GOOD GOVERNANCE REQUIRES GOOD GEOINFORMATION
Geo-Information and Earth Observation in a Globalizing World

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Abstract
The rapid technological developments, as well as developments in demand for information, imply the continuous need for the upgrading of professionals through "lifelong learning". This is not only true for professionals, but also for their organizations which are in a permanent state of change. The must continuously to adjust to their changing environment, be it the changing role of government, the globalization of the economy and provision of services, the global scale of processes that have to be dealt with or the ever accelerating development of technology. All these aspects affect the geo-information community as much as any other sector of society.

Introduction

The final output of a mapping process used to be a map which had a fixed content defined by theme, scale and symbolisation, a static and two dimensional representation of a terrain situation. In the recent decades the mapping disciplines have gone through a revolution where the objective of spatial data collection shifted from map production to spatial information and data service provision.

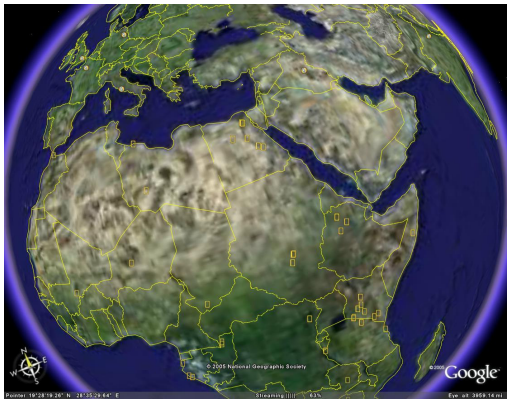

Figure 1. Google-Earth offers new access to spatial data.

Maps and 3-dimensional topographic data can now be accessed through Google-Earth (Figure 1) and where accurate positioning used to be the professional pride of highly trained geodesists we now see that such services can be provided with GPS based consumer products. The rapid technological developments, as well as developments in demand for information, imply the need for continuous upgrading of professionals through "lifelong learning". This observation is not only relevant for these professionals, but also for their organizations (Molenaar, 2005). These organizations are in a permanent state of

change to adjust to their continuously changing environment, be it the changing role of government, the globalization of the economy and provision of services, the global scale of processes that have to be dealt with or the ever accelerating development of technology (Friedman, 2005). All these aspects affect the geo-information community as much as any other sector of society. We will discuss some of these issues in this paper.

Geoinformation for Civil Society

Spatio-temporal information, or geoinformation, is produced and used by organizations and institutions which are involved in the management of our living environment and resources. They are monitoring and managing natural or man induced processes that have geo-spatial aspects. These might relate to urban development, sustainable land use, biodiversity, water resource management (Bos, 2005), disasters, land management, land tenure (Augustinus, 2005a, b) etc. Governments, but also Civil Society at large, are involved in monitoring, analysing, understanding and managing these processes. Earth observation and geoinformation are essential to provide professionals, decision and policy makers with relevant information in this context (Figure 2.).

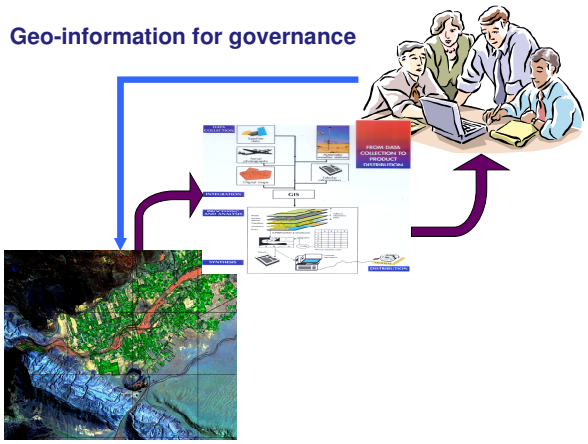

Figure 2. (Geo-) informed decision making.

The two buzzwords *"sustainability"* and *"security"* play a dominant role in the international agendas. We find them in the UN Millennium Development Goals, in the Kyoto Agreements and The Johannesburg Summit on Sustainable Development of three years ago. The connection between earth observation, geo-information, sustainability and security is also manifest in the European program for the Global Monitoring for Environment and Security (GMES, 2005). This is the European contribution to the development of the Global Earth Observation System of Systems (GEOSS) for which a 10-year implementation plan has been accepted by the participating countries earlier this year (GEO, 2005).

Geoinformation and earth observation will be of great importance for monitoring the progress that has been made with respect to these international agendas. An important prerequisite is then the specification of indicators. Here we could think a development line with the statistical legacy of the United Nations where indicators have been defined for monitoring economic and social development (Ward 2005, Wold 2005). Such specifications require a profound knowledge of the technology for earth observation and

geoinformation processing as well as the processes affecting issues like poverty reduction, biodiversity, land use development etc. Information can only be extracted from data if that is done in the context of conceptual models based on a profound theoretical basis (Ward 2005). This means that geo-information is no longer the monopoly of specialized mapping experts in the traditional sense. Of course they are still indispensable for the acquisition and production of spatial information and for the delivery of information products and services. But they have to work in close interaction with professionals and scientists from other relevant disciplines.

It is evident that geo-spatial information is indispensable for modern governance. Indeed when discussing issues of governance, or if you like Good Governance, then the focus is generally on institutional aspects, on transparency of legislative processes, on poverty reduction and access to resources, etc. It is true priority should be on these issues, but we should be aware that Good Governance requires good information and because almost all human activities have a spatial footprint this implies to a large extend geo-spatial information, see e.g. (Augustinus 2005b).

It is evident that earth observation and geoinformation provision are essential for the monitoring of processes and that that should be done at different aggregation levels (Tateishi and Hastings, 2000). Furthermore the management of such processes requires decision power also at different administrative and political levels ranging from local to global scale.

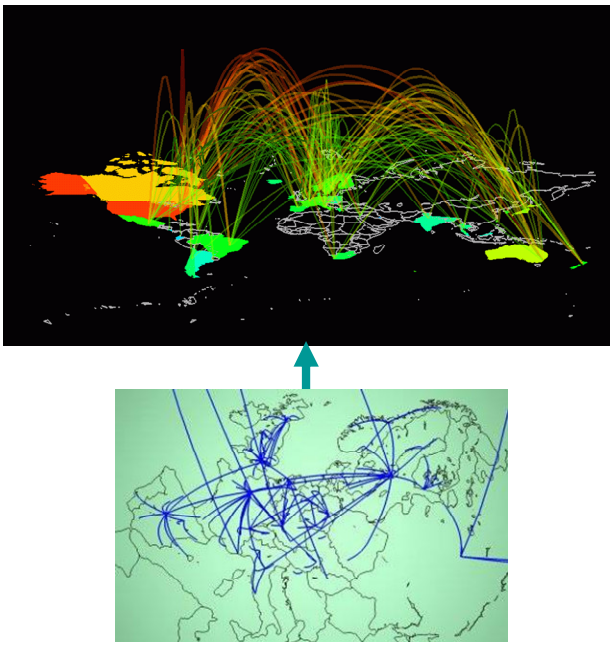

Figure 3. SDI's is embedded in the infra structure of the Web and Internet.
(sources: http://www.cybergeography.org/atlas/geographic.html)

This implies that it is no longer sufficient to organize spatial data infrastructures (SDI) and the related service provision at a national or regional level only. This and the fact that the development of SDI's is embedded in the fast developing infra structure of the Web and Internet (Figure 3) implies that the GI-sector, like many others, will have to deal with the

fact that we live in a world where services and service supply chains are provided in a fastly globalizing setting. National geoinformation industries, and the national mapping organizations among them, will have to accept that fact and redefine their roles and mandates in this changing context.

From map production to information provision

The information components of the geo-data infrastructures (GDIs) are still largely based on the traditional map paradigm. But within this paradigm we see the development of new products and services. The old concept of maps evolved into digital maps and from there into seamless databases and presently we see scaleless databases emerging. The line map is being replaced by object-structured representations. The dimensionality evolves from 2D to 2.5D and users have access to data and services that allow them to create rectified or draped high-resolution images according to their own needs. Spatial data are also provided through new delivery mechanisms that support the present fast development of location based services and mobile GIS.

But developments are presently going into a new stage. Object structured approaches allow other spatial representations that go beyond the old map paradigm. The development of the dimensionality of spatial data bases from 2D to 2.5D and to 3D (Figure 4) will allow new types of representation of spatial complexes where we can travel through space and through objects. Based on the integration of images with these 3D data base models, VR and augmented reality representations have been developed in the form of e.g. city models, street models and buildings. First developments have been shown on the combination of GIS and CAD techniques where city models zoom in to individual buildings, which can be entered to inspect their interiors.

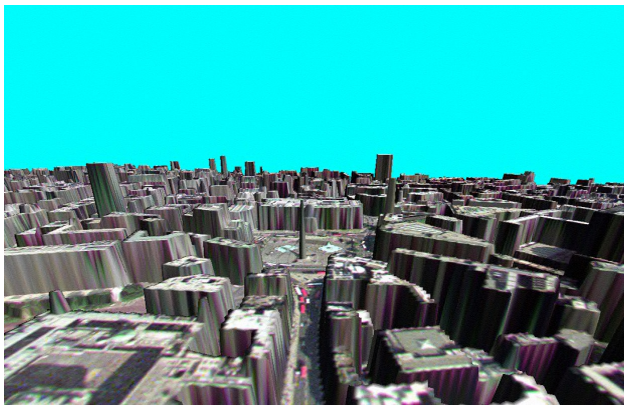

Figure 4. The development of the dimensionality of spatial data to 2.5D and 3D.
(source: Terra *Imaging*)

Modern laptops are powerful enough to handle dynamic representations to simulate fly-tracks through 3D terrains or cities or to handle terrain representations, changing through time. We move away from the static map which could only handle the spatial component of a terrain situation; with these new media we can also handle the temporal aspect. In fact the modern technology allows us to generate any type of terrain representation, be it 2D, 3D, static, dynamic, spatio-temporal (Vosselman 2005). There are still many problems to

be solved with respect to spatio-temporal representations, but we can trust that the solutions will be available in due time. With these developments we have gone far beyond the stage of map production into the stage of spatial information provision. That implies that the scientific interest is shifting from the development of more advanced representational models to the information content, to the understanding of the dynamism of real world processes.

Some Topics for the Geoinformation Community

When talking about governance we should keep in mind that that implies decision making at different levels, i.e. local, regional, national, supra national and even global. That is because the dynamics of our living environment is generally the resultant of interacting geo-spatial processes at different spatio-temporal aggregation levels:

- Flood risks in the Lower Rhine basin are mainly due to changing land use in the Upper Rhine basin which is to a large extend the effect of European land development policies of the last fifty years
- The reduction or elimination of agricultural subsidies in the North should give better chances for southern producers to participate in the global market and that is good. But we should be aware of the possible growing pressure on marginal production systems which might have affects contrary to our ambitions with respect to sustainability.
- The development of urban land use should be understood in the context of urbanisation processes which are due to changing national or continental economic conditions which cause a depopulation of rural areas.
- But urban change is also due intercontinental migration due to an uneven global distribution of wealth and economic opportunities.
- Mineral deposits occur in regional or continental geologic formations whose origin can often only be understood properly in the context of the processes that formed the present continents.

These are some examples that demonstrate the complexity of the problem areas in which geo-information should play a role for monitoring, understanding and management. These examples confirm the observation of (Bressers and Kuks 2003, Hveem 2002) that in the context of governance several important aspects of policy implementation can be identified. They mention among others the multi level and multi actor aspects of policy implementation and the multi facetted character of problems and objectives.

The provision of geoinformation in this context requires a profound knowledge of the technology, sensor systems, information technology and procedures and method for data acquisition, information extraction and management. But a good understanding of the spatial processes is equally important to specify the relevant information needs for their monitoring and management. Furthermore a profound understanding of the different aspects of governance is required, because these define the context in which information will be used. These problems imply some interesting areas for the further development of geoinformation science:

- *Spatio-temporal issues*: The modern technology can handle dynamic presentations, but the conceptual developments for geodata handling to date dealt mainly with thematic and spatial aspects only. Concepts for modelling time related issues require much more attention before we can model and represent the dynamics of our living

environment. Furthermore we should distinguish between different types of dynamics, such as the analysis of the history of processes, the simulation of future process development, the projection of scenarios in the context the planning of land use or urban development.

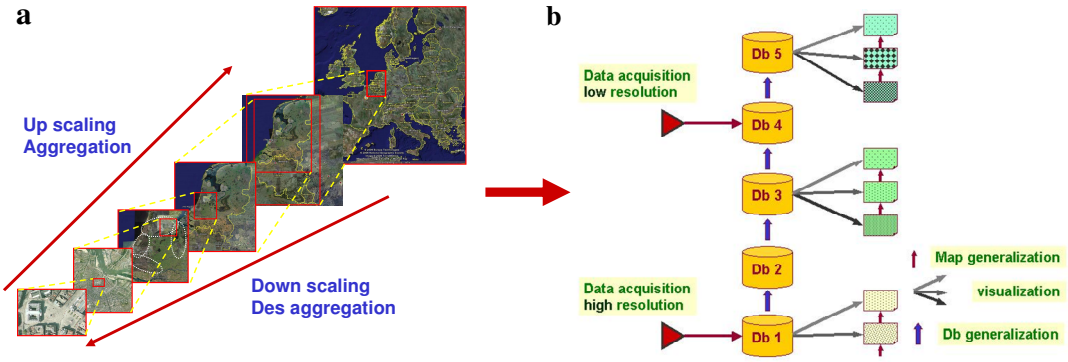

Figure 5. Processes at different geographic aggregation levels (**a**) require mutually consistent multi level representations of spatial data (**b**).
(source of Figure 5.a: Google Earth)

- *Multi scale issues*: The fact that we are dealing with interacting processes at different aggregation levels implies that methods should be further developed to manage data at multi scale levels (Tateishi and Hastings, 2000). Semantic definitions at all levels should be mutually consistent and harmonised. These levels should be linked to the different levels of policy implementation as might be identified in the context of the relevant governance contexts. Information transfer between these levels should be possible and consistency rules should be developed (Figure 5).
- *Multi theme data integration*: The monitoring and management of such complex processes requires interdisciplinary cooperation. Experts from different disciplines have to join their expertise and information which implies multi theme data integration. In the relevant governance contexts different actors representing the multi facetted aspects and multi objectives of dealing with these processes should be able to interact and share their knowledge and views.
- *Cross jurisdiction problems*: Managing our living environment and geo-processes require actions at a supranational level. This means that cross jurisdiction solutions have to be found for disparate institutional arrangements with respect to mandates and decision power, but also with respect to the disparity of the available information and information concepts and services.
- *The third dimension*: Most of the representations to day are still two dimensional. Our living environment is three dimensional though, so that we do need three dimensional representations.

The integration of different strands of geo-information requires a common reference. This might be through geodetic reference systems, but more often use is made of topographic core data. These are traditionally provided in the form of topographic maps which have their conceptual roots in the early 19th century. These are quickly becoming obsolete for many modern applications. New concepts for (large scale) topographic core data provision must be

developed with new delivery mechanisms. These should certainly be based on the opportunities provided by new sensors for 3D data acquisition in combination with concepts developed for spatio-temporal object-structured representations (Vosselman, 2005) in scale-less and seamless databases and virtual reality technology.

Institutional Aspects of GI Provision

The importance of earth observation and geo-information and with that of GDIs for governance has implications for the national (public and private) organisations responsible for establishing and operating these GDIs. National mapping agencies and other organizations involved in processes of spatial information production, dissemination and use will have to continuously redefine their position and role in this field in the future (Dale, 2001), (Lawrence, 2001).

The new opportunities offered by the modern technology, the new concepts of the role of government and the evolving new (global) economy will have a fundamental impact on the development of (national) geo-data infrastructures. Within the modern evolving information society a new business and Geo-ICT environment is emerging which forces GI-providers to develop new business strategies. Consequently they have to adjust their Geo-ICT strategies and develop new Geo-ICT architectures and adjust their organizational structure. This has been illustrated in Figure 6.a, see also (Lemmen, 2006). The new business strategies require the elaboration of scenarios anticipating the opportunities offered by the new technology and the development new GDIs.

These scenarios should also consider new paradigms for the definition core or reference data and for the new products and services that should be provided and the technological infrastructure required.

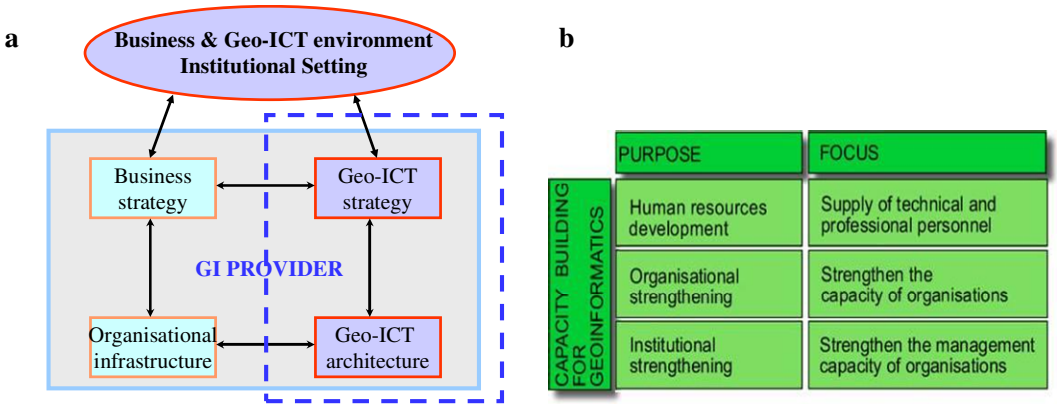

Figure 6.a. Strategic alignment model, after (Henderson et al, 1992)
Figure 6.b. Levels of capacity development.

Hence, the permanent capacity development of entire organisations is required. That is what was meant with the observation in the introduction that "lifelong learning" is not only relevant for professionals, but also for their organizations. The goal of education is to prepare (young) professionals for their tasks ahead, while the goal of capacity development is to simultaneously shake up the organisation that will employ them.

The aim is to strengthen organisations so that they can assume responsibility for designing, managing and sustaining development. For this, not only are thematic professionals required but also staffs that can formulate, design, manage and negotiate with other organisations and central government in order to address organisational and institutional issues in support of the acceptance of technological solutions (Figure 6.b) (Georgiadou and Groot, 2002). Hence capacity development comprises human resources development, organisational strengthening and institutional strengthening.

Conclusion

Governments certainly have a regulatory role with respect to information provision, but should they also be providers, or even producers? Or should they only facilitate the development of infrastructure through which geo-information is provided? But governments do not only have a regulatory role, they also have a direct interest in the use of information. The previous considerations made clear that geo-information is indispensable for many of the governance issues related to the management of our living environment and resources. Governments have an important role here in the context of the international agendas and treaties for the sustainable development of our planet. Geo-information is a prerequisite for good governance at all aggregation levels.

Organizations have to be very dynamic and permanently anticipate and adjust to the ever changing conditions; they should permanently adjust their mandates, their business strategy, there products and services. The must continuously redefine their niche in the GI-sector or they will risk to be overrun by the fast developments of their sector as was so nicely illustrated by a poem in (Friedman, 2005).

Every morning in Africa

Every morning in Africa, a gazelle wakes up
It knows it must run faster than the fastest lion or will be killed.
Every morning a lion wakes up.
It knows that it must outrun the slowest gazelle or it will starve to death.
It doesn't matter whether you are a lion or a gazelle.
When the sun comes up, you better start running.

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