government. Therefore, the scope of such an entity should cover both technical and non-technical aspects of the adoption of geospatial information and technology adoption and use. • Support the encouragement of national collaborations among key geospatial information organizations fundamental to the facilitation of improvements in the development, management, use and exchange of geospatial information, as well as the integration of statistical data and other information • Involve participation (of representatives) of citizens and stakeholders in decision-making processes as this could contribute to the overall adaptability and stability of institutions and promotes innovative policy dialogues.
	Slovenia	Slovenian coordination mechanism for infrastructure for spatial information	
S7. Partnerships	Australia	Building National Datasets Through Intergovernmental Partnerships in PSMA Australia Limited	• Partnerships often related to private sector, academia and/or other non-government sectors. • Partnerships can be national, supra-national or international, as befitting the strategic objective around collaboration. • Objectives for partnerships should be clear and transparent, and if possible, set by an entity such as S6. • Focus on the strength of the whole of the partnership outweighing the sum of the individual parts.
	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	As per above for S1, S2 and S3.
M1. Strategic Planning	Australia	The Consultative Approach of Australia's 2026 Spatial Industry Transformation and Growth Agenda	• Strategic planning should consider several time horizons, and therefore build in flexibility to be responsive to changes that will inevitably occur during implementation phases.
	Brazil	Action Plan for the Implementation of INDE	

NIA-Instrument	Country	Title	Lessons on what to do
	Denmark	Good Basic Data Everyone – A driver for growth and efficiency	• Strategic plans should have clear and well-defined priorities and objectives that are appropriate for the various implementation phases. • Strategic plans can be linear and incremental (e.g. see Macedonia) but can also be executed in parallel (e.g. see Denmark). • The efficacy and clarity of M1 will be affected by the outputs of S1-S3. • Strategic plans should aim to establish and/or maintain a suitable environment for allowing open access to geospatial information in an easy, timely, user-friendly way and consider appropriate access, fairness and equity are to be accorded to all stakeholders. • Stakeholder consultation is an important part of developing a strategic plan and should be prioritized to develop a plan that will deliver public value across different user segments. • Strategic planning includes the involvement of experts who are familiar with the key (inter)national future trends as well as relevant (inter)national legislation. • The Plan itself is an important communication tool in facilitating a change culture. It can clarify the role, contribution and position of geospatial information not only for the government, but nationally as well (e.g. see UK).
	Former Yugoslav Rep. 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. Financial management: input-oriented	Bahrein	Government Investment in Bahrein Spatial Data Infrastructure	• Funding can be identified and specially set aside if the political will to support geospatial information initiatives are apparent. • In China, renaming of the NSDI to something more aligned with political objectives of digitalization may have also contributed to funding accessibility. • There is a close relationship between budgets and policy objectives. Often, budgets can end up setting policy objectives and the implications (e.g. accountability) this might have on original aims needs to be examined carefully. • Budgets need to be accompanied by clear guidelines on what can be resourced.
	China	Financial investments in Chinese geospatial information Management	
	India	NSDI Financial Strategy and Funding Models	
	Mexico	Cadastral Modernization Program	
M3. Financial management: performance-oriented	Germany	Automated performance procedure for German SDI Monitoring	• Results-based management is a longstanding management strategy and its implementation can be really successful, or disastrous – this depends on existing organizational culture and work ethic. • Clear identification of incentives linked to organizational objectives is necessary in implementing such a strategy. Incentives can take many forms and are not necessarily monetary.
	United Arab Emirates	Geomaturity Assessment of Abu Dhabi Spatial Data Infrastructure	
	USA	Geospatial Maturity Assessment	
M4. Financial Management:	Australia/ New Zealand	Australia and New Zealand Cooperative Research Centre for Spatial Information	

NIA-Instrument	Country	Title	Lessons on what to do
Joined up working and cooperation	The Netherlands	Geonovum	• Joined-up working is demonstrated by the examples to deliver broader adoption, use and application of geospatial information. • Trust amongst the key participating organizations is vital • Successful initiatives have a governance structure and business model in place to support the direction, implementation and financing of activities for maximum benefits.
	Norway	Digital Norway (NSDI) shared financing of basis geodata	
M5. Inter-organizational culture and knowledge management	Canada	Federal Committee on Geomatics and Earth Observations (FCGEO) and Canadian Commit-tee on Geomatics (CCOG) – Public Sector Geomatics Cooperation in Canada	• The easiest mechanism to do this is through the provision of training, as shown in the examples. This can reach a fairly broad audience, especially if professional associations are partnered. • However, training sessions do not necessarily ensure that cultural change is achieved. Organizations need to consider how culture change can be assessed and develop strategies that support behavioral change. • Issues related to principles collaboration, transparency, openness, confidentiality, standards of service, participation and inclusion need to take into account when establishing and maintaining a strong inter-organizational culture and knowledge management. • Strong political support is necessary to make a sustainable cultural change and knowledge management happen.
	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. Capacity Building	Brazil	Capacity Building in the National Spatial Data Infrastructure of Brazil (INDE)	• Institutionalize to arrange the value of capacity building in geospatial information management activities in order to sustain the usage of the deliverables. • The easiest mechanism to do this is through the provision of training, as shown in the examples. This can reach a fairly broad audience, especially if professional associations are partnered. • Strategies should also consider other user segments of the community – both current and future, typical and atypical segments.

General Insights into The Implementation of the NIA Instruments

13. The production of 61 examples across 38 Member States provided some general insights into the implementation of the NIA instruments:

    i. The instruments represent a set of tools that can support strategy development in the national management of geospatial information. Some clear trends are evident: 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.

    ii. The examples demonstrate that governments recognise this and are seeking to legislate to establish the appropriate facilitative governance structures. However, the examples also demonstrate that it 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.

    iii. Therefore, there are expected overlaps between instruments. For example, NIA-instruments S1. Establishment of coordinating functions and entities, and S2. Reshuffling division of competencies, and S3. Legal framework are all bound up with each other. There is also a close relationship between these NIA instruments and M1. Strategic Planning The examples show that S3. Legal framework often comes first in 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.

    iv. NIA-instruments S1. Establishment of coordinating functions and entities and S2. Reshuffling division of competencies are often a consequence of S3. Legal framework, especially where existing government organisations and/or functions are considered to be inappropriate or inadequate for delivering the requisite changes. 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.

    v. In the context of the implementation of NIA-instrument S4. Regulated market it is strongly recommended to 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.

    vi. NIA-instruments S6. Entities for collective decision-making and S7. Partnerships also have an overlap, but the distinction lies with S6. Entities for collective decision-making having decision-making powers – and this can be useful in seeking to penetrate new areas where geospatial information is not yet commonly used. The application of S6.

should be holistic – seeking to manage not just technical aspects, but also non-technical aspects such as business process and service delivery. S7. Partnerships should be perceived to be more of a collaborative relationship.

vii. 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.

viii. 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.

ix. The examples represent significant diversity in demonstrating how the NIA instruments could be applied on their own, but more often in combination with others. While there is no one model that can be recommended, the examples illustrate some clear roles for some of the NIA instruments, and connections amongst others. This has been abstracted and represented in Figure 2. 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.).

Lessons learnt

1. **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, which reflect the principles identified. These commonalities have been abstracted and are shown as a possible roadmap for institutional design in Figure 2. 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.).

2. **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.

3. **The need for an integrated change process.** Governments are cognizant 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.

4. **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.

5. **Catalyzing 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.

6. **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.

7. **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.

8.   **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.

9.   **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.