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CAPACITY BUILDING FOR GEO-INFORMATION DEVELOPMENT: HIGHLIGHTING ISSUES AND INFLUENCING FACTORS

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CAPACITY BUILDING FOR GEO-INFORMATION DEVELOPMENT: Highlighting issues and influencing factors

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1. Capacity Building: what is it about?

To answer the question *What is capacity building?*, Georgiadou and Grot in 2001 used the definition of Harvard Institute for International Development from 1997, saying that it is „Improvements in the ability of public sector organizations to perform appropriate tasks, either singly or in cooperation with other organizations". To characterize "*What is capacity building for* National Geospatial Data Infrastructure (*NGDI) in a broad sense*? they responded that „Improvements in the ability of NMOs, Statistics Departments, Environmental Departments, Geological Surveys, Soil Surveys, etc. to perform appropriate tasks within the broad set of principles of a *NGDI*." And *What is capacity building for NGDI in a narrower sense*, i.e. for an NMO? They answered that „Improvements in the ability of the NMO, to lead in the development and maintenance of foundation data within the broad set of principles of a NGDI " The word "to lead" means - guarantee foundation data completeness, consistency and accuracy, - catalyze and collaborate in partnerships, - integrate data from other participants.

What has changed from 2001? Capacity building emerged from the Johannesburg Summit as a key condition for effective implementation of the reaffirmed Agenda 21 and Millennium Development Goals (MDGs) commitments.

Capacity building in geoinformatics should not be an isolated and deserted island; its efficiency has to be connected with important World efforts and solutions of crucial problems. Many of them have been formulated in WSSD 2002 in Johannesburg. In the Plan of Implementation, the following action points can be found in paragraphs:

126. Support local, national, subregional and regional initiatives with action to develop, use and adapt knowledge and techniques and to enhance local, national, subregional and regional centres of excellence for education, research and training in order to strengthen the knowledge capacity of developing countries and countries with economies in transition through, inter alia, the mobilization from all sources of adequate financial and other resources, including new and additional resources.

127. Provide technical and financial assistance to developing countries, including through the strengthening of capacity-building efforts, such as the United Nations Development Programme Capacity 21 programme, to:

(a) Assess their own capacity development needs and opportunities at the individual, institutional and societal levels;

(b) Design programmes for capacity-building and support for local, national and community-level programmes that focus on meeting the challenges of globalization more effectively and attaining the internationally agreed development goals, including those contained in the Millennium Declaration;

(c) Develop the capacity of civil society, including youth, to participate, as appropriate, in designing, implementing and reviewing sustainable development policies and strategies at all levels;

(d) Build and, where appropriate, strengthen national capacities for carrying out effective implementation of Agenda 21.

Geoinformatics and cartography are now more accepted and articulated on all political levels; the problem is that GI is still not enough included to all ICT processes not only from technological but mainly policy, organizational, economical and ethical points of views. There are new initiatives in the developed countries pushing necessary solutions ahead and giving good examples also for the developing countries, such as GMES and especially INSPIRE initiatives and efforts connected with so called "i2010 – A European Information Society for growth and employment".

For example in one of the important documents in the United Kingdom "**Connecting the UK: the Digital Strategy"** on page 22, there is a definition of OS MasterMap saying that it is:„a definitive digital map of Great Britain, providing detailed geographic information for a wide range of business and government purposes. OS MasterMap underpins a huge range of commercial services used by millions of people every day."

Since the Clinton's presidential order about creation of NSDI in 1994, this is the second clear remark about geoinformatics and cartography on the highest political level.

2. Science and Society

One of the important moments of the capacity building process is to harmonize and improve relations between Science and Society. Umbrella organization the International Council for Science (ICSU, 2006) created a document called Priority Area Assessment on Capacity Building in Science (2006, p. 5-9) which is "focusing on efforts to make capacity building in science a global priority, to build and strengthen human capital, to communicate between science and society, and to strengthen the links among education, research, and society. The first challenge, a development problem, is the widening gap between advancing scientific knowledge and technology and society's ability to capture and use them. This is not just a question of the digital

divide, since access to information is not necessarily equivalent with having knowledge. Introducing science and technology to a world with diverse experiences is one barrier to overcome. The expanding use of knowledge in developed countries, as developing countries continue to lag behind, is another. Better communication of science to the public will help transcend the diversity of experiences, and enable constructive dialog about the risks and benefits of scientific discoveries and new technologies. Closing knowledge gaps will require developing national strategies for science and technology development that are linked with effective policies. There is a need to build national innovation systems. Science is also an important basis for sound decision making in many sectors of society. International science and technology cooperation and exchange also play a critical role in narrowing knowledge, information, and technology gaps between countries and societies.

The second challenge, a workforce problem, is the apparent declining interest in the study of science and engineering around the world. Attracting, developing, and retaining talent in science and technology should be a priority of the scientific community in all fields. The issues include improving the quality of science education; teacher training; science curricula; and testing, evaluation, and assessment; as well as expanding the number of educators and the links between formal and informal education. Because of the role that women play in society, special emphasis should be placed on encouraging more women to enter careers in science. Better and more uniform testing, evaluation, and assessment are needed to keep abreast of what works and what does not work in efforts toward improvement and reform, as well as more effective forums for sharing experiences in science education and educational-reform movements.

The third challenge, an institutional problem, is the need to turn knowledge consumers into knowledge creators. Better institutions are needed to move knowledge to where it is needed, especially in developing countries. The greater challenge to education and science ministries, international organizations (including aid agencies), and the international scientific community is to help build local capacities in science and technology to produce useable knowledge, and to connect local universities ."

The ICSU document also highlights several key points how to improve relations between Science and Society.
"First is an apparent crisis in science, capacity building, and ICSU's mission and role. Progress in science and technology offers dramatic opportunities for providing a safer, more prosperous and more sustainable world for people everywhere. Yet, there is a crisis in science, stemming from a range of factors: from the unequal distribution of the benefits of science to the mismatch between the supply of scientists and the demand for scientific advance. The lack of an open dialogue with the public adds to the crisis. Capacity building in science is a critical part of the solution to the crisis in science. ICSU has played a role in many aspects of capacity building in science: from training of scientists, to contributing to science education reform, to helping reduce the isolation of scientists, to assisting with infrastructure improvements, to building global research programmes and networks

Second, making scientific capacity building a priority. Clear national strategies for capacity building are necessary to link science and technology with goals for economic growth and human well-being, to improve science-based decision-making and problem-solving, and to build

future workforces capable of capturing the advances of science and technology. Meeting the challenges of the 21st century and responding to the UN Millennium Development Goals will require international approaches to capacity building that reinforce national strategies, engage society (decision-makers as well as the public and private sectors), and build strong regional and international scientific communities working together toward common goals. Ensuring that efforts are on track will require improvements in census-taking, measurement, and assessment.

Third, building and strengthening human capital. Meeting societal goals for sustainable development will require substantial growth and maturation of human resources, including training the next generation of scientists, building scientifically literate publics, improving science education at all levels (especially through inquiry-based methods), assessing the effectiveness of various interventions, solving problems of mobility and brain drain, and encouraging the participation of women in science.

Fourth, communicating between science and society. The rapid advance of science and technology requires a renewed and strengthened relationship between science and society. Improvements in public appreciation of science through formal and informal methods, as well as efforts to engage the public and the media with science, are needed to help ensure that public policy is informed by science.

Fifth, strengthening the links among education, research, and society. Strengthening the links among education, research, and society is essential for building future scientifically trained workforces, developing effective national systems of innovation, and connecting the benefits of science with the goals of society. A variety of institutions are designed to reinforce the national, regional, and global connections among education, research, and society. These institutions need continuing support to be effective. Universities play an important role in educating future workforces and in nurturing the basic sciences. Increasingly, they are challenged to strike a balance between academic excellence and research competitiveness, and playing a greater role in national innovation systems. The scientific community needs to help improve incentive structures that recruit talented students to universities and into careers in science, as well as working toward increasing access for scientists and universities to educational materials and scientific publications."

All these principles are very important for future harmonization of the efforts of almost all scientific organizations which are members of ICSU, incl. ICA.

3. Geoinformatics and Cartography: capacity buildings approaches

Development of geoinformatics in the last 20 years, improvement of cartography in the interactive relations with geoinformatics and many other disciplines, development of the civil society and efforts to open science to decision makers on the one side and global challenges, urgent tasks (tsunami, forest fires, floods, etc.), early warning (EW) and disaster management concepts on the other side are influencing today capacity building process. Perhaps that second part and connected society requests are influencing and accelerating the entire process. We have good examples of world famous institutions such as ITC and some other

universities in developed countries devoting their efforts to investigate capacity buildings tasks in developing countries, but still the general and perfect concepts of it are missing.

GeoInformatics is also changing and developing itself. The most radical changes are provocated by the creation of the national, regional and global Spatial Data Infrastructures - SDI's (GDI's).

Martin Molenaar (2002 p. 3) pointed out that geoinformatics „community became aware of the fact further development of this field should no longer rely on spontaneous growth and evolution. The growing importance of this field for civil society requires involvement of governments to set policies and to make and stimulate large investments to create and develop spatial data infrastructures. This issue is manifest nowadays and appears high on the agendas of the international gi-community". He also observes that with time the character of the gi-community is changing. In the early days of remote sensing and GIS this community consisted of interested experts from other fields and pioneering amateurs who obtained their skills by training and through experience. Nowadays the gi-community consists increasingly of highly educated professionals. These professionals can be divided in three major groups:

1. Experts in the field of spatial information handling (or specialists in certain aspects of this field),
2. Users of geo-information and
3. Professionals and policy makers, who are aware of the importance of geo-information for Civil Society. (Molenaar, 2002 p. 3)

Their education requires programs that are carefully designed, based on the mature paradigms of geo-information science and its related disciplines. The design of the educational programs should also be based on a proper understanding of the contexts in which geo-information is produced and used and of the role that the three different types of professionals play in this field.

The required human capacity development should therefore be geared towards the following four levels in order to provide the three groups of the afore-mentioned GI professionals (Kufoniyi, 1999):

(a) High-level policy-makers: This can be achieved through short-term intensive training in the fundamental aspects of geoinformatics particularly when GIS implementation is being initiated.
(b) Management and Professional staff: New employees in this category should be already educated in the modern technology while opportunity must be also provided for mid-career (re)training of those already in employment for the purpose of broadening their outlook and keeping up to date on modern developments in geoinformatics.
(c) Technical Support Staff: Education and (re)training of technicians and technologists for efficient production, management and use of geospatial information.
(d) General Public: through mass media and public lectures, to sensitize the public on the benefits derivable from geospatial information.

4. ICA offers for Capacity Building Support

International Cartographic Association - ICA (www.icaci.org) in its Strategic Plan (ICA, 2003) defined basic concepts and objectives such as:

Values *(Our basic priorities):*
• Members of ICA respect the freedom and universality of science, the equality of individuals and cultures, and appreciate creativity and critical thinking.
• ICA seeks the highest quality in technology, standards and production processes.
Vision *(The grand ideas):*
To see….
• Cartography and GIScience applied to their full potential in science and society.
• ICA recognized as the world authoritative body for Cartography and GIScience.
• ICA recognized for outstanding service to its members.
• ICA attracting membership from national Cartographic and GIScience societies, universities, government and business and commercial organizations, as well as individuals from every country of the world.
Mission *(A leadership statement for action):*
• To ensure that geospatial information is employed to maximum effect for the benefit of science and society through promotion and representation of the discipline and profession of Cartography and GIScience internationally.
Aims *(Subsidiary targets for accomplishment of the vision/mission):*
• To contribute to the understanding and solution of world problems through the use of Cartography and GIScience in decision-making processes.
• To foster the national and international use of geospatially referenced environmental, economic and social information; and to encourage introduction of a focused geospatial basis for national and international statistical information.
• To provide a global forum for discussion of Cartography and GIScience.
• To facilitate the transfer of new Cartographic and Geographic Information (GI) knowledge between and within nations, especially to the developing nations.
• To perform or to promote multi-national Cartographic and GI research in order to solve scientific and applied problems.
• To enhance education in Cartography and GIScience in the broadest sense through publications, seminars and conferences.
• To promote the use of professional and technical standards in Cartography and GIScience.
• To support map-related research in specific topics such as those concerning children, history, theory and the visually-impaired.

ICA has commissions and working groups and task force activities which are offering best practices and solutions created just for local and regional needs in the context of continental and global approaches. Activities are in fact covering all three points mentioned by Moolenaar in this paper. To the group covering Experts in the field of spatial information handling we have Commission on Spatial Data Standards (which is covering core areas of SDIs, incl. specifications in developing countries in Africa and Latin America), Commission on Generalization and Multiple Representation, Commission on Incremental Updating and Versioning, Commission on Map Projections, Commission on Visualization and Virtual Environments, Working Group on

Geospatial Analysis and Modelling and Working Group on Spatial Data Uncertainty and Map Quality.

Second, User group can use knowledge from: Commission on Maps and the Internet, Commission on Management and Economics of Map Production, Commission on Mapping from Satellite Imagery, Commission on Marine Cartography, Commission on Mountain Cartography, Commission on Theoretical Cartography, Commission on Ubiquitous Mapping,

Third group, Professionals and policy makers, who are aware of the importance of geo-information for Civil Society: Working Group on Mapping Africa for Africa , Working group on Early Warning and Crises Management Mapping, Working Group on Digital Technologies in Cartographic Heritage, Working Group on the History of Colonial Cartography in the 19th and early 20th Centuries, Commission on National and Regional Atlases, Commission on Education and Training, Commission on Maps and Graphics for the Blind and the Partially Sighted. There is also the potentially very helpful Commission on Cartography and Children which could place important role in the creation of new culture of usage new technologies by children (Egeland, 2005) not only in everyday life but as well as in the emergency and crises situations (Bandrova, Konecny, 2006).

It is a fact that this dividing of the commissions is done for this purpose with the target to show potentials of cartography to the above mentioned three groups of geoinformatics specialists. Every mentioned ICA commission or WG has own scientific program and intentions and many of them can have very important role in all groups of users. ICA also decided to develop two special strategies for cooperation with Africa and South America where are in some aspects quite different but in other ones similar conditions, problems and barriers.
ICA is also preparing for the next ICC in Moscow, 2007 "horizontal" (task force) activity GIS and cartography in Society which will also cover problem of capacity building.

From 2003 at the International Cartographic Conference in Durban, South Africa, ICA started the idea of the so-called Joint Board of Geospatial Organizations (JB GIS) and asked to be followed by other sister organizations, such as ISPRS, FIG, IHO, IAG, IMTA, ISCGM and IGU. Joint Board ambition is to start knowledge and education capacity building together, to link separate initiatives and create and participate in efforts connecting with geo-fields complimentary and together especially in developing countries. In GICON conference in Vienna (July 2006) building the work programme of the JB GIS ad hoc committee on capacity building in Africa was further developed. This included a strategy in finding new partners to help with many GI oriented crucial issue for all African countries.

5. Current Situation in the Developing Countries in Geoinformatics Capacity Building and Possible Ways to Go Ahead (on the African Example)

The development of geo-information requires a great of investment of time and resources. Some of the *key factors* that are necessary for the accelerated geo-information development are:

- Political will
- Political stability
- Participatory approach

- Enhanced participation of the private sector
- Human and institutional strengthening
- National budget allocated for ICT policy implementation
-

Many countries in the developing nations are yet to make appreciable progress in developing their spatial data infrastructures, let alone succeeded even in laying the foundation for a strong and competitive ICT sector.

Areas that still need much attention are the generating of awareness amongst policy and decision makers about the value of GIS in formulating policy, implementing decisions, monitoring performance, evaluating the impact of programmes and showing the financial benefits of using geo-information. In addition attention should be focused on establishing National geo-information policies, strengthening the policy dialogue process, strengthen local capacity for handling spatial data and expanding access to geo-spatial information.
The surveys, mapping and environmental sectors are where there is still the greatest investment and collection of geo-information in many of the developing countries. Much work is still required to provide these countries with a total coverage of the basic fundamental datasets.
Critical factors that do negatively impact on the development of geo-information are: lack of funds, lack of policies and lack of standardization. The acceleration of the development of geo-information particularly in the developing countries, requires partnership of governments, international community and the broad spectrum of geo-information stakeholders sympathetic to this course.

Capacity Development

The acceleration of the development of SDIs will require competent personnel with adequate knowledge and skills to manipulate the technologies related to geo-information. Countries should endeavour to integrate geo-information related courses into regular curricula of primary, high school and tertiary institutions as one way of creating awareness of the importance of geo-information in our daily lives. There should also be a need to speed up the creation of a human resource base with high level of geo-information awareness (Nyapola, 2005).

In undertaking capacity building the latest understanding is that it should comprise of human resource development, organizational strengthening and institutional strengthening. These three components are closely related and capacity building needs to consider all three to be effective (Beerens, 2002).

Regardless of the technology used, it must be in the hands of the people most directly involved in the struggle for development on the ground and who understand the socio-economic and cultural context in which the technology is to be used (Taylor, 2003).

The rapid technological development, as well as development in demand for information, imply that there should be continuous upgrading of professionals as part of the "life-long learning" principle observed throughout present-day society. This in turn challenges the education and training institutions to keep up to date with scientific and technological developments while simultaneously dealing with the proliferating variety in demand (Kraak, 2005).

Plans that take into considerations the training needs and the capacity needs of geo-information workers should be developed before starting to run training programmes at training institutions.

Difficulties in the geo-information development

The geo-spatial datasets development in many developing nations is still public sector driven, and inherently is still inefficient. The basic datasets in form of topographical maps have not in many cases revised for a long time. Africa for example is poorly mapped and only few countries have maps covering their complete territories that can be used for national development purposes. The National Mapping Organizations that develop and maintain the maps get inadequate funding from their national treasuries, and can not afford to be consistent in the revision of these maps.

The development of the fundamental geo-spatial datasets is both technically complex and capital intensive. Many countries in the developing world are of low-income status. Their priorities are inconsistent with the need to focus on the development of geo-spatial information, but rather, solving myriad of problems affecting their populace in terms of poverty alleviation, HIV-Aids, perennial drought and famine etc.(Nyapola 2005).

Other notable difficulty is the geodetic framework. It is noted for example that many African countries have not yet established their geodetic framework that is based on a unified international system and have not captured the land cadastre into a GIS, which forms an important building block of other core datasets.

Challenges for the geo-information development

- The necessity of laying the foundation for a strong and competitive Information and Communication Technologies (ICT) sector
- The need to develop an ICT policy to guide and regulate the ICT sector
- Time for all stakeholders and governments to come up with a road map on how they will implement the needed policies for growth and wide establishment of the technologies
- Need to focus on lobby mechanisms upon governments so as to force attention to ICT strategies
- Challenges of lack of physical infrastructures such as electricity in the rural areas hinder rapid expansion of the ICT sector

All these challenges can be reached only in cooperation of all GI and ICT community players.

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