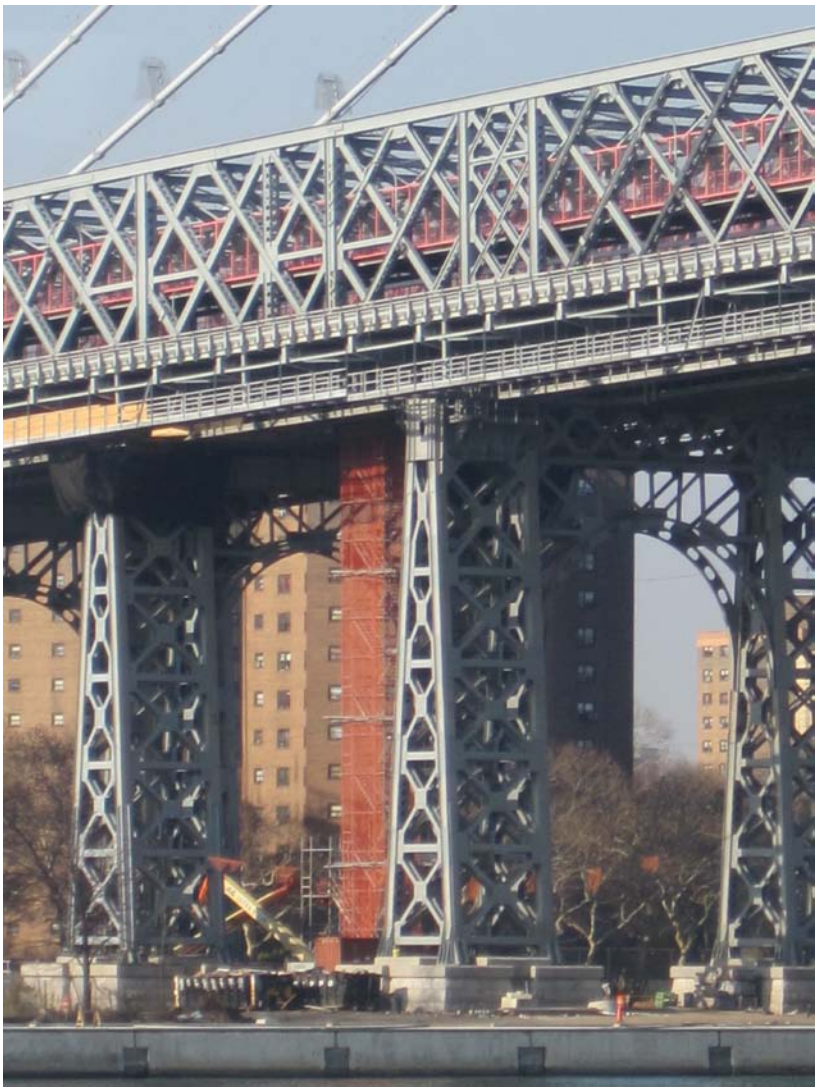
CAPACITY BUILDING STRATEGY



SEVENTH FRAMEWORK PROGRAMME

The work leading to these results has received funding from the
European Union's Seventh Framework Programme (FP7/2007-2013)
in accordance with grant agreement n° FP7-244172.

CONTRIBUTING TO DELIVERABLES:

D2.0.4 SYNTHESIS MARKETING STRATEGY

D3.0.1 STRATEGIC PLAN CONNECTING AND BUILDING

Photograph title page: courtesy Myrrh design

The bridge symbolizes the capacity to build new structures to connect and develop

Signatures

Author(s) : Mark Noort

Reviewer(s) : Project Partners / Advisory Board

Approver(s) :

Issuing authority : ITC

Change record

Release	Date	Pages	Description of change	Editor(s) / Reviewer(s)
1.0	16/02/2012	45	First version	Mark Noort / Project Partners
1.1	23/03/2012	50	Final version	Mark Noort

List of acronyms

ACMAD	African centre of meteorological application for development
AMESD	African monitoring of environment for sustainable development
ARCSST-E	African regional centre for space science and technology education in English
ASAL	agence spatiale Algerienne
BGR	bundesanstalt for geowissenschaften und rohstoffe
BSc	Bachelor of Science
CB	capacity building
CBC	capacity building committee
CD	capacity development
CENATEL	national centre of remote sensing and forest cover observation (Benin)
CEO	chief executive officer
CNES	centre national d'etudes spatiales
CoP	community of practice
CRASTE-LF	centre regional Africain des sciences et technologie de l'espace en langue francaise
CRECTEALC	regional centre for space science and technology education in Latin America and the Caribbean
CRTS	centre royal de teledetection spatiale
CSIR	council for scientific and industrial research
CSSTEAP	centre for space science and technology education in Asia and the Pacific
CU	Charles university
DAC	development assistance committee
DMN	national meteorological directorate (Morocco)
EC	European Commission
EMBRAPA	Brazil's agricultural research agency
EO	earth observations
ESA	European space agency
ESPI	European science and policy institute
ESRI	environmental systems research institute
EU	European Union
FP7	seventh framework programme
GEO	group on earth observations
GEO-BENE	global earth observations – benefit estimation
GEONetCab	GEO Network for capacity building
GEONETCast	global network of satellite based data dissemination systems
GEOSS	global earth observations system of systems
GIS	geographical information system
GMES	global monitoring for environment and security
GPS	global positioning system
INPE	Brazil's national institute for space research
INSPIRE	infrastructure for spatial information in the European Community
IOC	intergovernmental oceanographic commission
IRD	institute de recherche pour le developpement
ISPRS	international society for photogrammetry and remote sensing
ITC	faculty of geo-information science and earth observation, university of Twente
JEP	joint education programme

MDG	millennium development goal
MSc	Master of Science
NASA	national aeronautics and space administration
NGO	non-governmental organization
NOAA	national oceanic and atmospheric administration
OGC	open geospatial consortium
OSS	Sahara and Sahel observatories
PhD	Doctor of Philosophy
PHRD	policy and human resources development programme
R&D	research and development
RECTAS	regional centre for training in aerospace surveys
RS	remote sensing
SANSA	South African national space association
SERVIR	regional visualization and monitoring system
SRC	space research centre
SWOT	strengths, weaknesses, opportunities, threats
TIGER	technology informatics guiding education reform
UN	United Nations
UN-OOSA	United Nations office for outer space affairs
UNDP	United Nations development programme
USGS	United States geological survey
VITO	Flemish institute for technological research
WB	World Bank
WBI	World Bank institute
WHO	world health organization
WMO	world meteorological organization
WP	work package

SUMMARY

Marketing of earth observation is a combination of capacity building and brokerage. The GEONetCab capacity building strategy is part of a marketing effort to promote the use of earth observation products and services. The target group is a triangle formed by decision-makers, professionals, and (end-)users / beneficiaries, loosely described as communities. Decision-makers can be local authorities, such as government officials, politicians or managers in funding organizations. Professionals may be earth observation specialists, but engineers or technical managers working in disciplines related to the GEO societal benefit areas are also included in this group. Communities encompass civil society organizations (such as farmers associations), village councils, and NGO's.

Capacity building is of course part of, and should be anchored in, a broader development context. The GEONetCab project uses the following working definitions: capacity building is 'learning and being capable of adding something new and relevant to a previously defined purpose' and brokerage is 'linking providers and (potential) users of a product or service'. General definitions of capacity building evolve to broader, all-encompassing concepts. Definitions have expanded over time from initially focussing on individuals, to including organizations and a more general environment, as well as a broader political and societal context. Local ownership, empowerment, making implicit knowledge explicit, varying competence and knowledge levels, and value chains for networks are also key concepts in capacity development.

The GEO capacity building strategy distinguishes individual, institutional and infrastructure capacity development. The strategy aims to coordinate and elaborate on existing efforts: "GEO envisions a future where earth observation capacity building efforts are coordinated, and the access to and availability of capacity building programmes to users in all of GEO's societal benefit areas are enhanced. This coordination should increase access to earth observation data and products and seeks to encourage decision makers worldwide to use these tools to guide their decisions in sustainable development planning and policymaking". The GEONetCab project aims to make this strategy operational. To this effect several studies have been carried out to assess the current situation regarding capacity in earth observation and to identify opportunities and bottlenecks. Combining the outcome of these studies with the principle of complementarity, as applied in GEO and GEONetCab, the most promising interventions focus on a combination of capacity building and promotion to remove bottlenecks and achieve quick-win solutions. As indicated above, showing economic and societal benefit is of cardinal importance to enable adoption of earth observation solutions by new groups of users and decision-makers.

The GEONetCab project is outwardly oriented, as mentioned earlier: it operates outside the comfort zone of the earth observation community, although it also aims to provide feedback, such as results and experiences, to the community. This confirms the thesis that the way to marketing GEO and GEOSS leads through general earth observation marketing first. Key terms are therefore the business process (organizational innovations and change management), empowerment of local communities, focus on quick-wins and manageable practical achievements, making implicit knowledge explicit, and the network dimension. The main instruments for capacity building are marketing toolkits, success stories, and the capacity building web, supported by promotion activities (including quick-win demonstration projects) and a 'roadshow' visiting funding organizations and other potential clients. In agreement with the objectives of GEO's Seville roadmap this results in the addition of tools for promotion and capacity building to the list of prioritized actions.

TABLE OF CONTENTS

List of acronyms
Summary i
1. Introduction: the triangle and the quadrants 1
2. Capacity development / capacity building 3
3. GEO and capacity building in earth observation 10
4. Focus of the GEONetCab project: back to the triangle and the quadrants 13

Appendices

1. Capacity building: existing and potential markets (from GEONetCab report Marketing of Earth Observation Products and Services, part #1)
2. Success stories: example
3. Marketing toolkit: example of front page
4. Capacity building web: model
5. Literature list

List of figures

1. Target group triangle of the GEONetCab project 1
2. The four quadrants of GEONetCab project deliverables 2
3. Overview of six key messages for capacity development 6
4. Value chains for networks for capacity 8
5. Cycle for redesigning curricula 9

List of tables

1. Conditions that have made public sector capacity difficult to develop 4
2. Conditions favouring capacity development in organizations 5
3. Examples of competencies for each level of capacity development 7

1. INTRODUCTION: THE TRIANGLE AND THE QUADRANTS

Marketing of earth observation is a combination of capacity building and brokerage. This is the essence of the report "Marketing of Earth Observation Products and Services, part #1", elaborated in the framework of the GEONetCab project. Earth observation is on the verge of becoming available to new groups of end-users and has the potential to involve (and empower) these users in areas of benefit to society. To make this a success, aspects of the weakest links in the chain from provider to user need to be addressed. The GEOSS (global earth observation system of systems) provides a (technical) platform for all users and the GEONetCab project aims at making a small contribution to this process in the form of facilitating capacity building and brokerage. This report provides a first analysis of earth observation capacity building and the GEONetCab approach, with the relevant section presented in Appendix 1. To effectively target activities, a capacity building strategy for the project is needed. The aim of this report is to formulate such a strategy. The report is a synthesis of a literature study, web survey, regional studies and capacity building and brokerage experiences of project partners.

The GEONetCab capacity building strategy is part of a marketing effort to promote the use of earth observation products and services. The target group is a triangle formed by decision-makers, professionals, and (end-)users / beneficiaries, loosely described as communities (see figure 1).

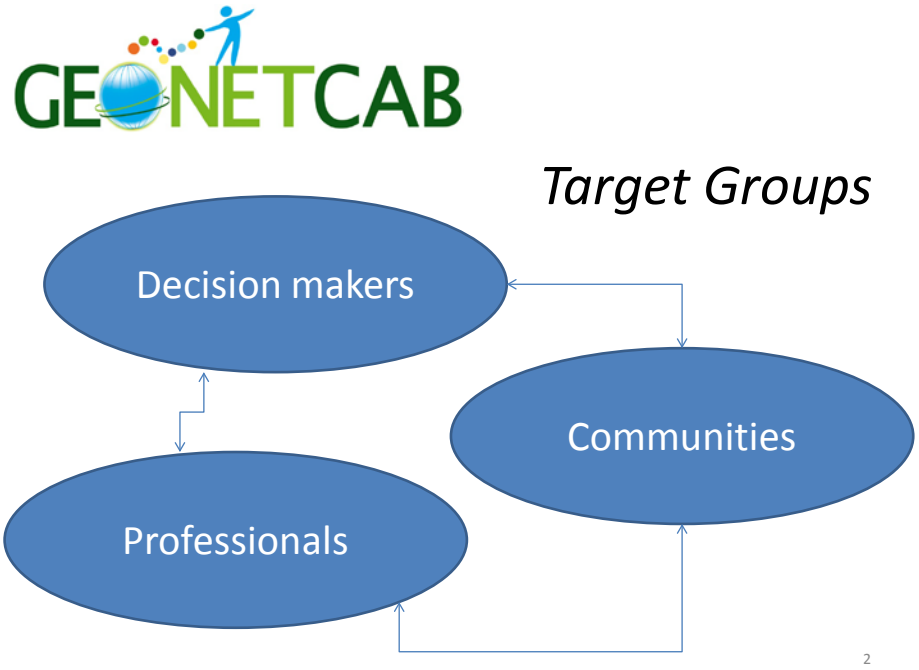


Figure 1: target group triangle of the GEONetCab project

Decision-makers are local authorities, such as government officials, politicians, or managers in funding organizations. Professionals can be earth observation specialists, but engineers or technical managers working in disciplines related to the GEO societal benefit areas (disasters, health, energy, climate, water, weather, ecosystems, agriculture, and biodiversity) are also included in this group, such as, for example, agronomists working on food security. The basic principle is that they apply or could apply earth observation in their professional practice. The group of communities consists of civil society organizations, such as farmers' associations, village councils or NGO's (although the latter two may overlap with decision-makers and professionals, respectively, depending on their

role). This group does not include communities, such as the earth observation community, GEO community, or capacity development community, etc., which appear later in this report. The target group of communities refers strictly to groups of people in civil society that are potential beneficiaries of earth observation products and services, but do not necessarily need to know about the intricacies of earth observation applications, be it from a technical or management perspective. In this report the selection of this target group is explained and the broader framework of GEONetCab capacity building activities is outlined.

Section 2 describes the general concept of capacity development / capacity building and presents typical aspects of capacity development. How this relates to GEO capacity building and capacity building in earth observation is shown in section 3. The GEONetCab capacity building strategy is part of the GEO capacity building strategy and complies with the GEO Seville roadmap. How the GEONetCab capacity building strategy, and the actions that result from it, are related to the other deliverables of the GEONetCab project, is illustrated in figure 2 (the quadrants).

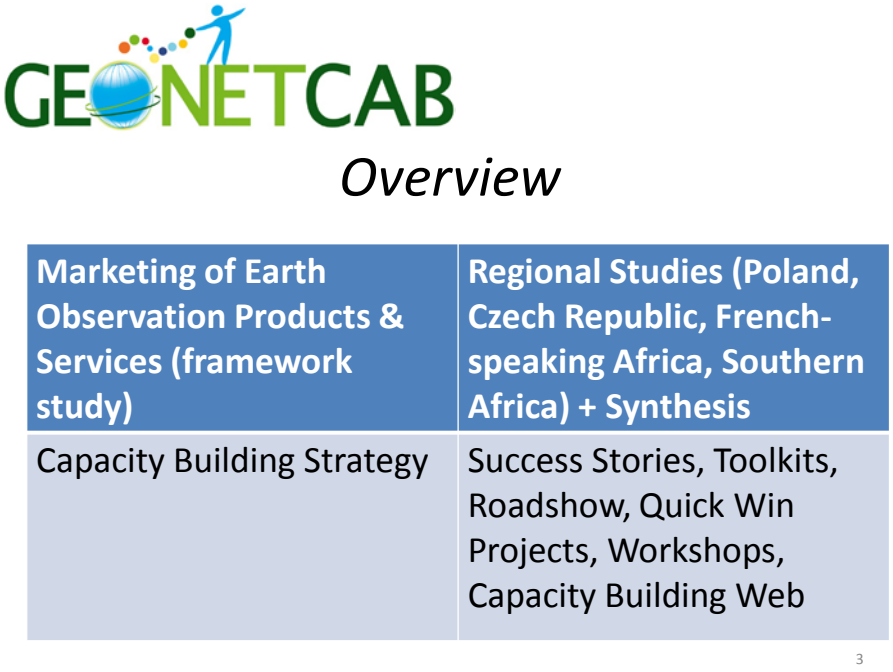


Figure 2: the four quadrants of GEONetCab project deliverables

The overviews and considerations presented below do not take a direct route to the outline of the GEONetCab capacity building strategy in section 4. They form part of an exploratory process, in which an attempt is made to assess what works best in relation to capacity building for GEO and earth observation in general and what contribution the GEONetCab project can make in particular.

2. CAPACITY DEVELOPMENT / CAPACITY BUILDING

Capacity building is of course part of, and should be anchored in, a broader development context. Before we analyse the concept of capacity building it is good to define capacity building and look at its place and role in the development context. The GEONetCab project uses the following working definitions: capacity building is 'learning and being capable of adding something new and relevant to a previously defined purpose' and brokerage is 'linking providers and (potential) users of a product or service'. For simplicity's sake, we equate capacity building with capacity development or capacity enhancement.

EuropeAid uses the following definitions: "Broadly taken, capacity can be defined as the ability to perform tasks and produce outputs, to define and solve problems, and make informed choices. Capacity development (CD) is the process by which people and organizations create and strengthen their capacity over time. Support to capacity development is the inputs and processes that external actors– whether domestic or foreign– can deliver to catalyse or support capacity development of persons, an organization, or a network of organizations (e.g. in a sector, or even at the public sector level." (Institutional Assessment and Capacity Development, why what and how? 2005).

UNDP defines capacity development as: "the process through which individuals, organizations and societies obtain, strengthen and maintain the capabilities to set and achieve their own development objectives over time" (Capacity Assessment Practice Note, 2008).

The World Bank describes capacity development as follows: "Involves the empowerment of societal actors through learning, knowledge, information and innovation to effect transformational and sustainable change in institutions, which in turn supports the achievement of the development goal" (Steps for Designing a Results-Focused Capacity Development Strategy, 2011).

The OECD, in the Paris Declaration, sees capacity development as a necessary endogenous process, strongly led from within a country, with donors playing a supporting role (Working towards Good Practice, the Challenge of Capacity Development, 2006). In the same report capacity is described as "the ability of people, organizations and society as a whole to manage their affairs successfully" and capacity development as "the process whereby people, organizations and society as a whole unleash, strengthen, create, adapt and maintain capacity over time".

One can see that definitions evolve into broader, all-encompassing concepts. Definitions have developed over time from having a focus on individuals, to the inclusion of organizations and a more general environment (for example society as a whole) and the inclusion of the broader political and societal context. Other definitions stress the dynamic nature or the complexity of capacity (as part of complex processes or systems). UNDP uses a three-dimensional cube as capacity assessment framework, consisting of the following three axes:

- Points of entry, sometimes also referred to as levels of analysis (individual, organization, enabling environment),
- Core issues (accountability, knowledge, leadership, institutional arrangement),
- Technical and functional capabilities (the latter consisting of the capacity to engage stakeholders, assess a situation and create a vision and mandate, to formulate policies and strategies, to budget, manage and implement, and to evaluate).

Compared to this the GEONetCab working definition of capacity development appears to be quite narrow and simple, but as it does not restrain the actors or entities involved, it is applicable to a wide range of subjects and contexts as a relevant working definition.

Capacity development has become an important issue for the donor community and most literature originates from this sector. Literature from the private sector mainly focuses on the improvement of business processes, human capital, enhanced marketing, or better service to customers. A reason for this is that the goals of international aid are far more ambitious: decrease poverty, eradicate hunger, and development of whole sectors, countries or regions. There are consequently a large number of strategies, guidelines and best practices for capacity assessment, planning, actions, monitoring, and evaluation. It is impossible to do justice to them all, but some interesting topics that are particularly relevant to capacity building in earth observation and the GEONetCab project are highlighted below. Strikingly, so-called developed countries rarely apply the term capacity development to themselves, but use terms such as 'knowledge economy', 'life-long-learning' and 'continuous professional development' instead.

The OECD report 'The challenge of capacity development, working towards good practice' stresses the importance of a new emphasis on local ownership (sometimes also referred to as inclusive ownership), accompanied by paying more attention to political leadership, and the prevailing political and governance system, when creating opportunities and setting limits for capacity development efforts. These aspects are also addressed in GEO, through its system of national representation, and more specifically in the GEONetCab project, through its promotion activities. With respect to capacity development, the report identifies difficult as well as favourable conditions for capacity development, some of which are also experienced in GEO capacity building (as earth observation caters mainly to a government market, see also section 4). The tables below give an overview:

Table 1: Conditions that have made public sector capacity difficult to develop (OECD, 2006)

Lack of a broadly enabling environment:	**Aspects of government ineffectiveness:**
- Lack of human security and presence of armed conflict	- Fragmented government, with poor overall capacity for economic and public financial management, and low levels of transparency and accountability.
- Poor economic policy that discourages pro-poor growth	- Absent, non-credible and/or rapidly changing government policies, and an overload of reform and change initiatives.
- Week parliamentary scrutiny of the executive branch	- Unpredictable, unbalanced or inflexible funding and staffing
- Lack of effective voice, particularly of intended beneficiaries. This is generally associated with weak social capital (trust) and with political systems with low participation, unclear and arbitrarily enforced 'rules of the game' and/or lack of respect for human rights.	- Poor public service conditions: salary levels incompatible with reasonable expectations of living standards; history of flight of qualified staff to other countries; excessive reliance on donor-funded positions.
- Entrenched corruption (political and administrative) in core government organizations.	- Segmented and compartmentalized organizations, with centralist, strictly hierarchical, authoritarian management.
- Entrenched and widespread clientelism or patrimonialism, weakening the pursuit of organizations' formal tasks	- Only a formal commitment to a performance-oriented culture, reflected in both a lack of rewards for performance and of sanctions for non- performance

Table 2: Conditions favouring capacity development in organizations (OECD, 2006)

-	Strong demand-side pressure for improvement is exerted from outside (from clients, political leaders, etc.).
-	Top management provides visible leadership supporting change, promotes a clear sense of mission, encourages participation, establishes explicit expectations regarding performance, and rewards well-performing staff (recognition, pay, and promotions based on merit).
-	Change management is approached in an integrated manner.
-	A critical mass of staff members, including front-line staff, is ultimately involved.
-	Organizational innovations are tried, tested and adapted.
-	Quick wins that deepen commitment to change become visible early in the process.
-	Top management and change agents manage the change process strategically and proactively, including both internal and external aspects of the process (communication, sequencing, timing, feedback loops, celebration of victories, and recognition of problems).

While the GEO process focuses on the overarching elements to create an enabling environment, the GEONetCab project targets the last four conditions in table 2. These are directly related to providing operational content to the concept of capacity. Peter Morgan (Morgan, 2006 & 2008) stresses the importance of providing such operational content to the concept of capacity, and identifies five characteristics:

- Empowerment and identity, i.e. allowing individuals and organizations to develop themselves,
- Collective ability, in terms of becoming more goal-oriented and effective,
- Capacity as a systems phenomenon, as a result of a dynamic interaction between tangibles and intangibles, such as attitudes, resources, skills, etc.,
- Capacity as a potential state, comparable to kinetic energy: acquired capacity that may be used,
- Creation of public value, in contrast to capacity to destroy public value, such as criminal activities.

Interestingly, there is a parallel in this list between capacity as such, and the added value of earth observation, as the application of earth observation contributes to the five characteristics mentioned above. Morgan further distinguishes different attributes of capacity:

- foundation components, such as financial resources, structure, information, etc.,
- competencies, such as skills, behaviour, motivation, etc. of individuals,
- capabilities, such as hard and soft collective skills, and
- capacity as a term for the overall ability to create value.

He then defines capacity as the 'emergent combination of attributes that enables a human system to create development value'. The definition is perhaps a bit vague, but is presented here because it provides the link to his identification of five core capabilities of capacity. These separate, but interdependent capabilities are:

- The capability to act,
- The capability to generate development results,
- The capability to relate,
- The capability to adapt and self-renew, and
- The capability to achieve coherence.

This list is useful as a checklist for capacity building interventions, as all five are necessary conditions, but none are sufficient on their own: the classical mistake of providing only training or only hardware can serve as an example. Morgan concludes that capacity must be seen both as an end in

itself and as a means to other development objectives and that one should not over-analyse ever bigger capacity development initiatives, but focus on manageable, practical pieces of capacity development.

Figure 3: Overview of six key messages for capacity development (EuropeAid, 2005)

There are several ways to carry out institutional assessments and formulate capacity development strategies. A practical flowchart is presented by EuropeAid; the page from the report containing this overview is shown as figure 3. The flowchart is presented as an example and coincides reasonably well with the GEONetCab framework for analysis of earth observation products and services.

It is interesting to mention a number of aspects and viewpoints that have not been presented yet. One is the distinction between explicit knowledge (as formally taught and available in written form) and implicit (tacit) knowledge (Alaerts and Kaspersma, 2009). The authors also show that the

presence of informal and formal networks among sector specialists and peers serves as an interesting indicator of knowledge facilitation. They distinguish four types or levels of knowledge for which different models of learning are appropriate: factual knowledge ('water boils at 100 degrees Celsius'), understanding ('where does rain come from'), skills (proficiency in a language, ability to work in a team), and attitudes (problem-solving attitude, capability to approach a complex challenge, etc.). The authors then use these types of knowledge to establish the divide between training (skills) or education (the other three). They provide an interesting matrix of competences (differing from Morgan's presented above) and capacity development levels, where the institutional level can be equated with the more general environment mentioned at the start of this section:

Table 3: Examples of competencies for each level of capacity development (Alaerts & Kaspersma, 2009)

	Individual level	**Organizational level**	**Institutional level**
Technical competence	Regularly updated knowledge and skills. Understanding of the broader technical context.	Appropriate knowledge and skills mixes for the services that are delivered, such as engineering, legal, financial, institutional knowledge. Knowledge on procurement and investment procedures.	Technical knowledge and available skills mixes in a broader setting. Procedures for critical review and corroboration of knowledge and information.
Management competence	Project management skills. Financial management skills. Personnel and team management skills. Mentoring skills. Understanding of political consensus building. Ability to 'deliver'. Leadership.	Leaders able to operate with goals and objectives as agreed with supervisory entities and main stakeholders. Ability to set goals, strategy. Financial management. People management. Appropriate staff rotation, talent spotting, incentive systems, etc. Project management. Ability to 'deliver' timely.	Sound and workable task assignments of sector agencies. Minimal overlap between agencies, and size and task of agencies facilitate proper management and task execution. Sound financial, fiscal and budgeting systems. Facilitating proper management by organizations.
Governance competence	Understanding of procedures. Ability to engage with and listen to stakeholders. Ability to apply inclusiveness. Focus on results.	Transparent decision making processes. Procedures to consult with stakeholders, and provide empowerment to others. Procedures to be held accountable, including transparency in budgets and plans.	Distinction between 'operator' and 'regulator'. Procedures to ensure inclusiveness in particular regarding objectives, priorities and strategies. Procedures to ensure transparency and accountability.
Learning competence	Desire to 'keep learning', readiness to critically reflect on one's own performance. Availability for training and education in new skills and knowledge.	Readiness, and procedures, to critically review own performance on a continuous basis, and revise if necessary. Goals, procedures and resources to support learning by staff, organization and, if necessary, other stakeholders. Support of 'communities of practice' and rewards for staff learning.	Procedures to promote open working atmosphere and critical reflectance on performance. Openness to review sector performance on a continuous basis and revise policies and arrangements, if necessary. Foster inclusiveness.

Another interesting concept is the value chain for networks for capacity as described in one of the World Bank Institute's Capacity Development Briefs (see figure 4). The value chain describes the approach also applied in the GEONetCab project, allowing for network dimension (mentioned in the previous paragraph).

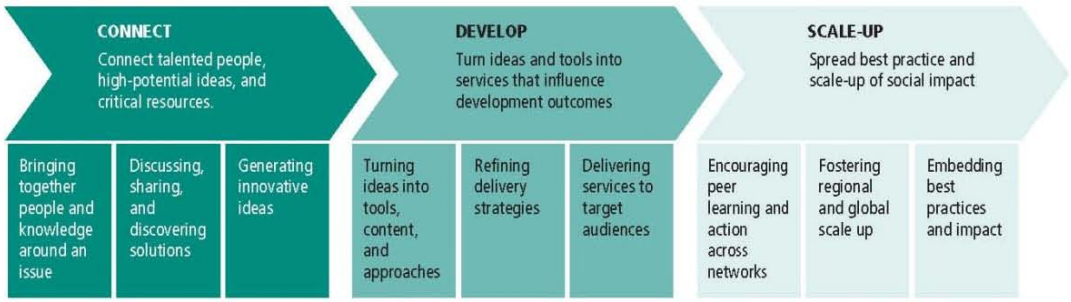


Figure 4: Value chain for networks for capacity (WBI, 2009)

In line with its slogan 'connecting globally, acting locally', the World Bank provides a practical guide for setting up capacity development programs in 'The Art of Knowledge Exchange, A Results-Focused Planning Guide for Development Practitioners' (WBI, 2011). Apart from providing a general approach, the concrete overview of capacity development instruments, including communities of practice, conferences and high-level events, twinning, expert visits, peer consultation, study tours, and dialogues, is particularly relevant and has already been extensively applied in the GEO approach.

Several sources agree that the establishment of performance indicators for capacity building as well as the monitoring and evaluation of capacity development are difficult. In GEO experiences are similar and three other factors add to this problem:

- No baseline was established at the start of the GEO / GEOSS process (see for example the reports of the GEO-BENE project),
- Activities within GEO are designed to be complementary to other existing initiatives. This makes it difficult to assess achievements: do they result from GEO or do they have other origins?
- As with all GEO initiatives, contributions to capacity building are of a voluntary nature; this complicates the establishment of a coherent, effective and efficient action package.

This topic will be addressed extensively in the next section, after discussing capacity development in earth observation in more detail.

Finally, capacity development in fragile states deserves special mention. Reports, such as 'Education for All, beating poverty, unlocking prosperity' (Brown, 2011) and 'Africa Capacity Indicators 2011, capacity development in fragile states' (African Capacity Building Foundation, 2011), provide a valuable general insight into this complicated topic. Experiences in capacity development at the level of tertiary education have been extensively documented as part of development cooperation. Japan's Policy and Human Resources Development Program (PHRD) with the World Bank (Potten, 2008) and the Dutch higher education cooperation program, with some case studies on geospatial capacity development (Boeren, 2005), serve as examples. South – South cooperation for capacity development is also on the rise. The term 'South – South' is hardly appropriate anymore under the current circumstances; 'new modalities for capacity development cooperation' would be a better term as it includes independent local initiatives. Building on Dutch experience, Wals offers a cycle for redesigning curricula in accordance with specific local circumstances, as part of a 'sustainability toolkit' (not to be confused with the GEONetCab marketing toolkits):

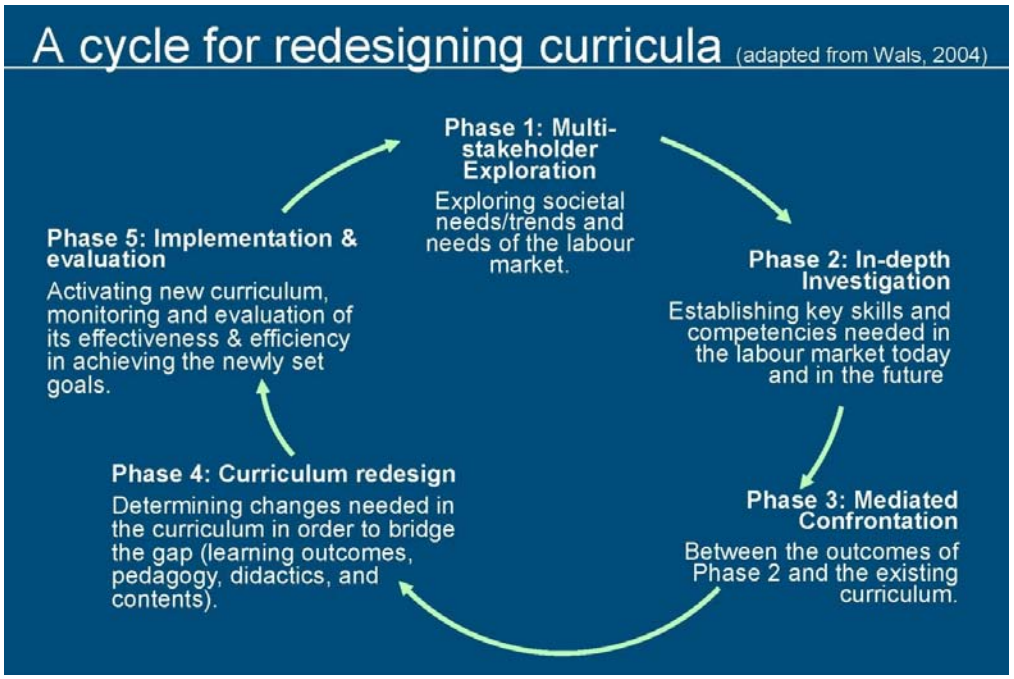


Figure 5: Cycle for redesigning curricula (Wals, 2011)

Although the topic curriculum development is not included in the GEONetCab project, the figure presents an outline for the design of training courses and for discussions on delivery mechanisms in general.

The topic of capacity development is too extensive to be dealt with adequately in such a short section. The aim is to use those elements of the concept of capacity and capacity assessment as well as different approaches, findings, ideas, and experiences that are especially relevant to capacity building in earth observation in the framework of GEO and the GEONetCab project in our more applied analysis in the next section.

Recapitulating the above, it should be stressed that, although the GEONetCab project pays special attention to developing countries, the concept of capacity development as construed by GEONetCab can be applied symmetrically to all GEO partners, to learn from each other's experiences.

3. GEO AND CAPACITY BUILDING IN EARTH OBSERVATION

The GEO capacity building strategy also distinguishes between individual, institutional and infrastructure capacity development (infrastructure in this case referring to enabling technology platforms). The strategy aims to coordinate and build upon existing efforts: “GEO envisions a future where earth observation capacity building efforts are coordinated, and the access to and availability of capacity building programmes to users in all of GEO’s societal benefit areas are enhanced. This coordination should increase access to earth observation data and products and seeks to encourage decision makers worldwide to use these tools to guide their decisions in sustainable development planning and policymaking“.

Why is such extra effort needed? A study by NASA on the societal impact of spaceflight (NASA, 2007) already indicates that scientific value of earth observation does not automatic translate to economic value or benefit to society. Questions related to who will ultimately pay for the information, how much they will have to pay for it, and what the actual value of the information is, are difficult to evaluate until after the information is obtained and actually used. The mixture of (concealed) public funding and private sector engagement makes the analysis of economic benefits difficult, because prices do not reflect total costs. Euroconsult (Keith, 2011), in a briefing on earth observation revenue growth, also observes a “relative immaturity of addressable markets to the earth observation solution”. Euroconsult advises earth observation operators to “educate potential end users and demonstrate benefits provided by earth observation data, using the role of Google Earth and similar virtual globes as examples”.

The answer to the “why” question lies therefore in the fact that application of earth observation has certain benefits that are not (fully) appreciated by potential users, nor, strikingly, by providers, who usually have a science- or technology-directed orientation and a focus on funding and implementation of space and associated programmes. The dual approach of capacity building and promotion based on more outwards oriented views is extensively outlined in the GEONetCab report “Marketing of Earth Observation Products and Services, part 1” and will not be repeated here. The action list for capacity building, resulting from the analysis, will be dealt with in the next section. Below we will discuss the findings of the GEONetCab regional studies that have been carried out since the first report appeared.

In the Czech Republic, Poland, Southern Africa and French-speaking Africa the current situation of capacity in earth observation has been analysed and bottlenecks and opportunities have been identified. The findings are summarized in a synthesis document and are complemented by a qualitative internet and literature assessment of existing initiatives and markets. Not surprisingly, the African studies conclude that most conditions for a successful implementation of earth observation solutions are lacking, although they also divide countries into different classes regarding uptake potential and different levels of activity and interest (not necessarily coinciding with the first classification!). Capacity development in earth observation for non-earth observation academics and professionals is emphasized, to increase impact. The Polish and Czech studies conclude that there are sufficient earth observation education academics and that earth observation education at tertiary level is of good quality. The main bottlenecks are the reluctance of public organizations to adopt earth observation solutions and a lack of private sector development (although GIS and location-based services are potential drivers).

This confirms the earlier hypothesis that the primary focus of the GEONetCab project should not be on formal education as such. The regular need for education is addressed, albeit imperfectly, by other initiatives ranging from activities for primary and secondary education, usually initiated and sponsored by national space agencies, to tertiary and professional education such as EduSpace and learnEO! by ESA. GEONetCab, of course, promotes these activities through the dissemination of earth observation success stories (see section 4). Using satellite technology for education, including earth observation applications, with India's Edusat program as an example, also belongs to this category. An interesting note is that at the end of the nineties quite some articles and scoping studies appeared about planning of education, training and capacity requirements for the earth observation sector in emerging economies. It seems that more than a decade later the issue is settled or at least not receiving priority anymore. The findings of the Polish and Czech studies appear to confirm this.

Combining the outcome of these studies with the principle of complementarity, as applied in GEO and GEONetCab, the best interventions focus on a combination of capacity building and promotion to remove bottlenecks and achieve quick-win solutions. As indicated above, showing economic and societal benefit is of cardinal importance to the process of enabling adoption of earth observation solutions by new groups of users and decision-makers. To date, most economic analysis has focused on the general or global benefit of earth observation: the system dynamics approach of the GEO-BENE project (Group on Earth Observations – benefit estimation: now, next and emerging, final report, 2006), and studies carried out by ESPI (Space-based services in Europe, 2009) are examples. Other studies show the economic benefit of spatial data infrastructures for governance at regional level, but these studies deal with geo-informatics in general, with earth observation in a supporting role. In its cooperation programme with ESA, the World Bank has commissioned a number of risk assessment and adaptation resilience studies for North African coastal cities. Although earth observation is only one of the elements used for the assessment, the use of earth observation facilitates the calculation of economic benefits (or avoidance of losses) with the simple internal rate of return method. This approach is more suitable for the GEONetCab project with its focus on local and regional communities and authorities.

In a study on representation for the earth observation sector in Europe and Canada (EO Service Sector Representation, EOVox, 2006) several general areas of action are proposed: raising of general awareness, creating a forum for networking, promoting capability, representation, influencing programmes (putting the subject on the agenda of funding organizations), as well as a large array of activities within these categories. GEO addresses all five categories and the GEONetCab project focuses primarily on raising awareness, promoting capability and influencing programmes.

The GEONetCab project is outwardly oriented, as mentioned earlier: it operates outside the comfort zone of the earth observation community, although it also aims to provide feedback on results and experiences to the community. This confirms the thesis that to market GEO and GEOSS general earth observation needs to be marketed first. That is one of the reasons that attention is paid to general capacity development literature in this document. Key terms from the previous section concerning the project are therefore the business process (organizational innovations and change management), the empowerment of local communities, the focus on quick-wins and manageable practical pieces, the changing of implicit knowledge into explicit knowledge, and the network dimension.

The aims with respect to the capacity attributes (Morgan, 2006 & 2008) are to:

- improve access to foundation components, such as financial resources, low-cost solutions, data, etc.,
- increase competencies of individuals so they appreciate and use earth observation solutions, and attract funding,

- increase capabilities, in the form of collective skills to empower communities and improve decision making,
- improve capacity to create value in a joint effort by the earth observation community and end-user communities.

All these aims affect the technical, management, government and learning levels indicated in the previous section.

Before we move on to the focal point of the GEONetCab project in capacity building, two more general issues deserve special attention: cross-border education and performance indicators for capacity building.

The topic of cross-border (recognition of) education in earth observation is a difficult but very relevant subject and a (minor) part of the GEONetCab project. Two seminars have been held on recognition of cross-border education and training in earth observation (ITC, 2007 and ITC and ISPRS, 2010), the latter resulting in a deliverable of the GEONetCab project. Cross-border recognition touches on complete educational systems, not just education in earth observation. The findings of the seminar are therefore very instructive and useful for knowledge exchange, but will not result in any actual cross-border recognition arrangements at short notice, as these depend on agreements at higher levels. The issue of certification of short courses, at least in the form of standardization of capabilities learned, is very pressing and appears easier to achieve. It should therefore be actively promoted within GEO and, where possible, existing systems (such as of ASPRS) should serve as models. Having an officially recognized system would be a bonus, but the main aim is to provide clarity to both students and sponsors.

Monitoring and evaluation is another difficult subject. The new framework for GEO monitoring and evaluation will be applied, as the work of the GEONetCab project is related to several GEO tasks. A study on performance indicators for capacity building was carried out within GEO (CBC Performance Indicators Report, 2011). In section 2 the absence of a baseline, complementarity of GEO activities and the voluntary nature of GEO, were already mentioned as constraints for measuring performance and evaluation. These constraints have to be taken in to account, when analysing the quantitative assessment of the performance indicators in the new GEO monitoring and evaluation framework. Intangible factors that affect the performance of the GEONetCab project, such as the power of story-telling, the delay in response time (getting results), the increasing portfolio of successful applications, empowerment of communities, and the success of the feedback received by the GEO community, merit a qualitative assessment. All these factors are difficult to measure in terms of effectiveness, efficiency and impact.

4. FOCUS OF THE GEONETCAB PROJECT: BACK TO THE TRIANGLE AND THE QUADRANTS

The GEONetCab project focuses on the triangle of decision-makers, communities and earth observation professionals. The main instruments for capacity building are marketing toolkits, success stories and the capacity building web, supported by promotion activities (including quick-win demonstration projects) and a 'road-show', in the form of visits to funding organizations and other potential clients.

The project aims at closing the 'soft' side of the information and skills gap that impedes the use of earth observation (the 'hard' side being covered by other initiatives in GEO). As a result of the analysis and interaction with professionals in the different fields marketing toolkits have been developed, each dedicated to a GEO societal benefit area (or a part thereof). There is a lot of implicit knowledge on a broad range of issues, both in the earth observation community and in general professional practice related to the GEO societal benefit areas. The aim is to provide easy access to this knowledge. Key issues related to the disclosure of this implicit knowledge are:

1. International trends and developments in earth observation (in subjects such as disaster management),
2. Steps to promote earth observation (again for application in a specific subject),
3. Raising funds for your activities,
4. Capacity building.

The approach is to offer an 'a la carte'-menu: different elements can be selected from the toolkits to serve as basic set for interaction with specific target groups, such as decision makers, earth observation professionals, NGOs, etc. References to documents and websites are provided and regional examples and other material can be added. The toolkits and reference material can also be found on the capacity building web, which will be part of the GEO web portal. The front page of a marketing toolkit is shown in Appendix 3 as an illustration.

Similarly, a portfolio of success stories is assembled. Success stories promote earth observation by critically assessing the following questions:

- What is the added value in the business process compared to using conventional methods?
- Which clients use the products and services and what do they use them for?
- How can the success story influence/improve decision making?
- In what phase in the life cycle of a product or service does the success story fit?
- Will the clients use the products in the future or will products/services be provided by others?
- Will the clients pay for the products and services / are the clients paying for them?

Success stories are two pages long, contain photos and graphs that support the message and are written in layman's terms. An example of a success story is presented in Appendix 2. Key issues are sustainability, feasibility, replication potential, societal benefit (for comparison: the food company Heinz uses comparable criteria, such as applicability, availability, affordability, and affinity, to introduce (new) products into new markets)[1]. The aim is not only to raise awareness with third parties, but also to disseminate information within the earth observation community about what can be achieved in an economically viable way with often limited means.

[1] Harvard Business Review, October 2011: 'How I did it – the CEO of Heinz on powering growth in emerging markets'.

The capacity building web gathers free and low cost capacity building and software solutions, with the aim to enable professionals from other disciplines to acquire earth observation skills and to discover new modes of delivery. It also provides an overview of possibilities for education and training as well as earth observation products and services, again with affordability as a criterion. In addition, references to the literature used for this project will be made publicly available. The capacity building web is being developed through the project website (www.geonetcab.eu), but will be integrated in the GEO web portal. The underlying model for the capacity building web has been presented in the report on Marketing of Earth Observation Products and Services, part 1. The types of resources used for the capacity building web are presented as example in Appendix 4.

The capacity building and promotion activities of the GEONetCab project support GEO's Seville roadmap for mobilization of resources. This roadmap aims to present GEO as an efficient coordinator of resource mobilization activities and an honest broker serving users, producers and potential resource providers. How the project supports each objective of the roadmap is added in *italics* below.

Seville roadmap objectives for mobilizing resources (for capacity building):

- Gain a comprehensive understanding of the needs and operations of donors, including their project cycles, methodologies, terms of reference, and priorities. *GEONetCab: roadshow, literature and market studies, using success stories to interest potential clients.*
- Focus on understanding the full range of user communities and networks, including their needs and priorities. *GEONetCab: all project activities.*
- Strengthen links between the user and donor communities. *GEONetCab: roadshow, success stories, marketing toolkits.*
- Sensitize donors to the value of earth observation and the benefits that building greater capacity for producing and using earth observations can bring to a variety of users. *GEONetCab: roadshow, success stories*
- Mobilize resources for building the capacity of the three key contributors to earth observations: individuals, institutions and infrastructure. *GEONetCab: roadshow, success stories, marketing toolkits.*
- Identify likely donors for each social benefit area and geographic region. *GEONetCab: literature and market studies, roadshow.*
- Coordinate resource mobilization in order to promote efficiency and capacity. *GEONetCab: the emphasis is on mobilizing resources first, efforts to this effect are coordinated with the GEO Secretariat.*
- Market capacity building for earth observation as a worthwhile investment and not merely as a cost. *GEONetCab: roadshow, success stories, marketing toolkits.*
- Engage and establish mutually beneficial relations with the private sector and establish private-public partnerships. *GEONetCab: roadshow, success stories, marketing toolkits.*

Similarly, it is good to recapitulate the action points for capacity building, as identified in the report on Marketing of Earth Observation Products and Services, part 1, and the response of the project:

1. Complete the inventory of open-source software and make an action plan for increased use for various purposes with partners in developing countries. *GEONetCab: capacity building web, marketing toolkits.*
2. Approach major providers of geo-information software to discuss increased support for capacity building initiatives with the aim to develop the market. *GEONetCab: roadshow, marketing toolkits.*

3. Further investigate the use of Google Earth type applications. *GEONetCab: capacity building web, marketing toolkits.*
4. Complete the inventory of successful modes of delivery for capacity building, minimizing the constraints of limited internet access. *GEONetCab: capacity building web, marketing toolkits.*
5. Further investigate the future possibilities of GEONETCast and related systems for capacity building and gaining access to new target groups. *GEONetCab: roadshow (such as the joint visit with VITO to international organizations in Washington in 2011), capacity building web, success stories, toolkits, coordination with GEONETCast related projects.*
6. Provide general marketing for earth observation applications, directed at the end-user target group, including decision-makers, especially paying attention to capacity building opportunities. *GEONetCab: all project activities.*
7. Alert the earth observations community to funding opportunities. *GEONetCab: resulting from roadshows, coordination with GEO Secretariat.*
8. Identify and collect success stories (in terms of income generation, sustainability, potential for replication, spin-offs from research, etc.). *GEONetCab: success stories.*
9. Provide feedback to the GEO community to ensure good synthesis in system development (involving end-users). *GEONetCab: all project activities.*
10. Develop promotion material targeted at the donor community. *GEONetcab: roadshow, success stories, references available at the capacity building web.*
11. Promote certification of short courses and compatibility between the systems used by major capacity building providers. *GEONetCab: continue dialogue to find best practice, capacity building web.*
12. Organize a workshop on performance indicators for capacity building in earth observations. *GEONetCab: originally planned as project activity, but to be determined in accordance with new monitoring and evaluation structure and GEO Work Plan 2012 - 2015, see discussion above.*
13. Provide the GEONetCab website (and the GEO Portal) with information on capacity building, open-source software, success stories, funding opportunities and certification of courses. *GEONetCab: capacity building web, to be integrated with GEO Portal.*

The proposed strategy is checked one last time, based on the following questions:

- What happens when we apply this strategy to ourselves? (reflexivity)
- How would we react if others approached us with this message, would we adopt earth observation solutions? (symmetry / role reversal)
- What happens if we have sudden and unlimited success in capacity building and promotion?
- What happens if we do not take action or we completely fail to get results?

The issue of reflexivity is clear: there should also be capacity development and a learning effect in the GEO community (as well as for the project partners themselves). It is the task of the GEONetCab project to make implicit knowledge on capacity building and promotion of earth observation explicit and to provide feedback on experiences with external stakeholders with the aim to achieve better understanding and compatibility of solutions.

The symmetry question is a bit more difficult to answer, as our position in the matter is not neutral: we would probably be receptive to new solutions, as long as could be proved that they are of economic and/or societal benefit, are reliable, little risk is involved in adopting the technology or method, little investment upfront is needed, it has the prospect of becoming the solution of the future, it is not complicated, and is easy to use. Then there are of course some less rational, but not less important, considerations, related to prestige and rivalry (as our experience with success stories has shown).

In the case of sudden and unlimited success, GEO, GEOSS and capacity building providers would have tremendous difficulties in satisfying demand. Taking this into consideration, a more gradual uptake is preferable, as it will take a few years to fully develop the GEOSS common infrastructure as well as better modalities for capacity development.

Finally, if no action at all is taken, adoption of earth observation solutions will probably still take place, but at a much slower pace, meaning a lot of potential benefit will be lost. If the mission is a complete failure, at least there will have been lessons learned, thus helping avoid repetition of mistakes in future initiatives, and increasing knowledge about the capacity building as well as promotion experience. To (mis-)quote Schopenhauer: "So hat z.B. meine Philosophie nie etwas eingebracht, aber sie hat mir sehr viel erspart".[2]

Although the worst-case scenario does have to be taken into account, the GEONetCab capacity building strategy is designed to achieve the opposite. The focus on the triangle of local communities, decision-makers and earth observation professionals, and the marketing mix of quick-win activities, success stories, marketing toolkits, roadshow, and the capacity building web, will definitely enable the project to achieve its aims: successful capacity building and promotion of earth observation.

[2] Aphorismen zur Lebensweisheit, 'My philosophy, for example, never has rendered anything, but has spared me a lot of trouble'.

APPENDICES

APPENDIX 1 - CAPACITY BUILDING: EXISTING AND POTENTIAL MARKETS (FROM GEONETCAB REPORT MARKETING OF EARTH OBSERVATION PRODUCTS AND SERVICES, PART # 1)

5. CAPACITY BUILDING: EXISTING AND POTENTIAL MARKETS

Opportunities and the role of marketing

Earth observations are now at the *verge* of becoming accessible to a whole new group of end-users. Applications have matured and are ready for the market. The authors are even convinced that general applications of earth observations will occur even if marketing efforts are not undertaken, but also realize that this may take a long time. It is necessary and beneficial to society to speed up the process and this involves making contact with new groups of end-users. The community of earth observation users has grown from a limited group of specialists to a broader community. Now is the time to facilitate the use of earth observations further, and accelerate its integration in regular organizational processes. To do this it is necessary to reach out to new groups of users and decision makers. To give an example: if one looks at the millennium development goals (MDGs), it is difficult to establish a direct relation between the individual goals and earth observations. But if one analyzes the individual goals and the whole process further, it becomes evident that earth observations can provide much added value. To make this clear is one of the aims of this project.

Another very important aspect is the *involvement* of the new group of end-users. This does not only entail a technical capacity to deal with earth observation applications, but also a sense of ownership that makes it possible to empower these new groups of end-users. For example: drinking-water projects in developing countries can be implemented as a strictly technical exercise, but may also be used to improve the organizational capability of villages and neighbourhood groups and to create new dynamics of development. The latter aspect could be even more important.

For successful application of earth observations for and by new groups of users it is important to look critically at the *'weakest link'* aspect. This is achieved by analyzing the whole supply chain from provider to end-user. In earth observation terms this means that products and services should provide an adequate temporal, spatial, radiometric and spectral resolution and that they are reliable, sustainable, affordable and easily adoptable.

The instruments to help achieve this are capacity building and brokerage forming the main objective of this project. Capacity building[3] is defined here simply as 'learning and being capable of doing something new and relevant to a previously defined purpose' and brokerage is defined as 'linking

[3] Sometimes it is useful to subdivide capacity building into human resources development (supply of technical and professional personnel), organizational strengthening (increase management capacity of organizations) and institutional strengthening (increase the capacity of organizations to develop and negotiate appropriate mandates and modus operandi, as well as appropriate (new) legal and regulatory frameworks (Georgiadou and Groot, 2002).

providers and (potential) users of a product or service'. Consequently, marketing is just capacity building and brokerage put together. It also implies that the process works both ways: marketing is not only 'selling' a certain product or service to clients, but also interaction with the earth observation community to find better ways of serving the client community. To summarize: marketing involves selling earth observation applications as well as providing feedback about client needs for earth observations.

Trends

The key to a successful approach to capacity building is extending the existing capacity[4]. To do that the existing capacity in earth observations has to be assessed. This is not an easy task, as earth observations are not only integrated in geo-information, but (like geo-information) are embedded in many different disciplines. As described in section 3, the inventory based on the simple UML-model provides a first insight and forms the basis for further development and refinement (work package 3.5.1). Still, some trends can already be distinguished and are described below.

In many cases applications of earth observations are still in the initialization, design, prototyping or system development phase. Markets (and funding opportunities) are therefore not well developed yet. Market studies, such as the remote sensing study by Global Insights/NOAA for North and South America, Asia, Africa, Europe and Australia show a continued upward trend in remote sensing data use and predict strong growth for the remote sensing sector. This is confirmed by other studies, even when the current economic crisis is taken into account. If the market really expands, there will be an accompanying strongly growing demand for capacity building.

A preliminary analysis of the available data shows some of the trends in capacity building needs for earth observations. The base flow consists of a regular need for professionals in geo-information, both in the technical substrata, such as cartography, surveying, visualization, database management, web services, spatial data handling, and geo-statistics, and in applied disciplines, such as water and natural resource management, agriculture, urban planning, earth sciences, meteorology, oceanography, and land administration. This need ranges from the vocational/technologist level to the masters/PhD level. There is not much information available and the situation differs per region, but the general assumption is that in most developed countries there is a steady, slow growing, but limited number of job opportunities available. In developing countries and emerging economies the situation may be different. Once a certain level is reached it is assumed demand will stabilize. Ball park figures for a developed country with a mature geo-information market are 3 – 5 geo-professionals per 10,000 inhabitants with a 20-40-40 ratio between university, polytechnic and vocational. The regular annual inflow needed to match demand and supply is estimated at 5 – 10 % of the total geo-information workforce. The demand is usually served through the regular educational system of the country concerned.

The other trend is that there is a need for short courses at all levels to familiarize professionals of all types with earth observation and its applications. This ranges from short courses for engineers or

[4] Building on capacity, Molenaar en Beerens, 2005

geographers with different backgrounds, to refresher courses for geo-information specialists (to keep up with developments), to seminars and workshops for decision makers. As mentioned above, the potential demand for this type of capacity building is huge, as the benefits of earth observation applications become more and more apparent. The number of different subjects is also substantial as the discussion on the different Societal Benefit Areas in section 6 will show. This demand is partly addressed by the regular educational system and partly by specialized organizations and/or special initiatives in a project or program format.

To successfully cater to this growing demand for capacity in earth observations and create a truly international dimension, issues such as certification of training, cross-border recognition of diploma's and certificates, and quality assurance become very important. This is of course a very ambitious exercise; within the framework of GEO various workshops have been organized to address the issue of cross-border recognition. The first step should be certification of international short courses on earth observations, allowing for all big players to keep or establish their own systems, but at the same time ensuring coordination and compatibility (a 'GEOSS within GEOSS' for capacity building).

The GEONetCab capacity building web would be the home base for this 'capacity building GEOSS' within GEOSS, forming a node within the GEO Portal network. This website should provide as much material as possible for free, and accompanied by references to other sites with training materials. Partners, including the GEONetCab project partners, are strongly encouraged, but not obliged, to provide capacity building material at no cost. As the recent example of the Massachusetts Institute of Technology has shown, the trend is to disclose the curriculum and contents of lectures to the general public, as the most prized commodity of educational and research institutions is not their material, but their intellectual capacity.

Global and regional aspects

The general components of capacity building initiatives are technical assistance (such as advice, and curriculum development), facilities (buildings, equipment and instruments, hard- and software, library, etc.), training, joint research, and general management. The modalities for training range from seminars, distance education, tailor-made courses, regular short courses, and diploma courses (technologist level) to BSc, MSc, and PhD education. These activities are usually directed at professionals and students. In some countries[5] the education of geo-information also receives attention in secondary schools, or even in primary schools. From this variety of capacity building tools, the best packages have to be composed to address different problems and target groups. It is clear that a 'one-size fits all' approach will not offer the optimal solution. An important aspect to keep in mind is that capacity building, certainly in the form of institutional strengthening, is a long-term process: the common perception is that the time it takes to start a program almost from scratch and to develop it into a sustainable program with (joint) research is about 10 – 12 years[6].

[5] Such as in Rwanda with support from ESRI.
[6] Common experience of IRD and ITC.

There are quite a number of capacity building initiatives and programs under implementation worldwide. Long-term players in global earth observation capacity building are the regional centres, resorting under the United Nations office for outer space affairs (UN-OOSA):

- the centre for space science and technology education in Asia and the Pacific (CSSTEAP) in India;
- the African regional centre for space science and technology education in English (ARCSSTE-E) in Nigeria;
- the African regional centre for space science and technology education in French (CRASTE-LF) in Morocco; and
- the regional centre for space science and technology education in Latin America and the Caribbean (CRECTEALC) in Brazil and Mexico.

Capacity building by CRASTE-LF

For more than 10 years, the African regional centre for space science and technology education in French (CRASTE-LF) in Morocco has provided training at masters and practical level for the French (and Portuguese) speaking African region. Through cooperation with organizations that work in the field of earth observations (UN-OOSA, ESA, CNES, Eumetsat, USGS, NOAA, WMO, WHO, etc.) and organizations in the region (ACMAD, AGRIMETH, CRTS, DMN, ASAL, CNTC, CENATEL, etc.) CRASTE-LF has promoted application of the latest developments in earth observation for development. CRASTE-LF now has more than 1,000 alumni, all active in application fields such as irrigation, urban planning, mining, and of course education.

Examples of other knowledge institutions long since catering to a worldwide public are ITC (faculty of geo-information and earth observation, university of Twente) in the Netherlands and ISU (international space university) in France. In Africa the regional centre for training in aerospace surveys (RECTAS) in Nigeria, and the regional centre for mapping of resources for development (RCMRD) in Kenya, play an important role.

As these examples show, it is difficult to do justice to all the existing and planned capacity building initiatives in earth observation. The project will therefore create an interactive web-facility, linked to the GEO portal, that provides information on and links to as many capacity building initiatives as possible (work package 3.5).

The following list just shows the great variety of initiatives that exists: ITC's joint education program, DLR's capacity building initiative, ESA's space education for kids, JAXA's mini projects coordinated by AIT, the EnviroGrids project for the Black Sea catchment, the SEOCA project for Central Asia, tutorials for personalized geo-information on Google Earth, the CAPaBLE program for Asia/Pacific, etc.

Different regions experience different problems and challenges. Europe, North America and Australia struggle to find enough students interested in technical subjects such as space science and earth observations, while for example in large parts of Asia there is a huge interest in these subjects. In many parts of the world funding is available and the choice for investment in earth observations capacity building is one of allocation, while in most parts of Africa there is a general shortage of resources.

This is precisely the reason why Africa receives special attention in earth observation capacity building, also by means of this project. Some examples of ongoing efforts in Africa are: IRD/CNES programs, ITC's joint education programs, SERVIR, TIGER, AMESD, national programs and programs funded by multi- and bilateral donors. South-south cooperation is also becoming more and more important. Most of these initiatives are supported by different fellowship programs facilitating capacity building in earth observations (and many other subjects) by sponsoring a study abroad.

Another preliminary observation that applies to most countries in Africa is that there is an overall shortage of capacity, but that, on the other hand, the number of professionals and scientists trained to PhD and MSc level is relatively high. This is confirmed by the work these highly skilled professionals (have to) do in practice. There is a huge need for professionals at technologist level. This is confirmed by the demand for existing courses at this level[7].

Earth observations education in the Czech Republic

Earth observation education is a key element in the process of EO capacity building. Not only university educated people, but also high school and elementary school students and a wide range of public employees should be able to use EO data and tools. For this purpose several successful activities have been developed by Charles University, Faculty of Science:

1) CITT-ESF project: 2,000 people trained in GIS, GPS and EO and study materials published and disseminated;
2) Education at high schools using LEOWorks software;
3) Earth observation lessons on the basic principles of EO and data source possibilities for high schools and management of national parks;
4) Publications and practical information about EO in a popular geographical magazine for high schools and elementary schools (teachers and students); and

[7] Such as the 9-month technologist courses in geo-informatics given by ITC and partners in Tanzania and Ghana.

5) Preparation of an Academy of Geoinformatics Skills in cooperation with the Ministry of Education.

The European Space Agency is a strong partner in educational activities. Through this range of activities target groups such as students, teachers and public administrators have been reached and interest is created in investing in long-term capacity building.

Link with GEO capacity building tasks

Within GEO are the following GEO capacity building tasks:

CB-09-01 'resource mobilization (Seville roadmap)'
There is an overlap with this project, WP 3 (connecting and building), 4 (awareness and dissemination) and 5 (evaluation and follow-up for brokerage) basically cover this task.

CB-09-02 'building individual capacity building in earth observations'
The project has a link with subtask a) 'recognition of cross-border education' through WP 3.5 (capacity building web). Subtasks d) 'CBERS/GEO network' (WP 4) and g) 'GEONETCast training' can be used as success stories.

CB-09-03 'building institutional capacity building in earth observations'
There is definitely a link with the task in general, although the project does not link specifically to any of the current subtasks.

CB-09-04 'capacity building needs and gap assessment'.
WP 1 (inventory) and 2 (bottlenecks and opportunities) of the project should deliver the results for subtask a) 'identifying best practices, gaps and needs'. There is a link with b) 'capacity building performance indicators': a workshop on the subject is planned in WP 4. The IOC principles for capacity building report and BGR capacity building in GEOSS document are used as reference for this subtask.

CB-09-05 'infrastructure development and technology transfer for information access'.
The project has links with the task in general, but not specifically with any of the current subtasks.

CB-10-01 'building capacity through outreach and awareness raising'.
There is a link with WP 4 of the project.

There is also a relation with GEO-tasks ST-09-01 'catalyzing R&D funding for GEOSS' and US-09-01 'user engagement'. The results of this study and future actions resulting from the project will be shared and, where applicable, carried out jointly with the coordinators of these tasks.

Analysis of bottlenecks and needs

The analysis presented below is based on the issues relevant to capacity building indicated in section 4. Each constraint and need is dealt with and further treatment in relation to SBAs is taken up in the

next section. Action points for the GEONetCab are formulated to reach the end-user ('last mile' aspect) and to remove bottlenecks and satisfy needs ('weakest link aspect').

Initialization

High costs of software licenses (use and development of open-source software needed)

This constraint affects developing countries most and can be removed by making use of free or low-cost software. There are a number of free packages available, such as GRASS, SPRING and ILWIS, that are accessible, free and available in different languages. The market leader in geo-information software, ESRI, sponsors activities in developing countries. For instance, ESRI not only provides free software to ITC graduates, but also to ITC's education partners in developing countries and their graduates. Also, more and more people are getting familiar with web-based initiatives such as Google Earth and quite a number of manuals and tutorials have been developed to facilitate use for specific purposes.

Action points for the project:

1. *Complete the inventory of open-source software and make an action plan for increased use for different purposes with partners in developing countries.*
2. *Approach major providers of geo-information software to discuss increased support for capacity building initiatives with the aim of market development.*
3. *Investigate the use of Google Earth type applications further.*
4. *Put the opportunities derived from actions 1 – 3 on the GEONetCab website (as part of the capacity building web) and create a link with the GEO Portal.*

Easy and fast internet access is lacking (sufficient bandwidth needed)

Again, this constraint is most severely felt in developing countries, often accompanied by the more traditional problem of power outages. New modes of delivery of data and capacity building material in the form of, for example, the GEONETCast initiative, can help solve (parts of) this problem. Distance education by satellite is already applied successfully in several countries, for instance in India (ISRO/IIRS). As long as easy and fast internet are not readily available, other modes of data distribution have to be considered, such as through CDs. ITC, for example, uses a combination in its distance education courses (with participants all over the world): the software, course material and data are sent by courier (on CD) and the actual communication during the course is done through the internet.

Action points for the project:

1. *Complete the inventory of successful modes of delivery of capacity building that minimize the constraints of limited internet access.*
2. *Further investigate future possibilities of GEONETCast and related systems for capacity building and gaining access to new target groups.*
3. *Put the opportunities derived from actions 1 – 2 on the GEONetCab website (as part of the capacity building web) and create a link with the GEO Portal.*

Insufficient capacity building resources to provide a sustainable human resource base

This is a general constraint that is being addressed by GEO and other initiatives. If the other capacity building constraints are removed and the needs are satisfied, then this problem will also be solved.

Lack of infrastructure to access, use and develop EO data and products (infrastructure for data access, analysis and distribution needed)

This is again a general constraint, addressed by GEO and other initiatives. The problem is tackled in two ways: on the one hand more and better infrastructure is provided, on the other hand ways are sought to provide cheap, easy to use and robust alternatives (see the GEONETCast example).

SPOT 5 multi-user government licence, South Africa

Access to data is a major bottleneck in the usage of Earth Observations (EO). This is especially a big challenge for Africa. Low-cost access to Landsat improved the situation. However, access to high-resolution data is still a major problem. South Africa is not immune to this problem.

Various government agencies in South Africa formed a partnership to source high-resolution data, with the CSIR Space Application Centre in a brokering role. An agreement was made with Spot Image, for a multi-user government licence for Spot5 data.

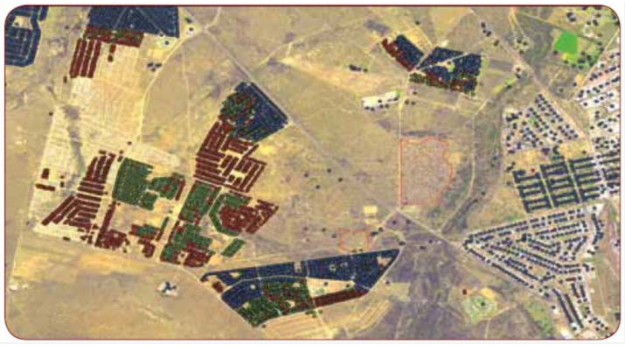
The project ran for a total of 5 years and provided the following added value:

- Cost reduction on data access;
- Data available at project level and annual coverage of the whole country;
- Access to high resolution data (from 30m to 2.5 m);
- Enhancement of processing capability.

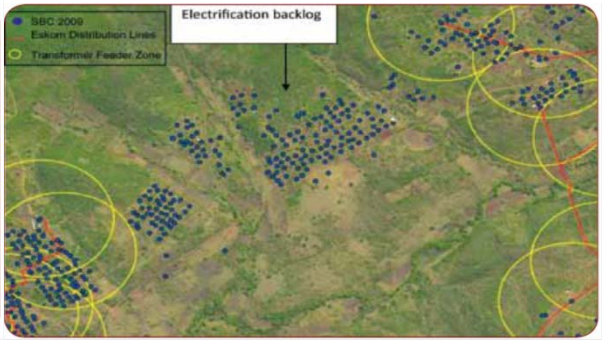
The Eskom Spot Building Count (SBC) project presents a typical example:

Eskom, the South African power utility, used the Spot5 data to map built-up areas. Through the capturing process using Spot5 data, different classes were classified (dwellings, schools, hostels, townhouses, mines, resorts, dense informal settlements, industrial and commercial structures). Eskom has made the 2008 SBC dataset available to all government departments and research and academic institutions at no cost.

"The availability of Spot5 multi-user license has enabled Eskom to continuously (yearly) update the SBC, which Eskom uses for electrification planning, load forecasting studies, electrification backlog, identification of fast growing areas and growth trends amongst others." Nale Mudau, Eskom



Updated SBC base layer – 2006 (blue), 2007 (green) and 2008 (red)



SBC 2009 update showing buildings (blue points) outside the transformer feeder zone (yellow circles)

Heavy financial constraints in general (boundary conditions)

This is the perennial constraint for all activities and requires a combination of marketing and demonstrating added value.

Action points for the project:

1. *Provide marketing for earth observation applications (general task of this project).*

2. *Alert the earth observation community to funding opportunities.*
3. *Identify success stories in terms of income generation and sustainability.*
4. *Put the opportunities and information derived from actions 1 – 3 on the GEONetCab website (as part of the capacity building web) and link them to the GEO Portal.*

System analysis and design

Insufficient collaborative research for and in developing countries

This constraint has several different aspects. Firstly, in developing countries there is a lack of absolute research capacity. Secondly, developing countries are not perceived to be an interesting market for targeted solutions. And thirdly, when an effort is made, products and services are usually one-to-one copies from other environments and consequently not suited to the particular situation on the ground. Most emerging economies went through this stage and have managed to establish a good research environment (EMBRAPA in Brazil is often used as an example). Apart from supporting all aspects of capacity building, showing the possibilities of building research capacity from within may help.

Action points for the project:

1. *Identify and collect success stories from emerging economies and developing countries in setting up a research culture for country-specific solutions[8] in earth observations.*
2. *Put the success stories on the GEONetCab website (as part of the capacity building web), link them to the GEO Portal, and use them for the dissemination toolkit.*

Low rate of introduction and incorporation of EO courses in the regular curricula of higher learning institutions (universities)

This general constraint is addressed by GEO and other initiatives. General promotion and capacity building activities will remove this bottleneck, as earth observations will become more popular and mainstream.

Rapid prototyping

Need for more focus of capacity building and research on development of prototypes of EO operational models and products

The need for more focus on development of prototypes is very much related to the need for setting up a good research environment. The actions relating to the project are therefore the same.

System development

Insufficient linkage between stakeholders, user communities to determine a research agenda and CB requirements (based on common interest), resulting in uncoordinated initiatives without common vision, common purpose or joint action

This constraint is very important. It is one of the main objectives of GEO to improve the link between all stakeholders. Regarding reaching the user community great progress has been made. The next step is the involvement of end-user communities, which are not necessarily earth observation oriented.

[8] And also for development of prototypes (see below).

Action points for the project:

1. *Ensure that all the promotion material developed by the project is directed at and intelligible for the end-user, including decision makers.*
2. *Ensure that the capacity building opportunities identified and highlighted by the project are accessible to and brought under the attention of the end-user, including decision-makers.*
3. *Provide feedback to the GEO community to ensure good synthesis in system development (i.e. end-users, including decision-makers, are also involved in products and services development).*

<u>Inadequate promotion and dissemination of achievements, capabilities and opportunities at various levels of decision-making</u>

This is one of the great impediments hampering the general acceptation and adoption of earth observation applications by a wider public. GEO has been instrumental in addressing this constraint in general and has put earth observations on the map. Now it is time to take a next step and increase the promotion and dissemination to specific target groups (see also section 6). The corresponding increase in interest will also lead to new opportunities for capacity building.

Action points for the project: see above at 'insufficient linkage…'.

<u>Promote the participation of research communities into established programs of EO research and technology development</u>

GEO has made great headway in achieving this and the GEO process is a catalyst in itself ensuring research participation dynamics.

Action points for the project: see above at 'heavy financial constraints…'.

<u>Develop or enhance EO capacity and EO curricula at universities and other tertiary institutions (scientific level); promote training of trainers to keep pace with changing environments and technology (refresher and vocational level)</u>

This need is most pressingly felt in developing countries. Institutions with a mission towards both development cooperation and earth observations, such as the UN centres mentioned above, are addressing this need. There is quite a range of initiatives, but in general it is difficult to convince the donor community of the direct relevance of earth observation for development as the subject does not clearly match any of the established support categories.

Action points for the project:

1. *Provide links to existing EO curricula and free material through the GEONetCab website.*
2. *Develop promotion material targeted at the donor community to show successful earth observations and create interest in investing in capacity building and system development for earth observations.*

ITC's joint education program

ITC is an international education institute established in 1951 with the express purpose of training midcareer professionals from organizations in developing countries. What started as training in aerial photography, photogrammetry and cartography, has evolved over the years into training in GIS and remote sensing and how to apply these technologies and techniques to various fields, such as urban planning, natural resources management, and the like. The professionals that came for training were groomed to become the backbone of national organizations in the field of geo-information science and earth observations, from Ministries, survey and mapping organizations, universities, and training schools to NGO's..

Being an institute for postgraduate training, ITC offered a broad range of courses at Diploma and Master of Science level. Most students opted for MSc courses with a duration of 18 months. Thousands of students came to the Netherlands, studied for one and a half years, and returned to their home country with a degree. But over the years, changes in the world's society have resulted in changes in the demand for ITC's products and services, particularly education. Client organizations have indicated that mid-career professionals in important decision-making positions, or with the potential to grow into such positions, have difficulty finding time to be away from their work and home for extended periods.

In response to this increasing demand for flexibility in courses, ITC has entered into partnerships with reputable qualified educational organizations for the purpose of providing joint courses in several countries. Under this arrangement, (part of) a course leading to a recognized ITC degree, diploma or certificate can be conducted in the student's home country. These courses are called Joint Education Programmes or JEPs. To give an example, in China ITC and Wuhan University cooperate in a joint M.Sc. course on urban planning and management. Students spend the first 6 months in Wuhan, where they will be taught the basic introductory modules on GIS and RS, as taught at ITC. Then they transfer to ITC for 6 months to participate in some specialized modules and write a thesis proposal. After that, they return to Wuhan to undertake their research, write their thesis and take the examination. The examination board includes an ITC professor. If the student is successful, he/she will be issued with a double degree, i.e. from both ITC and Wuhan University.

ITC first embarked on its JEPs in 2002. At present, 15 joint courses are in progress and three are under development. The JEPs are operational in countries such as Ghana, Kenya, Tanzania, Nigeria, China, Vietnam, Indonesia, India, Iran, Bolivia and Mexico. Through these JEPs, ITC has a much wider outreach than would be the case if it only provided courses and programmes in The Netherlands.

JEPs: KEYS TO SUCCESS

- Developed in response to customer demand;
- Close cooperation with established local institutions;
- Tailored to the need of the country;
- Cheaper to offer and run.

JEPs: APPROACH

- Select a partner (through a SWOT analysis of national universities);
- Jointly draft a Curriculum Development Plan;
- Write and agree on the Business Plan;
- Undertake a Training of Trainers programme;
- Implement the joint course.

JEPs: IMPLEMENTATION STRATEGY

- Obtain proper accreditation;
- Ensure embedding in the national higher education system;
- Most importantly, use marketing to ensure a steady influx of students.

Implementation

Lack of performance indicators, standards for accreditation, and certification procedures for education in the field of EO (and for the use of EO in general)

This is also a general constraint for capacity building. The issue is addressed by GEO through the subtasks on cross-border recognition and performance education. An additional difficulty is that this is not only a problem for earth observation education, but for international education in general. The worldwide problem is too big to tackle with GEO, let alone the GEONetCab project. The project therefore focuses on those elements that really stand in the way of capacity building for concrete applications, starting with short courses.

Actions for the project:

1. *Promote the use of certification for short courses on earth observation and promote compatibility between the systems used by major capacity building providers.*
2. *Put the certification results, or at least the acquired capabilities, of the different courses on the project website.*
3. *Organize a workshop on performance indicators for capacity building (WP 4), focusing on bottlenecks and needs to ensure successful applications of earth observations.*

Institutionalize CB to support proficiency in the development of EO applications and awareness of new applications

Traditionally this is one of the main bottlenecks in capacity building. In a lot of projects and programs capacity building is included and it often forms an important component of the initiative, but during the implementation phase it becomes an afterthought covered only (partly) at the very end. The GEO capacity building committee aims to achieve institutionalization of capacity building for earth observation. The contribution of the project to achieving this aim is highlighted by the actions presented above.

A common information platform is essential to assure cooperation between the different thematic networks and cross-cutting activities sharing EO data, technology and knowledge

The GEO Portal aims to be this common information platform. The goal is to direct customers through its network of networks to the right place at the right time. To accomplish this for capacity building is one of the main tasks of the GEONetCab project. The project website, linked to the GEO Portal, provides the common information platform. The different activities related to the website are presented above.

GIDEON – geo-information facility for The Netherlands

All public sector parties in The Netherlands which have the responsibility to gather, manage and use geo-information, have started to collaborate on a joint key information facility. This facility, called GIDEON, is to be completed by the end of 2011. The first initiative to set-up a national data infrastructure in The Netherlands started about 20 years ago.

For the government, geo-information provides plenty of opportunities for improving communication and interaction with the public and businesses. The Netherlands has an excellent knowledge base and a wealth of high quality geo-data suppliers and services. However, clear national guidelines and coordination have been lacking, which leads to fragmentation of the geo-data. Data are sometimes hard to find, the costs of use are relatively high, and the conditions for use vary greatly and are often restrictive.

Through GIDEON:

- The public and businesses will be able to retrieve and use all relevant geo-information for any location,
- Businesses will be able to add economic value to all relevant government-provided geo-information.
- The government will use the available information for each location in its work processes and services.

GIDEON's structure is formed in accordance with the principles set down in the INSPIRE framework directive. The Ministry of Housing, Spatial Planning and Environment is managing the GIDEON implementation strategy.

Post-implementation

Promote networking and capacity building (refresher courses) at all levels, especially cooperation between developing countries

This need is addressed by the GEO process in general and in particular through the work on capacity building. The planned creation of a GEO capacity building network group on Facebook is an example. Through the GEONetCab project website, its promotion activities and the continuing flow of information on success stories, updated information is provided on capacity building and new developments. The specific activities are already presented under the previous headings.

As mentioned above, the integration of earth observation in the business process of organizations is the determining factor for interventions in capacity building. To do this successfully, not only the supply side will have to be analyzed (existing capacity building and efforts to improve the existing capacity), but also the demand side: actual and potential needs emanating from the business process. The next section gives a first overview.

APPENDIX 2 – SUCCESS STORIES: EXAMPLE

GEONETCAB

SUCCESS STORIES

LONG TERM ECOLOGICAL MONITORING OBSERVATORIES NETWORK
ROSELT/OSS

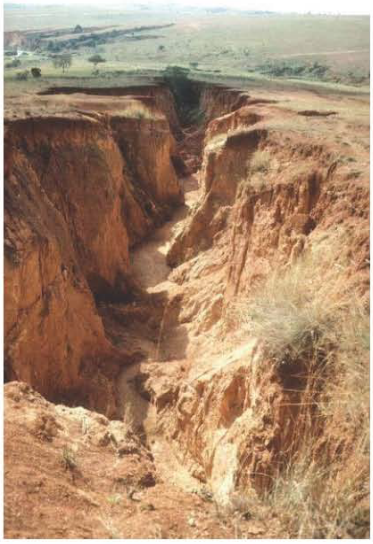
The ROSELT/OSS program, set up by OSS and coordinated by IRD from 2000 to 2005, aims to improve knowledge of the mechanisms, causes, consequences and scope of desertification in arid and semi-arid zones of the circum-Saharan area.
It consists of 25 observatories spanning the circum-Saharan region and is located in 11 countries (Algeria, Cape Verde, Egypt, France, Kenya, Mali, Morocco, Mauritania, Niger, Senegal, and Tunisia).

The fundamental objectives of ROSELT/OSS are:

- **To ensure long-term environmental monitoring:**
  - ✓ Use and enhance existing knowledge,
  - ✓ Set up a harmonized environmental monitoring system (harmonization of data to be measured and / or observed within the observatories, of sampling and data collection methodologies, of information processing methods),
  - ✓ Assure the sustainability of the monitoring system: a low-cost environmental monitoring system, institutional presence in national policies, reinforcement of the countries' technical and scientific capabilities.

- **To establish a research platform for desertification studies:**
  Better understanding of the interactive functions between populations and the environment at local level, in particular the influence and interactions of climatic and anthropological variations in land degradation.

This strategy is part of a hierarchical and participatory approach, that focuses on local and sub-national levels and that satisfies a need at national, sub-regional and regional levels in a coherent manner. It also takes the characteristics and particularities of the geographic region of the OSS (eco-climatic, socio-economic and cultural) into account.



ROSELT/OSS : 4 KEYS TO SUCCESS

♠ SUSTAINABILITY:
Involvement of international organizations; subscription to the Rio declaration and to Agenda 21 (conventions on bio-diversity, climate change and combating of desertification).

♣ FEASIBILITY:
Low-cost compared to conventional environmental monitoring with the same accuracy and coverage. Harmonisation of public policy and environmental monitoring practices.

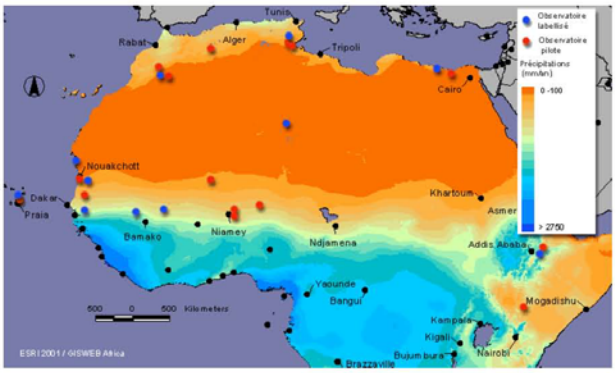
♦ REPLICATION POTENTIAL:
25 observatories are participating in 11 countries, funded through a combination of international and national funding.

♥ SOCIETAL BENEFIT:
Decision-making aids for policy making and adaptation related to climate, vegetation and land cover, land and soils, resources and resource use, biodiversity, and ecosystems.

OUTPUTS AND SERVICES

DECISION MAKING TOOLS

The term "ROSELT decision making aids" refers to spatial and other data and information that is designed to support decision-making tools for development planners at local level (the scale of the areas of the observatories), and at subregional and regional level (the scale of the circum-Saharan area). Support at national level has to be combined with the development of national environmental monitoring networks in the framework of the NAP / CCD .



Long term environmental monitoring consists either of analyses of time series of data, with a periodicity that is compatible with the dynamics of environmental changes (5-10 years), or of continuous observation of pertinent factors that highlight these changes (seasonal or annual periodicity). ROSELT/OSS proposes to combine these two approaches by delivering the following output:

- ✓ A description of the initial characteristics of the region,
- ✓ Genaration of analytical indicators from the interactive system of environmental resources and use of the environment,
- ✓ Scenario development.

MONITORING DATA

These data are for the most part gathered on the ground (measured and / or observed, in raw state), and are generally supplemented by remote sensing data as part of a long-term monitoring process.

The data constitute the basis of the output of the ROSELT/OSS observatories, through the processing of information that is most directly linked to the phenomenon observed or measured. The data also serve as components or parameters that are integrated into the information processing tools, and of the spatial models of the processes under investigation, leading to the development of ROSELT/OSS decision-making aids.

METADATA SERVICE

The aim of the data catalogue is to provide online access to references (metadata) to historical and current data collected or elaborated by the ROSELT network observatories.

Decision-making aids, such as desertification risk maps are provided through the LEIS tool (local environmental information system): up to now samples from the Ferlo (Senegal), Menzel Habib (Tunisia) and Dantiandou (Niger) observatories are available.

Full operationality will be achieved when this catalogue will reflect all the data catalogues of the network, elaborated in each observatory, together with references to general Circum-Sahara maps (elevation, soils, vegetation, rainfall, etc.).

IRD - Unité Espace
Maison de la Télédétection
500, rue Jean-François Breton
34093 Montpellier cedex 5
Tel: +33 4 67 54 87 05

http://prog.oss.org.tn/roselt/

APPENDIX 3 – MARKETING TOOLKITS: EXAMPLE OF FRONT PAGE

Earth Observation for Disaster Management Toolkit

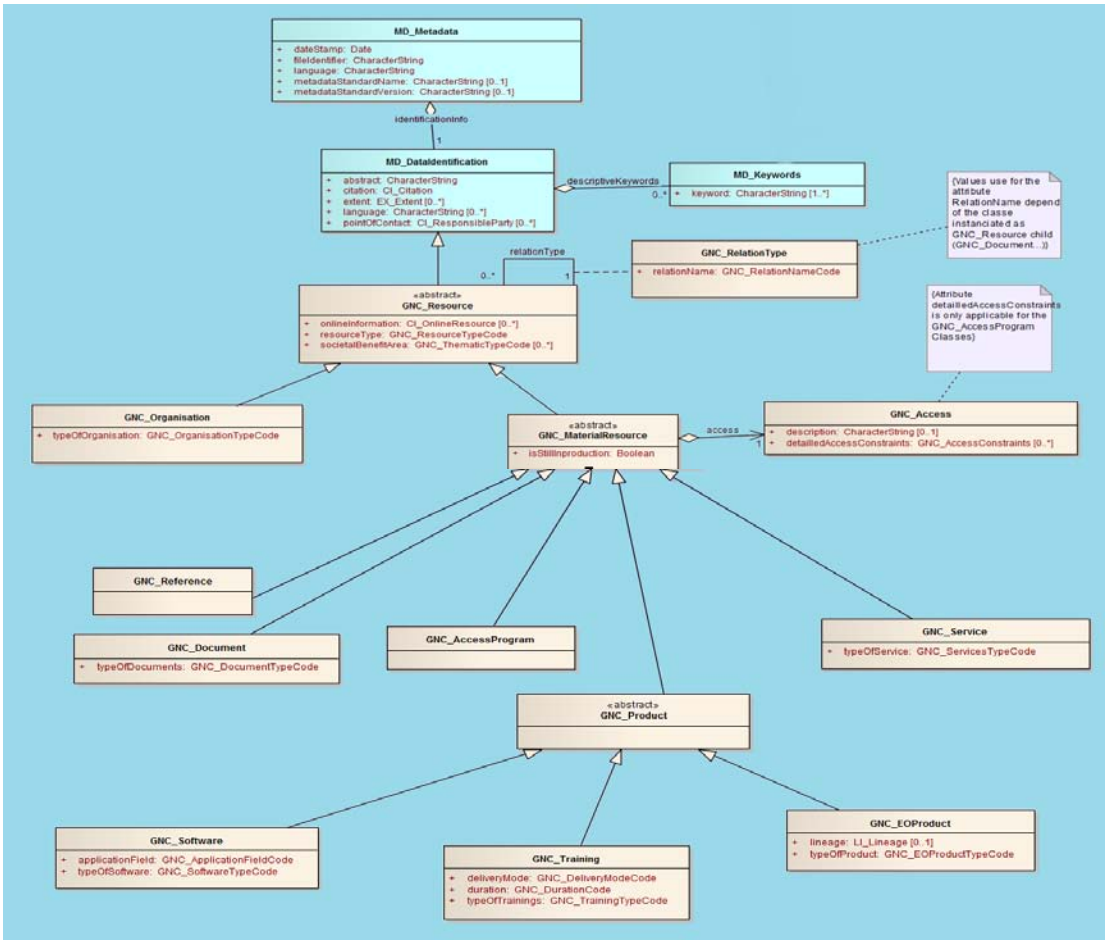
International trends & developments

How to promote earth observation applications?

How to get funding?

Capacity building?

APPENDIX 4 – CAPACITY BUILDING WEB: MODEL



APPENDIX 5 – LITERATURE LIST

African Capacity Building Foundation (2011). *Africa Capacity Indicators 2011, capacity in fragile states*.

Akinyede, J.O. and Adepoju, K.A. (2010). *Prospects and challenges of building capacity for space science and technology development in Africa.* ISPRS Commission VI mid-term symposium, Enschede, 2010

Altalo, M.G. et al. (2003). *The business case for the global observing system.* Oceanography, vol. 16, no. 4/2003

Atilola, O. (2007). *Geo-information, employment and knowledge economy in Africa.* Presentation. CODI-V, Addis Ababa, May 2007

Australian Academy of Science, Australian Academy of Technological Sciences and Engineering (2009). *An Australian strategic plan for Earth Observations from space*

Bakker de, M. (2010) *25 Years of experience with "cross-border" geo-information education. How can we improve?* ISPRS Commission VI mid-term symposium, Enschede, 2010

Baser H., Morgan, P. et al. (2008). *Capacity, change and performance. Study report*. European Centre for Development Policy Management

Beatson, M. et al. (2010). *The space economy in the UK: an economic analysis of the sector and the role of policy.* BIS Economics paper no. 3.

Blokland, M.W., Alaerts, G.J., Kaspersma, J.M., Hare, M. (Editors), (2009). *Capacity development for improved water management.* UNW-DPC, UNESCO-IHE

Bloom, E., Reeves, M., Leonard, A. (2009). *The network value chain.* Capacity development briefs, February 2009, no. 30. World Bank Institute

Boeren, A. (2005). *A bird's eye view: lessons from evaluations of international cooperation programmes in higher educations, research and manpower development*. Draft. NUFFIC

Brown, G. (2011). *Educating for all: beating poverty, unlocking prosperity.*

Canadian Council of Land Surveyors, Canadian Institute of Geomatics, Geomatics Industry Association of Canada (2001). *Geomatics sector – human resources study*.

CIESIN (2001). *Remote sensing applications at the state and local level.* Workshop report. Palisades, February 2001

Craglia, M. and Nowak, J. (Eds) (2006). *Assessing the impacts of spatial data infrastructures; report of international workshop on spatial data infrastructure cost-benefit/return on investment*. European Commission / JRC. Ispra, January 2006

Craglia, M. (Ed) et al (2008). *The socio-economic Impact of the spatial data infrastructure of Catalonia*. European Commission / JRC

Cummens, P. and Grise, S. (2006). *Making technology work in the real world.* Presentation. ESRI

Dam, G.T.M. ten (2011). *Preparing students for differences in educational style.* NUFFIC

Delmotte R. (2009). *The case of GMES as a support tool to meet the Millennium Development Goals*; *recommendations for the current and upcoming EU Council presidencies in 2010 on space applications and sustainable development in Africa.* ESPI perspectives 25

Deshogues, A. and Gilliéron, P.Y. (2010). *Enhancement of E-learning in geomatics by the integration of dynamic mathematics tools*. ISPRS Commission VI mid-term symposium, Enschede, 2010

Dick, S.J. and Launius, R.D. (Editors) (2007). *Societal impact of spaceflight.* NASA

EoVOX (2006). *EO service sector representation; Report T1: Analysis of industry issues.* LogicaCMG

EoVOX (2006). *EO service sector representation; Report T2: Analysis of scope for representation.* LogicaCMG

EoVOX (2006). *EO service sector representation; Report T3: Analysis of services.* LogicaCMG

EoVOX (2006). *EO service sector representation; Report T4.2: Representation brochure.* LogicaCMG

EoVOX (2006). *Position paper: "What should the public sector do to incubate the Earth observation value-adding sector?"*

EoVOX (2007). *EO service sector representation; Report T4.1: Analysis of representation mechanisms.* LogicaCMG

EoVOX (2007). *Business in Earth Observation; an overview of market development and emerging applications*.

ESA, Booz Allen Hamilton, VEGA (2004). *The state and health of the European and Canadian EO service industry; technical report.*

ESA, VEGA (2008). *The state and health of the European and Canadian EO service industry; executive summary.*

ESA (2011). *Statement of work for the ESA learn Earth Observation (Learn EO!) project.*

Eurisy (2010). *Fostering the competitiveness of European SMEs through the use of satellite services.* Conference conclusions and recommendations. Rome, June 2010

Eurisy (2010). *Creating sufficient user pull to secure the benefits of satellite services for society*. Position paper

Euroconsult (2010). *The future of commercial space – opportunities along the value-chain.* Presentation. International commercial remote sensing symposium, Washington DC, May 2010

EuropeAid (2005). *Institutional assessment and capacity development: why, what and how?* Tools and methods series, reference document no. 1. European Commission

Fairbairn, D. and Fraser, D. (2010). *The role of international geomatics organisations in the promotion of continuing professional development (CPD)*. ISPRS Commission VI mid-term symposium, Enschede, 2010

Genovese, E. et al. (2008). *Evaluating the socio-economic impact of geographic Information: a classification of the literature.*

GEO (2007). *Mobilizing resources for implementing GEOSS*; the Seville roadmap. GEO IV

GEO (2010). *Performance indicators report.* Capacity Building Committee

GEO (2011). *Development of a GEOSS gap analysis strategy.* 21st Executive Committee, document 13

GEO (2011). *Group on Earth Observations (GEO) 2012 - 2015 Work Plan*. GEO VII

GEO-BENE (2007). *Deliverable D3 – Benefit assessment and framework report*.

GEO-BENE (2007). *Deliverable D4 - Methodology and tools report*.

GEO-BENE (2007). *Deliverable D6 - GEO-BENE database report*.

GEO-BENE (2007). *Deliverable D7 – Interim aggregate benefit assessment*.

GEO-BENE (2009). *Deliverable D10 - Draft synthesis report*.

GEO-BENE (2010). *Deliverable D13 - Final report*.

GEONetCab (2011). *Marketing of earth observation products and services, part #1.*

GEONetCab (2011). *Inventory of the current situation, identification of opportunities and bottlenecks – French-speaking African countries context.*

GEONetCab (2011). *Inventory of the current situation, identification of opportunities and bottlenecks – Polish context.*

GEONetCab (2011). *Inventory of the current situation, identification of opportunities and bottlenecks – SADC context.*

GEONetCab (2011). *Inventory of the current situation, identification of opportunities and bottlenecks – the Czech Republic context.*

Gershenzon, V.E. (2007). *Remote sensing data market trends*. Interview on trends in Russia

Giannopapa, C. (2010). *European-African Partnership in satellite applications for sustainable development; a comprehensive mapping of European-African actors and activities.* ESPI report 26

Global Earth Observation trends. Brochure.

Hazarika, M.K. et al. (2010). *Capacity building in applications of remote sensing and GIS for disaster management.* ISPRS Commission VI mid-term symposium, Enschede, 2010

Horton, D. (2002). *Planning, implementing, and evaluating capacity development.* ISNAR briefing paper 50

Ikhuoria, I.A. (2010). *RECTAS: Strategies and synergy of accomplishing objectives, vision and collaborative research*. ISPRS Commission VI mid-term symposium, Enschede, 2010

ITC (2007). *Recognition of cross-border capacity building in earth observation.* Report of the executive seminar, ITC, Enschede, November 2007

Ivanova, I. et al. (2010). *Developing a distance education programming skills course for geo-Information sciences and earth observation students.*

Johnson, S.P., (2006). *NOAA sponsored 2005-2015 international remote sensing research overview.* Paper number 1045

Johnson, S.P., (2007). *NOAA sponsored Asian remote sensing market Study 2006 – 2016*. Paper number 1069

Johnson, S.P., (2009). *2008 – 2018 Africa remote sensing study*. Paper number 1021

Kastler, T. and Grendus, B. (2010). *Efficient communication strategies for online training in geo-informatics*. ISPRS Commission VI mid-term symposium, Enschede, 2010

Keith, A. (2011). *Earth Observation: emerging markets, partnerships set to fuel global worth.*

Kinsey, D.J and Raker, J.R. III (2003). *Capacity Building for nonprofits.* New directions for philanthropic fundraising, no. 40, Summer 2003

Köbben, B. (2011). *UN Course thematic mapping*. ITC news, issue 2011-1

Kufoniyi, O. (2010). *Cross-border education*: *experiences and challenges.* ISPRS Commission VI mid-term symposium, Enschede, 2010

Lance, K. (2010). *Monitoring the Earth Observation sector in Africa*. Extended abstract

Maathuis, B. (2011). *DevCoCast and GEONETCast capacity building.* Presentation. Faculty ITC, University of Twente, Department of Water Resources

Malhotra, R. et al. (2010). *The role of geospatial associations in promoting the profession to young people*. ISPRS Commission VI mid-term symposium, Enschede, 2010

Mathieu, C. (2007). *Space in Central and Eastern Europe; opportunities and challenges for the European space endeavour.* ESPI report 5

Mathieu, C. (2009) *Space-based services in Europe; addressing the transition between demonstration and operation.* ESPI report 17

Mgendi, M.F. (2010). *Introducing web-based Elearning platform at an African university*. ISPRS Commission VI mid-term symposium, Enschede, 2010

Missika-Wierzba, B. and Nelson, M. (2006). *A revolution in capacity development? Africans ask tough questions.* Capacity development briefs, May 2006, no. 16. World Bank Institute

Molenaar, M. and Mannaerts, C. (2008). *Capacity building networks for Earth observation and GEO-ICT.* ISPRS, Beijing, 2008

Morgan, P. (1997). *The design and use of capacity development indicators.* CIDA

Morgan, P., (2006). *The concept of capacity.* European Centre for Development Policy Management

Nelson, M. (2006). *Does training work ? Re-examining donor-sponsored training programs in developing countries.* Capacity development briefs, February 2006, no. 15. World Bank Institute

NOAA (2005). *Survey and analysis of remote sensing market, aerial and spaceborne*. *Study documentation.* Global Marketing Insights.

NOAA (2006). *Survey and analysis of the Asian remote sensing market, aerial and spaceborne*. *Study period 2006 – 2016.* Global Marketing Insights.

OECD (2005). *Solutions in Space*. Policy brief

OECD (2006). *The challenge of capacity development: working towards good practice.*

OECD / DAC Capacity Development Team (2009). *Inventory of donor approaches to capacity development: what we are learning.*

OECD (2011). *Capacity development in aid business processes: getting it right!* Issues brief 9, January 2011

Ortiz, A. and Taylor, P. (2009). *Learning purposefully in capacity development. Why, what and when to measure?* Institute of Development Studies

Paresi, C. and de Vries, W.T. (2010). *E-delivery of education services as enabling factor for worldwide network of academic partners in land administration*. ISPRS Commission VI mid-term symposium, Enschede, 2010

Peeters, W. and Jolly, C. (2004). *Evaluation of future space markets; project on the commercialization of space and the development of space infrastructure: the role of public and private actors*. OECD

Potten, D. (2008). *Learning by doing: the Japanese PHRD fund and capacity development.* Capacity development briefs, June 2008, no. 27. World Bank Institute

Pycroft, C. and Butterworth, R. (2005). *Where capacity is not the only problem, moving from generic capacity building to support for issues-based change in Nigeria.* Capacity development briefs, September 2005, no. 12. World Bank Institute

Raju, P.L.N. and Dadhwal, V.K. (2010). *IIRS perspective on lessons from implementation of a cross-border joint education program*. ISPRS Commission VI mid-term symposium, Enschede, 2010

Raju, P.L.N. and Dadhwal, V.K. (2010). *EDUSAT based distance learning program in remote sensing, GIS and GPS; sharing experiences of IIRS, India.* Extended abstract

Ramage, S. (2010). *Standards, interoperability and business value.* Presentation. OGC. Third workshop on the use of GIS/OGC standards in meteorology

Rathgeber, W. (2009). *Space policies, issues and trends in 2008/2009*. ESPI

Rip, F.I. and van Lammeren, R.J. (2010). *Mapping geo-information education in Europe*. ISPRS Commission VI mid-term symposium, Enschede, 2010

Ryaboshapko, O.A. (2008). *Russian geoinformatics market in 2008 – market activities trends.*

Sahagian, D. et al. (2010). *Earth Observation; serving the needs of an increasingly global society.* Chapter 5 of *Global Geodetic Observing System*, Plag, H.-P., and Pearlman, M., (Eds)

Skalsky, R. et al. (2006). *GEO-BENE global database for bio-physical modeling v1.0.*

Space Activities Commission (2005). *Japan's Earth Observation satellite development plan and data utilization strategy.*

Sutton, T. et al. (2009). *A gentle introduction to GIS.* South Africa, Province of the Eastern Cape, Office of the Premier.

Taylor, P. and Clarke, P. (2007). *Capacity for a change.* 'Capacity collective' workshop, Sussex, January 2008, Institute for Development Studies

Technofi (2007). *European knowledge-intensive services based on Earth Observation, "doing business with the help of GMES".*

Tejasvi, A. (2007). *South-South capacity development: the way to grow?* Capacity development briefs, February 2007, no. 20. World Bank Institute

Thomas, V. (2006). *Linking individual, organizational and institutional capacity building to results.* Capacity development briefs, December 2006, no. 19. World Bank Institute

Tuohy, M. (2010). *A web-enabled remote sensing and GIS course for extramural students*. ISPRS Commission VI mid-term symposium, Enschede, 2010

UNCTAD (2010). *Economic development in Africa, report 2010; South-South cooperation: Africa and the new forms of development partnership.*

UNDP (2007). *Capacity assessment methodology; users guide.* Capacity Development Group, Bureau for Development Policy

UNDP (2008). *Capacity assessment practice note.*

UNDP (2010). *Human Development report; the real wealth of nations – pathways to Human Development.*

UNECA (2005). *The use of geographic information system in national statistical offices for data collection and poverty mapping*. Statistics team, ESPD. ESPD/NRP/05/05

UNESCO (2005). *IOC principles and strategy for capacity building.* Intergovernmental Oceanographic Commission

United Nations (2010). *The Millennium Development Goals report*.

UNRISD (2010). *Combating poverty and inequality; structural change, social policy and politics.*

USGS (2008). *2008 Africa remote sensing study, aerial and spaceborne ten-year trends.* Global Marketing Insights.

Vega, M.Y. (2009). *The change approach to capacity-building assistance.* AIDS education and prevention, 21, supplement B, p 137 – 151, 2009

Vekerdy, Z. et al. (2010). *TIGER capacity building facility: growing from projects to professional community.* ISPRS Commission VI mid-term symposium, Enschede, 2010

Vliet, M. van, Kok, K., Veldkamp, T. (2010). *Linking stakeholders and modelers in scenario studies: the use of fuzzy cognitive maps as a communication and learning tool.* Futures 42 (2010) 1 - 14

Wals, A. (2011). *A presentation on education and sustainability that should trigger creative thinking and shed a light on sustainability.* Wageningen University.

Westen, C.J. van, (2009). *Risk City: a training package for the use of GIS for urban multi-hazard risk assessment.* UNU-ITC DGIM

Westen, C.J. van, et al. (2010). *Development of training materials on the use of geo-information for multi-hazard risk assessment in a mountainous environment*.

Westerbeek, H. (2010). *Go GEO!!* ISPRS Commission VI mid-term symposium, Enschede, 2010

Woldai, T. and Kufoniyi, O. (2020). *AARSE geoinformation vision and the way forward for Africa.* Presentation. 8th AARSE conference, Addis Ababa, October 2010

World Bank (2008). *Using training to build capacity for development, an evaluation of the World Bank's project-based and WBI training*.

World Bank Institute (2011). *Steps for designing a results-focused capacity development strategy*. *A primer for development practitioners based on the capacity development and results framework.*

World Bank Institute (2011). *The art of knowledge exchange, a results-focused planning guide for development practitioners.*