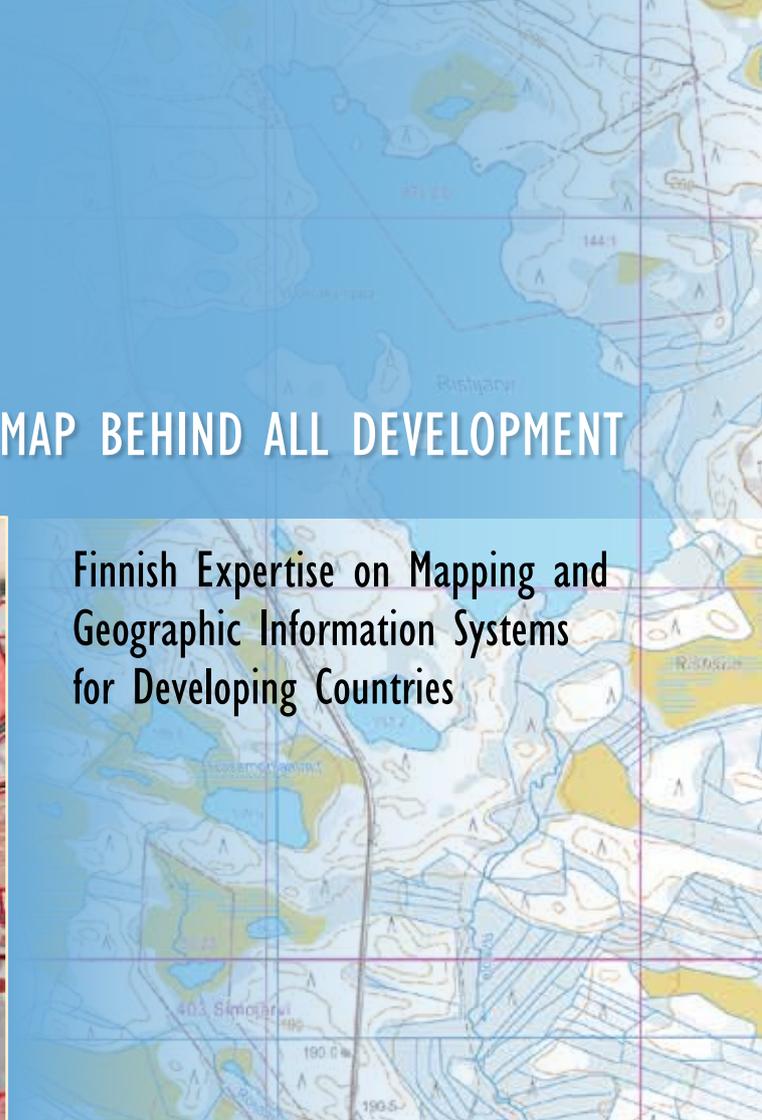




THERE'S A MAP BEHIND ALL DEVELOPMENT



Finnish Expertise on Mapping and Geographic Information Systems for Developing Countries



MINISTRY FOR FOREIGN AFFAIRS

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## Foreword

Recent decades have witnessed tremendous advancement in the use of new mapping technologies and geographic information systems. The accessibility to the primary data has improved and new applications of the mapping data for novel purposes are published continuously. The modern technology has proved to be user-friendly and to provide major cost savings for the governments and the other customers.

This publication presents the Finnish high-tech expertise on mapping and geographic information systems with special focus on developing countries. Finnish companies, governmental agencies and universities have a long tradition of international cooperation. This linkage has created a wealth of spearhead applications which combine the latest technology like satellite image interpretation with concrete needs like forest coverage mapping. The mapping services which earlier required years of data collection and interpretation can be completed in a fraction of time and cost. We are proud to present this wealth of expertise and its applications.

The publication is intended for leaders, administrators and companies in the developing countries when seeking partners for development cooperation or commercial ventures. The company presentations include links to web-pages which provide more detailed information in English. The Finnish embassies and Finpro (Finnish Export Promotion Agency) offices provide additional information for your convenience.

Ritva Koukku-Ronde  
*Under-Secretary of State*



## Lands and fields onto the world map

### Geographic information and development cooperation

The acquisition, maintenance and utilization of geographic information is more important to the functionality of society than ever before. Precise data about the terrain and environs as well as their condition is required in, for example, planning and implementing construction projects. The same need exists in both developing and industrialized countries. The greatest benefit is obtained when the

In the second stage, we proceed to bringing the basic materials up-to-date and supplementing them with new themes. Only after these, in the third stage, are the greatest benefits obtained, when the materials can then be put to use for various purposes.

In the industrialized countries, it has generally been possible to get to the third level, i.e. the basic ma-

collecting the basic materials, and even more of the data would require updating. With the collection of basic information, the foundation for a National Spatial Data Infrastructure (NSDI) is formed.

With information supplied with spatial data, widespread benefit is obtained in various tasks and services. These are, for example, the construction of individual sites such as buildings or streets, the planning of local or national land use, maintenance of real estate data systems, forest use, power plant design, and many other community functions. What these have in common is that spatial data has great significance both in the planning and implementation of projects and in later follow-up.

In the developing nations, the problem is the lack of many types of basic data, the wide dispersion of existent information, or the inadequate organization of distribution. For example, information appropriate for preparing for floods and post-flood measures or for monitoring animal disease is unavailable. Moreover, the civil engineering authorities, banks involved with real estate matters, and many other basic functions require fundamental data, but frequently the data administrators concerned are not in the least eager to distribute their own information to others.



data used as basic information is reliable and up-to-date.

In acquiring and handling spatial data, the various stages must be segmented, the first of which is the collection of basic information.

materials are in good shape and utilization of the spatial data systems is comprehensive in scope. On the other hand, in the developing countries they are often hardly beyond square one in this area. In many cases, they should concentrate on

### Finnish spatial data know-how

Finland is one of the leading countries in the utilization of geographic information. Its topographic data system, covering the entire country, is constantly updated. Informa-

tion on properties and their owners has been stored in the registers. Many other kinds of themes, such as population data, building details and land-use plans, have been

stored in registers of their own. The comprehensive use of all this data is furthered by a spatial data portal which distributes information on the data.

This brochure contains a short description of the basic products and services in the field of spatial data which Finnish operators are able to offer. These are, among other things, geodetic measurements, aerial photography, photogrammetric measurements, digital orthophotos and remote sensing data. It is possible through this combination to collect basic topographic data that covers the entire nation, composing a complete national spatial data framework. In the final section of the brochure, we present some Finnish actors in the spatial data field.

The basic data should be continuously updated, and new themes can be connected. These sorts of projects can be, e.g. the carrying out of data collection, topographic models, land-use classifications and natural resource reports for land management and the cadastre. Also in these kinds of assignments, Finnish operators have excellent readiness and broad experience. In what follows, we present these operators from this perspective as well.

Programs for spatial data systems are generally produced and mar-

keted by large software companies. As such, they are not always ready for production use: rather, they are separately adapted and applied for each application and operational environment.

In this connection, development of the national spatial data system is also being implemented. International and national standards should be applied, so coordination between various actors is required. Finnish operators have much to give developing countries in this program sector as well.

## There's a map behind all development

### Surveying – Land Management – GIS

A large part of the data we handle is spatial. A traditional map is an image of reality printed on paper. Depending on the scale, a quite detailed description of the terrain and its features can be presented thereby, or only a general characterization based on some particular theme. Plans made for the development and building of the community have traditionally been presented on maps, and they are used to outline many varieties of environmental change.

In recent decades, digital map data has appeared alongside and as a replacement for the paper map. The information is stored in databases and is used in a computer-aided manner. On their basis, it is possible to make plans, or the data can be combined with other databases. Data can also be used when printed maps are created automatically by means of information technology.

Whether it is a case of traditional maps or data stores, the information needed for these must always

be collected. Generally, the acquisition of basic data – national mapping work – is the responsibility of the national mapping authority in each country. When the data store

changes occurring in the terrain and environment.

The second basic element of land-related data is made up of the land



has once been created, the job does not end there. The materials must be updated continuously and supplemented in rhythm with the

management registers, i.e. the cadastre, land register and plan register. These components, too, are linked with basic topographic and map data.

What is common to these databases is that there is a link to the location/actual terrain site or its features. This link is in most cases coordinate data, but it can also be, for example, a real estate code, place-name or postal code.

Utilizers of the data make up their

own group in the spatial data field. The authorities and enterprises build their own information systems on the basis of and on top of the basic data. They obtain benefits in their operations from the basic topographic data, real estate information and general spatial data systems in building information levels

connected with their own projects. As examples of these sorts of projects, the monitoring of environmental conditions, geological reports and meteorology may be mentioned. The component applied to this spatial data field is referred to by the general term GIS (Geographical Information System).

## National Spatial Data Infrastructure – NSDI

National Spatial Data Infrastructure (NSDI) refers to a total entity made up of societal structures, technical solutions, data management principles, information services and personnel, which together enable the effective upkeep and distribution of integral spatial data as well as its comprehensive use.

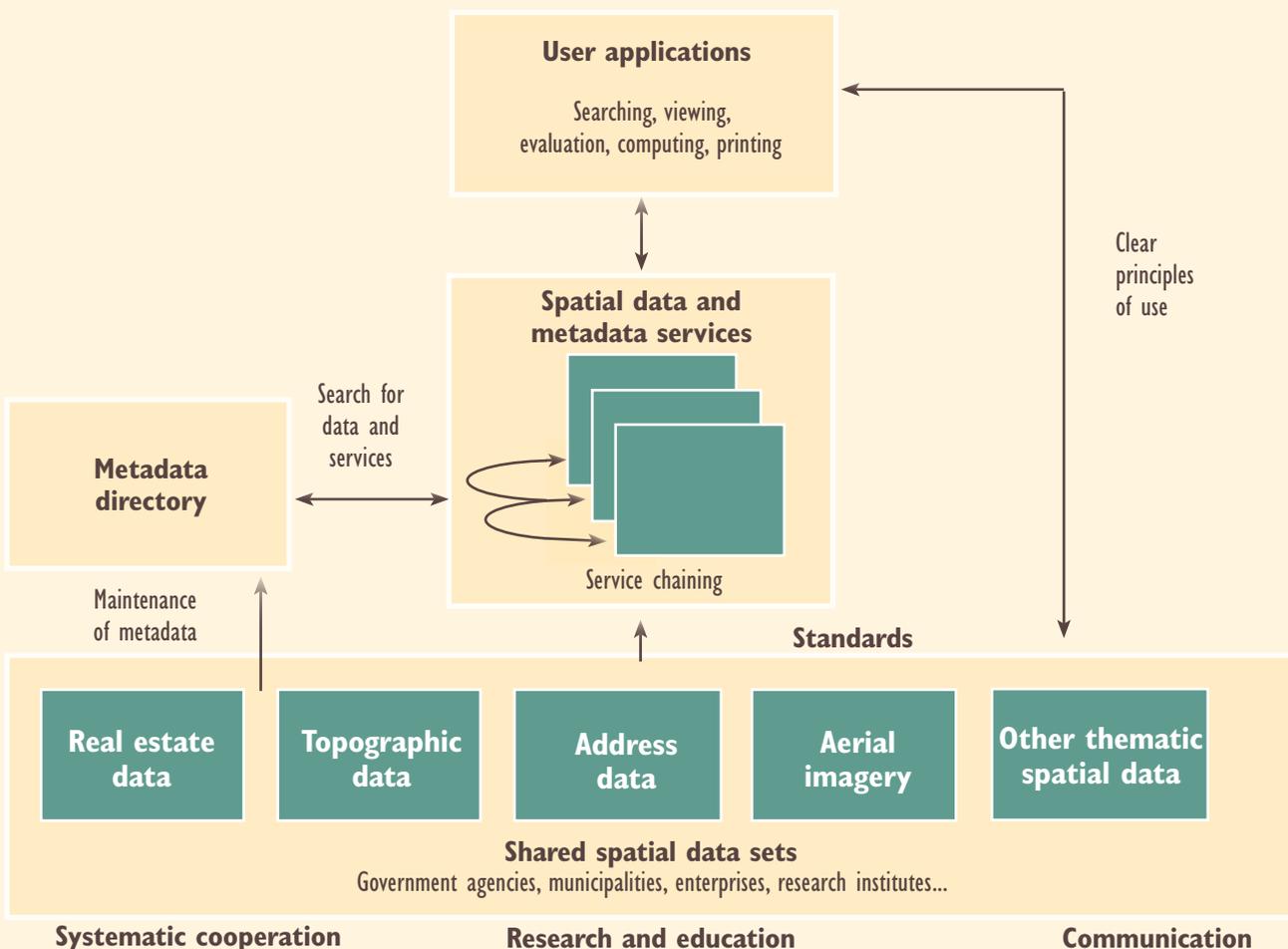
The goal is to create a functional and effective information infra-

structure that ensures accessibility to integral spatial data and enables its versatile use on behalf of the community as a whole.

The National Spatial Data Infrastructure is built on the foundation of spatial data and information services maintained by the authorities and business enterprises. On the other hand, it supports functions based on the use of spatial

data by various organizations and sectors and is, on the other hand, dependent on their ability and willingness to maintain and distribute the materials and services required in the community.

Viable national cooperation links sector-related, regional and organization-based spatial data functions. NSDI also supplements, on its part, the international service network.



General model of a National Spatial Data Infrastructure.

# Getting basic topographic data into shape

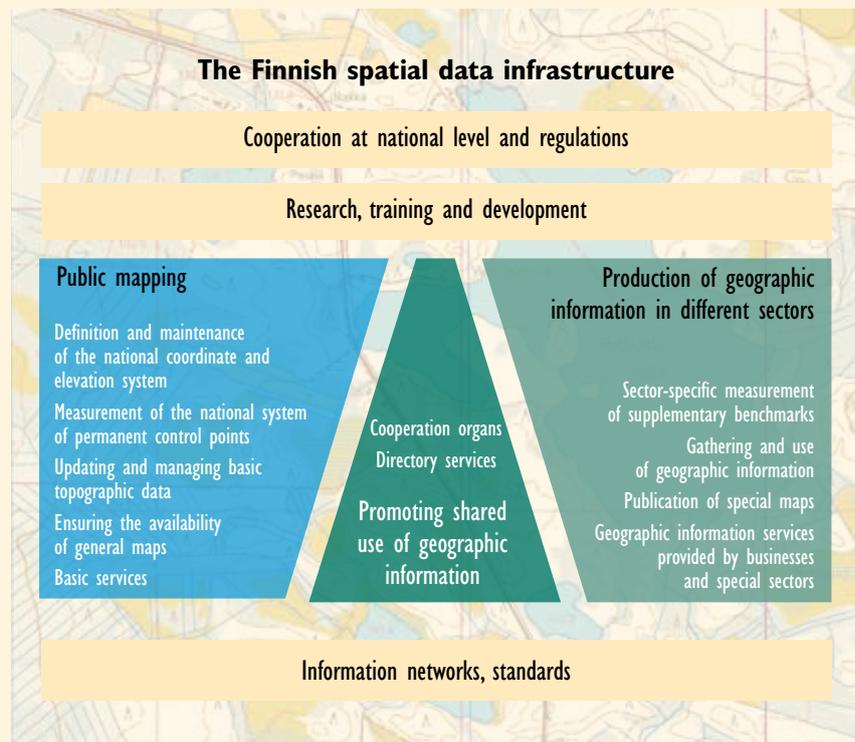
## National mapping work

National mapping work refers to the collection, administration and upkeep of nationwide basic topographic data. With these, the foundation for other spatial data-based data, plans and construction is established. This task is one of society's basic services and comparable to other infrastructure components, such as road or information networks. As a result of this overall mapping work, general topographic maps covering the entire country are prepared. Topographic data is also obtained thereby in digital form for public use.

The goal of those producing and maintaining data polls, products and services as national mapping work is to serve as wide a user group in the society as possible. It is still the case that general mapping work offers a reliable and integrated foundation for the versatile application of spatial data and maps. The aim is that maps and topographic data materials will be in nationwide use by the civil service as well as by industry, trade and private citizens.

The starting point for general mapping work is the registration of permanent and widely known features specific to the terrain and living

environs. In this manner, optimally general-purpose materials are ensured without leaving any element in the terrain unduly ignored.



**Public mapping as part of the national spatial data infrastructure.**

## Gathering topographic data – a continuous process

There will never be a day that national mapping work is all done. Basic matters, such as coordinate and altitude systems, rarely change, but detailed themes – e.g. buildings and traffic networks – must be continuously updated. Nationally handled spatial data tasks can be grouped in the following manner:

- Nationwide coordinate and altitude system specification and upkeep
- Nationwide measurement of basic control points and management of the control point register
- The production of nationwide basic terrain data, updating and topographic data system management
- The preparation of map products intended for public use and maintaining their accessibility
- Ensuring the general use of basic topographic data and map products as electronic services

The data collected as national mapping work usually covers the following themes:

- Geodetic Control Network
- Imagery, aerial and satellite
- Topography
- Hydrography
- Boundaries
- Geographic names
- Land management units and areas
- Transportation
- Utilities and services
- Natural environment

## Methods for collecting basic data are being developed

As the foundation for compatible data collection, a nationwide coordinate and altitude system as well as their realizations – the control points measured on the terrain – are always required. In many countries, these were completed decades ago. However, they are not precise and compatible enough that new data can be integrated into them.

In many developing nations, the first task is the reorganization or renewal of the set of control points. By means of the Global Navigation Satellite System (GNSS), work can be done effectively and precisely. When universal systems are used as a foundation, such as the International Terrestrial Reference System (ITRS), compatibility with neighbouring countries' systems is established at the same time. Because of the movements of the

continental plates, regional systems have been realized through the ITRS, which are, e.g. the African Geodetic Reference Frame (AFREF) and the European Reference Frame (EUREF).

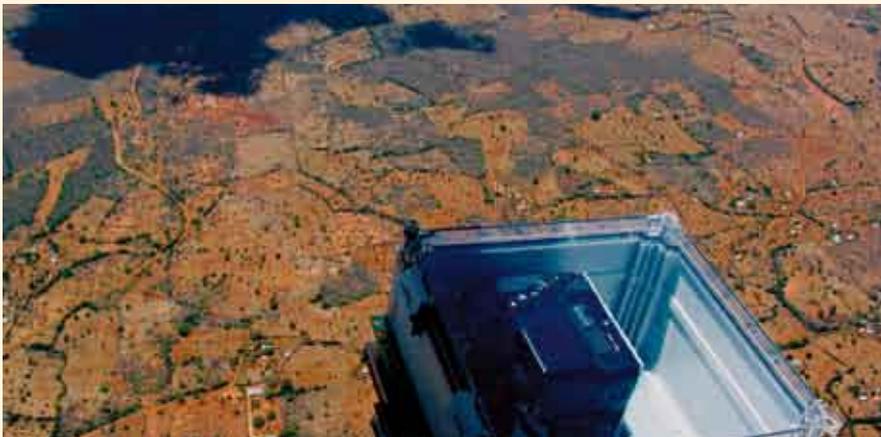
The collection of detailed data has long been based on the use of aerial photograph techniques. In this area as well, the switch has been made almost exclusively to digital data. An intermediate theme has been the scanning of films into digital form, but in using digital cameras this stage is also dispensed with. Various laser scanning techniques have become prevalent in acquiring raw data. With these, equipment installed on an airplane or helicopter can, on low flights, record images and raw data of the object using a large scale. In taking pictures from a higher altitude, the data suits the processing of the

data on a smaller scale.

Satellite images and materials can also be used in the collection of basic data. Due to the smaller resolution, they are best-suited for the collection of small-scale data. Satellite images are also quite appropriate for the updating of data. Basic data is collected into digital form. So that the data can be made maximally comprehensive as quickly as possible, it often makes sense to also digitize the existent traditional map data as part of the system. In this respect, care must be taken that the data gathered with various techniques and various precisions thereby are properly classified in the system. This way, older and less precise materials can, within the limits of the resources, be updated.

Different sorts of digital products and digital maps of various scales can be managed on the basis of the basic topographic data. The data can also be employed as the foundation of other GIS systems, and different kinds of printouts or printed maps with varying content and scales can be made.

Modern data collection techniques are naturally also appropriate for the generation of theme-based information such as forest reserve inventory and land-use classification.



*Examples of Finnish operators' development cooperation projects concentrated on surveying and basic data collection:*

- FM-International Oy FINNMAP

Western Nepal Topographic Mapping Project, 1:25 000 and 1:50 000; Aerial photography with GPS positioning of photo centers, GPS survey, topographic mapping, printing of approx. 268 map sheets.

- GIS Air SMK Group

Small Format Digital Aerial Imaging, Ortho-mosaic Processing and Digital Elevation Model Generation for Cloudy Bay, PNG Sustainable Development Program Limited, Papua New Guinea.

- National Land Survey of Finland

Topographic Mapping of Vientiane Plain. Supervision of the Project. 1:4000 scale digital maps were prepared for the Vientiane Plain region, approx. 3600 km<sup>2</sup>. The primary purpose of the project was to train the staff of Laos' mapping agency in this sort of production.

- Sito Group

Road Network Reclassification Study, GIS consultancy, Zambia

## A functional mapping strategy as the goal

The general goal of the national mapping work is to promote good management and entrepreneurial competitiveness as well as the well-being of citizens at the same time through the production of high-quality, multi-purpose topographic data, maps and spatial data services. Support for general mapping work means that there has to be research and development effort on the theoretical foundation in order to produce sustained solutions suitable for application in practice.

The strategic operational policies of general mapping work can be distributed into four fields:

- A multi-purpose entity of topographic data, products and services
- Quality norms and clear quality control supporting comprehensive use that are based on international standards
- Pricing and hand-over principles that promote usage
- Strong support for research and development work

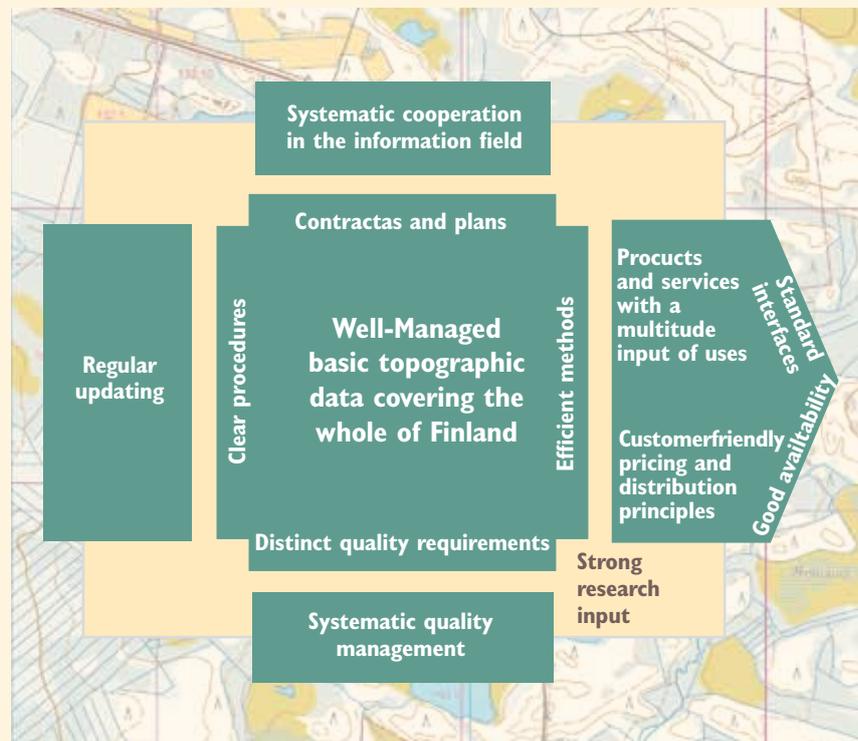
So that the information from various organizations can be incorporated into the effective use of all potential users, the functions should fulfil certain basic conditions – whether this concerns basic topographic data, other basic registers or the application of this information. Responsibility for the collection of basic data and the organizing and coordination of its distribution must preferably

be given to one organization – the national land survey. To other national actors, enterprises and citizens should be offered nationally operating information services according to harmonized principles that emphasize openness.

It must be possible for companies to process the data and services in a versatile manner. This way it is possible to reduce the expenses incurred to the community by building services. Data and services must be arranged for wide use in the community, so that the benefits gained from gathering the

data and building the services are as substantial as possible.

In the developing nations, the creation of the public mapping strategy is frequently in its initial stages. For the most part, integrated map data is in the form of traditional paper maps, and they too are often not updated. Sometimes it can be technically and economically reasonable to begin the collection of basic data “from a clean slate” and thereby establish a sustainable foundation for all spatial data on which land development can specifically be built.



**A functional mapping strategy forms the basis for the National Spatial Data Infrastructure.**

## Data collection for basic registers

Basic topographic data collected as national mapping work establishes the foundation for other registers. Basic data as such can be used in the form of a traditional map in order to provide a picture of the en-

vironment. However, full benefit in societal operations can be derived from maps and basic topographic data only when they are combined with the community's other basic registers.

By 'basic registers' is meant the official registers maintained on a continuous basis that describe population, buildings, real estate and business activity. Official codes are issued to these processed

sites, such as buildings and real estate. By means of these codes, the registered sites are plainly identifiable and can be combined with the data in other registers. Location data is linked to the data in most basic registers. Through this, the data from various registers connected with the same coordinate point is easily combined without any confusion.

The basic topographic data and the general maps derived from it thereby establish a basis for spatial data for all other basic registers. The content of the basic registers must be connected with its actual geographical environs by means of data that indicates the location. The goal of data creation and process-

ing should be that the topographic data and basic registers' data are, via the coordinates, spatial data and code connections, compatible and fulfil, e.g. the requirements of information analysis.

The authorities must ensure that the usability and service capability of the information systems meet a high standard. Special attention must be given to ensuring data security and the continuity of operations, also under exceptional circumstances and emergencies.

Spatial data has already been collected in developing countries. In addition to the data collection conducted by the country's own administration, information concern-

ing the terrain and environment is gathered in many sorts of projects. A problem of the data collected in projects is frequently the fact that it cannot be put to other use. For this reason, development projects should penetrate into existent organizations in creating information products, since project-specific products seldom live beyond the life of the project itself.

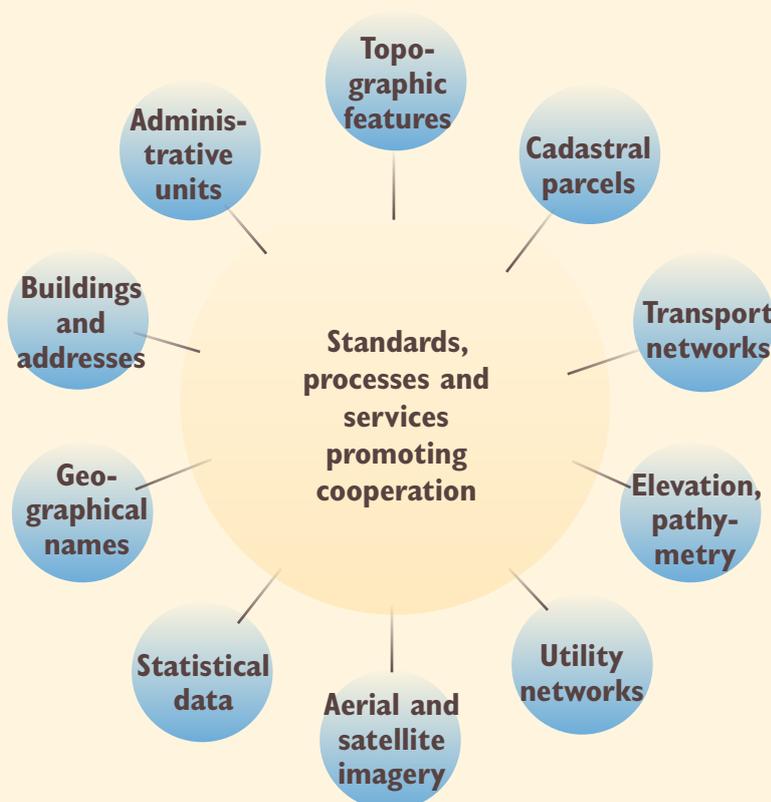
The more concrete the information products generated by the project are, the easier it is for decision-makers to understand the benefit produced by them for the community. The advantages of new projects are best realized when they are linked as early as possible as part of existent administrative structures.

## Investment for the future

On a nationwide scale, the task of maintaining topographic data and

map production is not in itself a profitable activity in the business

sense. National mapping work and distribution of spatial data are part of the nation's infrastructure upkeep and basic services. The greatest advantages are derived only when the administration, enterprises and citizens use them in a versatile way in their activities, and the quality of the information corresponds to the users' needs.



Example of a whole formed by shared geographic datasets.

Increasing the combined usage capability of data reserves and the compatibility of information systems together with reducing overlapping are of primary importance. This way it is possible to ensure that data once gathered can be beneficially utilized by other users and systems. Multiple collections of the same data also incur multiple costs.

Spatial data technology is frequently applied in long-term projects, and the benefits are targeted to many interests as multiplicative effects. For this reason,

advantages obtained from spatial data technology investments often cannot be measured and recorded with precision. In many applications, the benefits are strategically based. Frequently, it can only be said that operations would not be feasible without the support provided by spatial data technology.

In some international reports dealing with the advantages of spatial data, it is noted that the costs of spatial data productions

return fourfold as benefits. These benefits are regarded as dividing comprehensively into various fields such as the logistics and traffic sector; electric, gas and water works; agriculture and forestry; mining operations; and environmental protection.

The establishment of pricing policies that promote the usability of spatial data is a challenging task, particularly in the developing nations. Spatial data pricing depends on the circumstances of the users.

If development is emphasized in the country, the information should be free-of-charge. For advanced use, the market price can be charged for the information. Data producers should receive compensation for their products so that they have the capability of updating and improving them. However, high prices should not, under any conditions, shut out any particular user group, nor should a pricing model be able to obtain justification only from guaranteeing financing for a national mapping agency.

## Land is a limited commodity

### Land Administration

Registers and files including maps connected with land ownership make up their own total entity within the core of modern NSDI.

Land is a limited and non-renewable commodity. The appropriate management and maintenance of real estate property promote investments and economic growth as well as increasing social stability, but they are also the cornerstones of sustained development and nature preservation.

All human action is rooted in the land. Raw materials and food required by human communities are found in or produced by the land. What sort of land is concerned and where as well as which matters are connected with it should be known in order to decently utilize the land. For this reason, the land must be surveyed.

Land use for building, production, services and other social functions also requires that suitable areas are specified with regard to its various applications and users.

Consequently, the land must, in practice, be divided into use-related units or properties, and the feasible, permitted applications for them indicated. It is also important to know who is entitled to property administration and use. This requires, on its part, that a register is maintained with regard to both the areas and their owners/administrators.

The permitted land use methods are specified in the planning (i.e. zoning) processes. This data, too, is registered – preferably in a nationwide register, but at least in the database specific to an organization that supervises local or regional planning. It is, at any rate, necessary that the plans concerning each area or property can be clarified in an easy manner.



## Property information into registers

The three registers connected with land management exist in most countries. A *cadastre* describes the distribution of land into real estate property, a *land register* the rights pertaining to real estate, and a *planning system or plan register* the restrictions on land use. In planning land use, information about the people residing in the area and its buildings as well as the businesses and other corporate bodies operating there is needed. The information on these matters is recorded in the population register in addition to the registers concerning legal persons.

The registers and databases described above are also existent in many developing nations. In these, however, special attention must be given to the coverage of data as well as its real-time character, high quality and shared usability. The significance of understanding spatial data is essential from the perspective of the development of

the entire community. The design and realization of concrete physical projects, such as bridges and hospitals, are also built, at best, on the basis of a spatial data.

Credit, i.e. financing acquisition, represents a basic prerequisite for economic operations, and land is the most important type of collateral in granting credit. The national economy would not function effectively in practice for even a day

without a safe, dependable and transparent real estate system and the registration of rights connected with it, all enabled by financing.

The system also enables, on its part, social compensation for losses incurred from infrastructure-related construction, preservation and other similar projects on private landowners' land, so that each landowner receives full reimbursement corresponding to his losses.



## The land administration jigsaw puzzle

All land management components are built on the cornerstone of basic topographic data, i.e. the basis of everything is the geodetic networks, aerial and satellite image materials and basic topographic data gathered on their basis – in traditional terms, the topographic map data.

Ordinary land management embraces, more precisely segmented, the following elements:

- Land legislation
- Land policies
- Cadastral surveys
- Land registration
- Land tenure
- Archiving
- Information exchange

Land legislation, land management policies, institutions, data pricing and distribution procedures must be formulated into a harmonious structure in place of loosely sepa-

rated tangents. Subsequently, all these elements form a viable national spatial data infrastructure, i.e. The NSDI component.

*Examples of Finnish operators' development cooperation projects concentrating on land management:*

- FM-International Oy  
Land Management and Administration Project. Technical Assistance for Component 3; Land Titling Program and Development of a Land Registration System, Cambodia.
- Sito Group  
Sustainable Management of Land and Environment in Zanzibar, Mapping Consultancy, Tanzania.

# GIS – Geographical Information System

## Systems for data management and utilization

By means of the Geographical Information System (GIS), it is possible to record, manage, analyze and present spatial data. Its basic component is a computer program. GIS software is available on the market as products from various commercial operators. Various open source programs are also serious alternatives.

*Examples of GIS application areas are:*

- Land Management
- Transportation Planning
- Watershed Planning
- Tax Mapping
- Monitoring of Water Quality
- Mapping of Tourism Facility
- Land Cover Monitoring
- Road Mapping
- Business Location Planning
- Disaster Management
- Carbon Management

**By means of GIS it is possible to use spatial data for various purposes.**



## GIS – a tool for many purposes

As the examples on the previous chapter indicate, many GIS applications focus on a well-detailed theme or problem. It can be local, by which the scale is greater and the basic materials of the topographic data are itemized. On the other hand, the phenomenon handled may be global, whereby the scale as well of the data is smaller and is generalized.

An example of a subject that should be approached from both a local and global perspective is climate change and the rise in sea-level associated with it. This represents a challenge, particularly to small island states. Naturally, the climate cannot be changed with GIS systems, nor can water levels be pre-

vented from rising, but spatial data and the technologies linked with it play a decisive role in preventing catastrophes. For example, by means of terrain altitude models, it is possible to design flood protection and direct construction towards risk-free areas.

In the presentation of Finnish operators in the field at the end of this brochure, there are many other examples of GIS applications. Actually, connecting GIS with any area of life or phenomenon in terms of its data and features is feasible and desirable.

*Examples of Finnish operators' development cooperation projects, in which GIS is integrally involved:*

- FCG  
Capacity Building in Environmental Information Management Systems (EIMS) in Central Asia, Kazakhstan, Kyrgyz Republic, Tajikistan and Turkmenistan. The purpose was to strengthen and more effectively utilize national Environmental Information Management Systems: data collection, processing, information displays, decision-making and monitoring. The Project helped to provide standardized information, which is collected and displayed in a harmonized manner, from all the Project countries.



Joint Maputo River Basin Water Resources Study, Mozambique, Swaziland and South Africa. The broad objectives of the programme that this project is part of are to provide a detailed water resource assessment and recommended management and development options, as well as to propose suitable institutional and financial arrangements for the Maputo River Basin. These will be presented as an Integrated Water Resources Management Strategy (IWRMS).

- Finnish Environment Institute (SYKE)

Support to Environment and Sustainable Development in North West, South Africa. Provincial and municipal spatial planning and land use management legislation development and pilot spatial plans, Biodiversity inventory and database. Databases on historical sites. Information Management and GIS strategy development. GIS training.

Land use expert for Mekong River Environmental Programme, South East Asia/Thailand. Land use and allocation plan assessment, biodiversity conservation corridors, land use budgets, Training of partner agency staff in best land use planning, zoning and allocation practices, technologies and tools.

- Geological Survey of Finland (GTK)

Geological mapping, Geochemical Surveys and Mineral Resources Assessment, Uganda

Geological Mapping in Mozambique, The Task was to carry out geological mapping for creating a comprehensive coverage of geological spatial databases with adjacent data sets like mineral deposits. The outcomes included high quality digital and paper maps on the scales of 1:250 000 and 1:50 000.

- Helsinki University of Technology

Jabal Haroun, 3-D Modeling and Archeological Documentation, Jordan.

- Indufor Oy

Support to Development of Production Forestry and Rural Development in Lao PDR Project, including remote sensing and GIS technologies in forest management planning and piloting different methodologies for monitoring deforestation and forest degradation.

Forestry and Climate Feasibility Study in Mozambique, included screening of potential areas for forest based carbon sink project.

- Keypro Oy

Establishment of Utility Data Center (UDC) / feasibility study for the City of Rijeka, Croatia

- NIRAS Finland Oy

Development of Forestry Information Systems (FOMIS) in Vietnam: The purpose is to make more accurate information available for forestry decision-making. The approaches will be piloted in three provinces, but the information system will be scalable up to the national level.

Support to Forest Sector Reform in Kenya: The aim is to technically set up and build capacity to operate GIS facilities in GPS field data collection, geodatabase management in the LAN environment, and digital map production.

- Pöyry Environment Oy

Digital City GIS for Guiyang, China. System design and implementation. The five GIS applications of GYGIS include; building a comprehensive Emergency Response System, WebGIS, "Digital Community" application to support local community-level administration and services, Flood forecasting and Decision support system, Air Quality Forecasting.

- Ramboll Finland Oy

Integration of ICT – including GIS – in Municipal Management and Decentralization, Nicaragua, 2008

- University of Helsinki, Department of Geography

Geoinformatics in environmental conservation and community based natural resource management in the Taita Hills, Kenya.

- University of Joensuu

New Technologies to Optimize the Wood Information base for Forest Industries – Developing an Integrated Resource Information System, Brazil, 2008-2011

- University of Turku

The Zanzibar Research – is aiming to synthesize information on landscape change dynamics, biodiversity, land use potential and stakeholder preferences into an understanding of the sustainability of Zanzibar landscapes and environment. The team has experience in the use of GIS and remote sensing in vegetation studies, environmental (land cover, land use) change studies and use of GIS in the analysis of social environment and land use values (participatory GIS).

- VTT Technical Research Centre of Finland

Feasibility study on the forest monitoring, Concept using very high resolution satellite data, Laos.

# The challenges of developing nations in building NSDI

## Spatial data – the starting point for all development

The economy of most developing nations is still dependent on agriculture and other means of livelihood directly connected with the land, such as mining and tourism. The land ensures food production and socio-economic security for a large section of the population. Successful land policies together with various application areas are therefore of primary importance as regarded from the perspective of sustainable development. Reliable data targeted on real estate properties is the foundation for systematic land use and functional real estate markets.

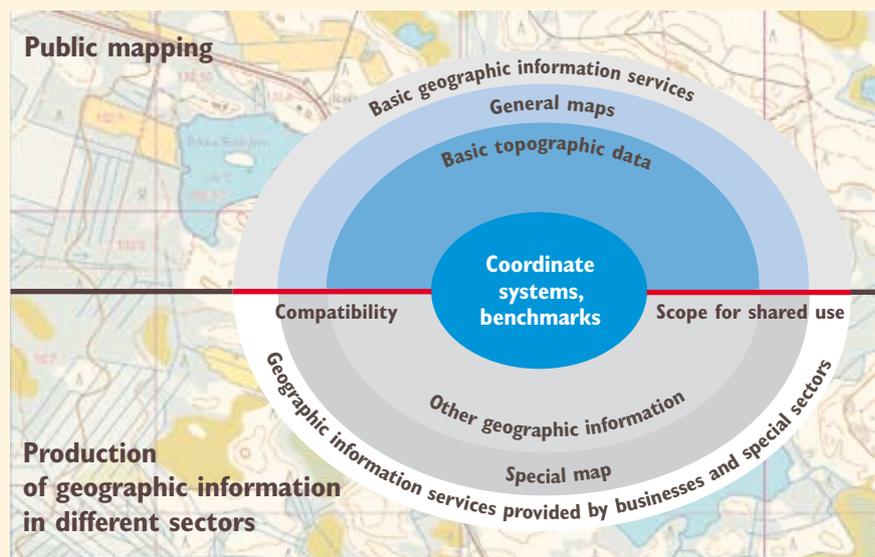
The construction and reinforcement of the basis of the developing nations' NSDI require many actions. In this respect, the existence of national mapping and register agencies and the consolidation and development of their operations occupy a key position. Only when these are assured can they really start working on their main task.

**Compatible and integrated topographic data and other geographic information play essential role in the NSDI.**

Generally speaking, the actions in accordance with the following list are important:

- national digital basic topographic data collection and arrangement of updating
- the production of up-to-date printed maps
- the creation of a digital cadastre and corresponding land management data
- arranging for the combined use of data
- initialization of the international standards of the field

NSDI is one of the basic pillars behind the advancement of sustainable development. It is important for decision-makers in the developing countries to understand the importance of the functional spatial data field. Politicians on the local, regional and national level must acquaint themselves with the benefits enabled by NSDI and its active beneficial utilization in various operational fields.



## From words to deeds

Already decades ago, it was observed that it is sensible to collect information about some matters only once. The same information can then be transferred to other potential users via information networks. This way, considerable resources would be saved. The next innovation was the observation that nearly all information was connected with a certain place: information has a location speci-

fied by coordinates. This again, on its part, enables the integration of the data contained within several information sources, all indicating the same site. This way, the concept of a spatial data infrastructure was ready.

Technical methods and information networks have developed since the period of time when the SDI idea was born. Equipment and software

utilizing spatial data have come into wide administrative, business and individual citizen use. The greatest challenge in the developing nations remains the lack of spatial data materials and their distribution. Development of these matters poses a challenge to the actors in the field. In these efforts, Finnish surveying and spatial data experts gladly offer their help to NSDI builders in the developing nations.

# Company index

	<b>Data collection</b>	Geodetic surveys	Aerial photography	Remote Sensing	Laser scanning	Digital Map Products	Consulting	<b>GIS utilization</b>	Data magament, maintenance and updating	Thematic data collection	Land use planning	Infrastructure magament and planning	Land registration nad cadastral mapping	Environmental information systems	Natural resources management	Consulting	Capacity building	<b>GIS and NSDI development</b>	GIS development	Consulting
Dimenteq Oy																		•	•	•
FCG International Oy								•			•			•	•	•	•	•	•	•
FM-International Oy FINNMAP	•	•	•	•	•	•		•				•		•				•	•	
GIS Air SMK Group	•	•	•			•		•					•	•						
Indufor Oy	•			•				•		•				•	•					
Keypro Oy								•		•						•	•	•	•	
Logica																		•	•	•
NIRAS Finland Oy								•						•	•	•	•			
Pöyry Environment	•			•		•		•			•	•				•	•			
Ramboll Finland Oy	•	•	•	•	•	•		•				•		•	•		•			
Sito Group	•	•					•	•	•							•		•	•	•
Tekla Oy																		•	•	•
Finnish Environment Institute	•			•				•		•						•		•	•	•
Finnish Geodetic Institute	•	•					•													
Geological Survey of Finland	•							•	•	•				•			•			
Helsinki University of Technology	•						•													
National Land Survey of Finland	•						•											•		•
University of Helsinki	•		•	•				•	•					•	•		•	•	•	
University of Joensuu								•							•					
University of Turku	•			•			•	•	•						•		•			•
VTT - Technical Research Centre of Finland	•			•			•	•	•					•						

Vision without action is merely a dream  
 Action without vision is merely passing time  
 Vision with action can change the world

*Nelson Mandela*

## Finnish experts at your service



Spatial data represents the basis of sustainable development and part of the community's basic infrastructure, also in developing nations.

Finnish surveying and spatial data experts have many years of experience in development cooperation projects – both in collecting data and in its utilization in various application areas. We are capable of offering expertise and know-how for various projects, depending on the needs of partners and their wishes.

Solutions applicable to the special conditions of developing nations have been developed for data collection. Know-how covers the entire collection of basic data from terrain measurements and aerial image interpretation to map products and digital materials. An integral part of the projects is the training of the local people in data collection and upkeep tasks, so that the data remains usable and up-to-date in the future as well.

Finland also has expertise in the development of spatial data infrastructure development-related tasks, in which the consolidation and development of national mapping and register agencies occupy a pivotal position. Finnish specialists have been involved in many projects connected with the development of land management. They have participated in the development of information systems, the registration and surveying of real estate properties, and the establishment of legislation and land management procedures.

Finnish businesses have considerable experience of natural resources-based information systems, particularly with regard to information systems intended for forest reserves surveying and the management of forest reserves data. Know-how has also accumulated from various infrastructure projects as well as in the collection and management of the data needed therein.

Many developing countries are located in areas that are susceptible to various natural catastrophes. Spatial data can be utilized in forecasting such catastrophes, e.g. in predicting floods. It also assists in rescue work and post-catastrophe repair.

These are only a few examples of the great many spatial data applications in which Finnish firms can be involved in the development.

More precise details on the services and special expertise offered by these enterprises have been gathered in the accompanying company directory. You will also find the contact information for these companies including their contact persons.

## Dimenteq Oy

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### Overview

Dimenteq Oy is an information technology service company that understands geographic information solutions (GIS), information system deliveries and the related consulting. It has strong competence regarding the use of geographic and location information to develop business functions and services. The information system deliveries cover all the phases from preliminary surveys through specification and design to realization, implementation and maintenance of the system.

### Experience

The personnel have extensive experience of using different application development technologies to im-



Observations of large predatory animals are entered into the Tassu system.

plement GIS solutions in both workstation and server environments. For example implementing systems in the following sectors: retail, media, industry, banking and insurance, real estate, forestry, transportation and logistics as well as public administration.

### Main services

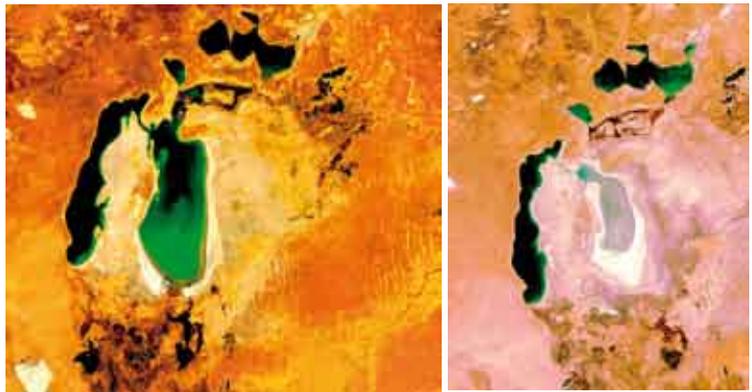
GIS and information system consulting, project manager and project management services, procurement consulting and supervision of customer interests during information system procurement, utilization of geographic information in business and service development, modern application and service development with agile and traditional methods.

### References

- A system for reporting observations of large carnivore (Tassu), Finnish Game and Fisheries Research Institute / Ministry of Agriculture and Forestry, Finland, 2008
- A geographic information system for sports facilities, University of Jyväskylä, Finland, 2009
- Data warehouse, maintenance and reporting, integration with GIS; Precognition and Proof of Concept, Ministry of the Environment, Finland, 2009.

## FCG International Oy

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Aral sea from above. The picture on the left has been taken in May 2004, the one on the right four years later in October 2008.

### Overview

FCG International Ltd. is responsible for the international operations of FCG Oy (Finnish Consulting Group). During 35 years of experience in development cooperation work in Eastern Europe, Africa, the Pacific, Latin America, Asia and the Middle East, FCG International has carried out over 600 projects in around 100 countries worldwide. In the year 2007, the volume of operations in the FCG International Group was MEUR 31.7. The company has a permanent staff of 100 professional and employs approximately 900 short and long-term experts in its projects.

In international development project consulting, FCG is one of the largest in Europe. Projects are funded by the World Bank, ADB, AfDP, IADB, EBRD, NDF, EU, UN organizations and bilateral aid agencies. The main fields of services include environment, municipal infrastructure, education, public sector management and social services.

### References

- Capacity Building in Environmental Information Management Systems (EIMS) in Central Asia, Kazakhstan, Kyrgyz Republic, Tajikistan and Turkmenistan, ADB, 2004–2006
- Environmental and Socio-economic Management Plan for the Merowe Dam, Nile (EMP, EMS, OH&S, RAP), Sudan, Islamic Development Banks, 2005–2008
- Kazakhstan Forest Protection and Reforestation Project. World Bank / EU Tacis: Joint Environmental Programme, 2004–2005
- Joint Maputo River Basin Water Resources Study. Mozambique, Swaziland and South Africa, EC - EDF, 2006–2008
- SADC Information and Communication Technology Project; Southern Africa; based in Botswana. Ministry for Foreign Affairs, Finland, 2002–2004
- Tri-nation Programme of Sustainable Development in the High Watershed of the Lempa River. El Salvador, Guatemala and Honduras, Nordic Development Fund, 2006–2009
- Integrated Ecosystem Management and Environmental Protection of the Baiyangdian Lake Catchment Project (incl. GEF Component), Asian Development Bank, 2006–2007
- Aerial photographs from Honduras. NDF; 2/2009-7/2010

### Main services

Consulting (Capacity Building, planning, inventories, thematic mapping, resources use planning, nature protection, rural development, image interpretation, GIS, etc). *In the environmental sector, the expertise includes the following fields:*

- Institutional development and capacity building
- Environmental administration, legislation, management tools & protection
- Water, waste and hazardous waste management
- Energy & environment
- Watersheds management
- Environmental Awareness Raising
- Agriculture and forestry
- Land use planning and administration
- Livelihood development and poverty reduction
- Environmental Information Systems
- Financial management of environmental programs
- Project cycle management services
- Training & extension

## FM-International Oy FINNMAP

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 www.finnmap.com



FINNMAP has provided technical assistance for Cambodian Cadastral Programme since 1997. 1,012,512 title certificates have been delivered, 1,096,242 parcels publicly displayed and 1,306,487 parcels surveyed and adjudicated during 2002-08.

### Overview and Main services

FINNMAP was established in 1951 as a mapping and planning company and is today providing services in aerial photography, LiDAR laser scanning, remote sensing, geodetic surveys, photogrammetry, digital mapping, cartography, photo laboratory work, mosaicking, GIS development, land registration, cadastral mapping as well as various photo and satellite image interpretation features such as forest inventory and classification, land use, soil and population classifications, forest management planning, terrain modeling and volumetric and profile measurements.

Through the years of our international operations, the main policy has been the sustainable technology transfer through training and local production without any race or gender discrimination. The overseas project and production offices are currently occupied by dozens of locally trained staff. The operations employ at the moment 30 highly qualified Finnish professionals, whose experience covers the full spectrum of the surveying profession and procedures.

### Experience

FINNMAP has carried out projects worldwide in over 25 different countries. The main clients consist of local governments, bilateral development cooperation agencies, the Ministry for Foreign Affairs of Finland, the United Nations, the Commission of the European

Union, Development Banks and other international organizations.

- Kosovo 2004–05
- Zanzibar (Tanzania) 2003–06
- Bosnia & Herzegovina 2003
- Egypt 1987–1999
- Macedonia 2007–09
- Ghana 2007–
- Romania 1999–2007
- Libya 1979–1986
- Turkey 1998–2000, 2005–08
- Saudi Arabia 1980–86 and 2004–
- Azerbaijan 2000
- Palestine 2005–09
- Uzbekistan 2000–2002
- Nepal 1992–2004
- Georgia 2005
- Mongolia 2005
- Tajikistan 2006–08
- Bangladesh 1986–2000
- Latin America (El Salvador, Guatemala, Honduras, Nicaragua, Belize, Panama) 1999
- South-East Asia (Thailand, Lao PDR, Cambodia, Vietnam) 1988–

## GIS Air SKM Group —

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Digital Small-Format cameras (here RGB and CIR) can be installed even to an airplane side-box.

### Overview

GISAir-SKM provides comprehensive mapping and surveying services in Finland and abroad. It is 100%-owned by its management. GIS Air-SKM is the biggest Finnish owned independent mapping company in Finland. The group employs presently 12 highly qualified specialists of different gender and ethnic origin. The management, as well as most of the specialists, have extensive experience in development cooperation projects in a wide variety of countries and continents. GISAir-SKM is a full service company in mapping and GIS and serves its customers with digital aerial photography, 3-dimensional stereo mapping and digital orthomap production. The whole range of field surveys with geodetic GPS receivers and conventional survey equipment form another important part of the activities.

### Experience

The speciality of the company is to provide developing countries and international organisations with comprehensive solutions for their data collection and handling needs in a sustainable and economical way.

### References

- Small Format Digital Aerial Imaging, ortho-mosaic processing and Digital Elevation Model Generation for Cloudy Bay, PNG Sustainable Development Program Limited, Papua New Guinea. 2007–2008
- Small-Format Digital Aerial Imaging, ortho-mosaic and digital terrain model processing for four new ore exploration areas, Orezone Inc, Burkina Faso, 2006–2007
- Gestion du Patrimoine Foncier Communale, GTZ, Small-Format Digital Aerial Imaging, ortho-mosaic for land management and cadastral mapping, user training, organisational development. River Niger, Mali, 2003–2005
- Land Administration Sub-Sector Program (LASSP)/Land Management and Administration Project (LMAP), Cambodia, 2003–2009
- Constant map production in Finland, annual number of projects varies from 30 to 50.

This is based on a revolutionary Small-Format Digital Aerial Photography and the related effective capacity building. A permanent solution for the customer is guaranteed through the use local ordinary airplanes, user-friendly software – together with low-cost hardware investment – and provision of a relatively short training. This helps to improve efficiency of regular data maintenance and updating work. Locally established aerial photography and digital mapping systems also allow the user organisations and customers to market and sell their mapping services and thereby generate synergy advantages and potential additional income. Development and implementation of land management and GIS projects are additional strengths of the company.

### Main services

Digital mapping and surveying, aerial photography, GPS surveys, institution and capacity building, GIS/LIS, land management and administration, cadastral mapping/land titling, forest inventories, environmental change monitoring.



## Indufor Oy

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### Overview

Indufor is an independent staff-owned consulting company founded in 1980. Services cover full range of forest and forest industry issues relevant for our clients. The five business areas are Forest and Climate Change, Forest Policy and Governance, Forest and Environmental Management, Forest Industry and Markets and Social and Environmental Responsibility. GIS and remote sensing services provided by Indufor are supporting each of the business areas. In total Indufor has approx. 60 employees of which 24 are currently working at the head office in Helsinki.

### Main services

*Indufor provides remote sensing and GIS related consulting services in:*

- Accessibility analyses and assessment of infrastructure and its development needs
- Forest, land cover change, carbon stock and fire monitoring system design
- Forest information system design
- Forest resource assessment design and implementation
- Forest resource mapping

### Reference examples (see more from [www.indufor.fi](http://www.indufor.fi))

- Support to Development of Production Forestry and Rural Development in Lao PDR Project, Phases I–II (2003–2012), including remote sensing and GIS technologies in forest management planning and piloting different methodologies for monitoring deforestation and forest degradation (REDD)
- Forestry and Climate Feasibility Study in Mozambique (2008); included screening of potential areas for a forest based carbon sink project.
- Plantation Inventory, Socio-economic Survey and Database Development in Tanzania (2006–2008)
- Preparation of Forest Management Plans for Forest Enterprises in Armenia (2005–2008)
- Screening and Defining of Potential Areas for Plantation Forestry, Agriculture and Ecotourism Investments in Niassa Province, Mozambique (2006–2007)
- Forest Resource Management Project in Zambezia and Inhambane, Mozambique (1999–2005)
- Forest Concession Management and Control Pilot Project, Cambodia (2003–2004).



Indufor has a strong and global experience on forest resource assessments.

### Experience

Indufor has worked at all levels of forest resource assessments and GIS-analysis and has strong in-house experience and understanding of the information needs at each decision-making level concerning forests. Methodologies used by Indufor range from conducting traditional field inventories to the application of highly sophisticated modern remote sensing systems to cover large areas with low cost. Global experience on forest resource assessments has brought Indufor deep understanding of the problems and their solutions in different types of forests, from boreal zone to tropical regions. The Company has a strong and close network in information and space technology, including several world-leading experts and companies in building remote sensing, GIS and information systems for forestry.

Indufor has been working actively in the field of development cooperation including projects related to remote sensing and GIS. These projects have covered building capacity to use remote sensing and GIS, creating new management, information and GIS systems, remote sensing-based forest inventories, forest cover / land use change monitoring and a variety of GIS analyses.

## Keypro Oy

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 fax: +358 (0)9 836 231 58  
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### Overview

Keypro Oy is an expert company for network and geographic information systems. Keypro's business aims at delivering and developing efficient planning and network information systems for customers and accelerating profit gain from system investments. This is accomplished by participating actively in the implementation phase, and also in maintenance if needed. Keypro targets its services into software development, systems implementation and data conversion as well as capture into new systems. It also works at integration between different systems and in the special knowledge, training and support services in the implementation phase. Keypro Oy employs approx. 50 experts of network and geographic information systems.

### Experience

Keypro provides the needed know-how and technology transfer together with the partners who have expertise in their respective fields. The local partner represents related IT systems in the target country and will be closely working with Keypro to receive and transfer know-how both during the feasibility study and implementation phase. Assess and analyze how to establish Utility Data Center (UDC) according to Helsinki and Vantaa models for Rijeka city in Croatia. *UDC will be operated after implementation by local partner and supported by Keypro:*

- Transfer of know-how includes, e.g. the following: on-the-job training – seminars and lectures – visit to existing UDCs in Finland.

### References

- Establishment of Utility Data Center (UDC) / feasibility study for the City of Rijeka, Croatia 2007–08



Project meeting in Rijeka city, Water and sewer department.

- Information systems such as: GIS (Geographical Information System) – MIS (Management Information System) – database systems – customer service technology (e.g. Internet and CRM [Customer Relationship Management] technology).
- Data collection technology such as: surveying and mapping technology – sub-surface surveying technology – data recording and transfer technology
- Production process of UDC includes services such as: establishment of customer service and data production and use agreements – collection and conversion of existing records to database – field data collection – input of new data into the system – data editing and quality verifications – information services.

### Main services

Application development and integration of new systems – Rapid, high quality conversion and storing of information into new systems – The special know-how needed in introductory stages – Consulting, training and support – Storing of data into numeric databases needed in network documentation from paper/plastic documents and from workshop drawings – Scanning services, correction and warping of raster material, coordinate and format transformations – Indoor network documentation and scheme storing in numeric format into the desired CAD/GIS systems.

## Logica

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### **Overview**

Logica is an IT and business service company, employing 39,000 people in 36 countries. It provides business consulting, system integration, IT and business process outsourcing services. Logica works closely with its customers to release their potential – enabling change that increases their efficiency, accelerates growth and manages risk. It applies its deep industry knowledge, technical excellence and global delivery expertise to help its customers build leadership positions in their markets. Logica is listed on both the London Stock Exchange and Euronext (Amsterdam).

Logica's strength in GIS has been built up over two decades of operations and acquisitions across its three competence centers in Finland, Portugal and Holland. Of the 200 or more GIS specialists in its employ, 70 people are based in Finland delivering a wide range of Geo-Information and Communication Technology (Geo-ICT) solutions. Of these, 80% hold university degree qualifications and boast an average of 7.7 years experience in GIS.

### **Experience**

In Finland, Logica has 65 GIS specialists and in Europe more than 200. We have personnel with several years of both management and GIS specialist experience in

The United Nations peacekeeping operations as well as in the Cartographic Section of United Nations headquarters.

### **Main services**

Logica's GIS competence extends across the full range of services starting from consultancy and design, system specification and integration, implementation, data processing, web services, applications and outsourcing.

Finland's competence center has built its reputation on the provision of location-based services, web services, Spatial Data Infrastructures (SDI), public safety solutions and intelligent transport systems, among others.

In its operations, Logica is not bound to any single technology platform. The principle technologies Logica uses include ESRI, Open Source Software (Open-GIS), Oracle, Microsoft, MapInfo, SmallWorld, AutoCAD and Google. Specifically, Logica has partnerships with most of the major platform vendors. Logica has particular experience in the application of open source GIS platforms, as well as the world-leading GIS modeling and mapping software vendor, ESRI.

### **References**

- INSPIRE map portal for the National Land Survey of Finland, 2008
- High volume raster map production for European Directories B.V., 2008
- Online distribution of GIS data for consultancy groups, 2008
- Nationwide SDI system for the Dutch government, 2007–2009
- SDI for Finland's National Board of Forestry, 2009.

## NIRAS Finland Oy

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Sustainable management of land and environment in Zanzibar.

### Overview

NIRAS Finland (formerly Scanagri Finland) is part of NIRAS International Consulting (NIC) within the NIRAS A/S Group, which has over 1,200 employees. NIC has main offices in Denmark, Finland, Sweden and Poland, and has a permanent staff of 70 and some 350 professionals working with projects worldwide.

### Experience

NIRAS ranks among the biggest European rural development consultancy companies, building on 30 years of managing international development projects in more than 100 countries with ongoing work in 40–45 countries. Over the past 5 years, NIRAS has implemented more than 500 assignments.

*Projects demonstrating NIRAS' expertise in GIS:*

- Development of Forestry Information Systems (FOMIS) in Vietnam: The purpose is to make more accurate information available for forestry decision-making. The approaches will be piloted in three provinces, but the information system will be scalable up to the national level.
- Miti Mingi Maisha Bora (MMMB) – Support to Forest Sector Reform in Kenya: The aim is to technically set up and build capacity to operate GIS facilities in GPS

### References

- Development of Forestry Information Systems (FOMIS), Vietnam, 2009–2012
- Programme for Luapula Agricultural and Rural Development (PLARD), Zambia, 2006–2010
- Miti Mingi Maisha Bora - Support to Forest Sector Reform (MMMB), Kenya, 2007–2009
- Regional Biodiversity Programme in the CAN, Andean-Amazon Region, 2007–2009
- Forestry Support Programme, Zambia, 2001–2004
- Fire Management on Rural Lands, Burkina Faso, 1998–2006
- Support to Forest Education and Training, Kosovo, 2004–2007
- Egyptian Cadastral Information Management project, Egypt, 2002–2006
- Land Management Programme (LAMP), Tanzania, 2001–2009
- Sustainable Management of Land and Environment (SMOLE), Zanzibar, 2005–2009
- Arid Lands Resource Management Project, Kenya, 2007–2011
- Capacity Building for Land Policy and Administration Reform, Afghanistan, 2006–2007.

field data collection, geodatabase management in the LAN environment, and digital map production.

- SMOLE – Sustainable Management of Land and Environment, Zanzibar, Tanzania: The purpose is to provide technical assistance and initial investments to ensure that sustainable land and environmental management practices are in use in 2009. One of the main results will be updated aerial photo coverage and topographic mapping conducted by the Zanzibari mapping staff.

### Main services

Environmental, economical and sustainable natural resource management, especially agriculture and forestry sectors from the development of forest policies and strategies to the participatory multi-purpose planning and management of forests. Experienced in leading forest sector reform processes, community-based forest management, forest and ecosystem resource assessments and the valuing of environmental services, developing forest information and monitoring systems, establishing M&E systems including chain-of-custody and forest certification, and developing national CDM/REDD strategies to mitigate climate change.

## Pöyry Environment Oy

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Aerial photos provided by SMOLE are used for production of updated digital maps. GIS applications are developed for land and environmental management and revenue collection.

### Overview

Pöyry Environment Oy is the leading firm in Finland for water and wastewater sector consulting services outside the domestic market. The company has extensive experience in developing countries and in countries in transition. Since the 1960s, Pöyry Environment Oy has carried out projects in more than 50 countries in Europe, Africa, Asia, the Middle East and North America. The company has established its Regional Representative Office for Asia in Hanoi, Vietnam and a permanent office in St Petersburg, Russia. At present the company has project offices for example in Vietnam, Russia and Zanzibar which complement the local offices of sister companies in the Pöyry Group, located in 45 countries around the world. Pöyry Environment Oy is recognised and registered by the leading international financing institutions and other agencies, including: the World Bank (WB), Asian Development Bank (ADB), European Commission (EC) etc. The company's leading consultants are members of FIDIC through the Finnish Association of Consulting Engineers (SNIL).

### References

- Sustainable Management of Land and Environment in Zanzibar 2005–2009: The overall objective is to reduce absolute poverty in the society through environmentally sound land management and socio-economic development as well as provide technical assistance and initial investments for ensuring that sustainable land and environmental management practices are in use in Zanzibar.
- Digital City GIS for Guiyang, China, 2005–2008: System (from feasibility study to detailed design) design and implementation. The five GIS applications of GYGIS include; building a comprehensive Emergency Response System, WebGIS, “Digital Community” application to support local community-level administration and services, Flood forecasting and Decision support system, Air Quality Forecasting.

### Experience

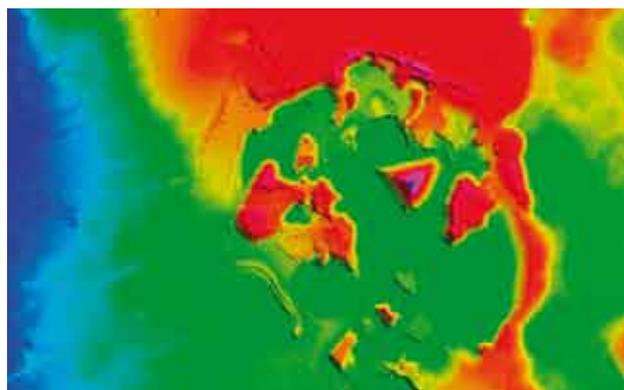
Pöyry is active in providing capacity-building support in developing countries, focusing on energy, water, health and environmental and land management. Identification, analysis and quantification of natural resources and environmental health issues affecting the poor in several countries in Africa (e.g. Egypt, Tanzania, Mosambique, Ethiopia) and Asia (e.g. Cambodia, Laos and Vietnam). Pöyry has undertaken a series of evaluation and appraisal assignments, including appraisals of institutions as well as specific development assistance projects.

### Main services

Water supply and sanitation strategy development, Water Supply and Sanitation Engineering, Water Resources Management, Waste Management, Environmental Consulting, Physical planning and Land Management, Digital Map Products and Geographic Information Systems, Remote Sensing Services

## Ramboll Finland Oy

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Airborne laser data (LIDAR) has been used to produce accurate digital terrain models and to assist GIS data survey operations.

### Overview

Ramboll is an engineering, design and consultancy company founded in Denmark in 1945. Today, the company employs more than 8,000 experts with a strong presence in Northern Europe, India, Russia and the Middle East. Close to 200 offices in 23 countries emphasise the local excellence combined with a global knowledge-base. Ramboll Finland Oy has more than 1,000 employees in 21 offices in Finland.

### Experience

Ramboll Finnconsult Oy is a Finnish consulting company specializing in development issues and development cooperation since 1963. Ramboll Finnconsult is part of Ramboll Finland Oy. Ramboll Finnconsult has successful references in more than 40 countries in the following service areas: Energy and Climate, Climate Change, Water Supply and Sanitation, Rural Development and Natural Resources Management, Environmental Management and Policies, Project Develop-

ment, Financing and Management, Health and Social Development, Education and HRD, Good Governance, Human Rights and Democracy.

### Main services

- Buildings & Design
- Infrastructure & Transport
- Mapping (aerial photography, remote sensing, airborne laser scanning (LIDAR), map production and digital terrain modelling (DTM))
- Surveying (Global Positioning System (GPS), tachymeter, laser measurements)
- Energy & Climate
- Environment & Nature
- Industry & Oil/Gas
- IT & Telecom (GIS software development, Internet WebMap applications, etc.)
- Management & Society

### References

- Capacity Building in Tax Mapping and Collection for Local Government Units in the Philippines, 2004
- Guiyang Geographic Information System (GYGIS) Project in China, 2004
- Poverty Analysis with Geographic Information Systems (Poverty GIS), Study, Ministry of Foreign Affairs of Finland, 2004
- Study on how to contribute to poverty alleviation by increasing citizen participation in rural infrastructure development (Participatory GIS), 2006
- Integration of ICT (including GIS) in Municipal Management and decentralisation in Nicaragua, 2008.

## Sito Group

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Zambia Road Network Reclassification Study project team in 2007.

### Overview

Sito, founded in 1976, is a consulting engineering firm specialized in comprehensive design for infrastructure, traffic and environmental sectors. Sito offers services from preliminary assessments and studies to total planning, project management and contract supervision and advanced information technology solutions together with geographic data collection and software solutions. Sito employs over 300 experts at six office locations in Finland.

### Experience

Sito has capabilities to deliver GIS and mapping solutions as well as the needed consultancy for institutional development to relevant organizations. Its

know-how includes full understanding of the mapping process from data collection to data processing and finishing.

Sito also has wide expertise in GIS technologies for the use of geographic data in planning and facilities management. Sito has also delivered cadastral register and mapping solutions. Its expertise includes full-scale software implementation tasks with state of the art technology.

### Main services

Surveying and Mapping, lidar data processing, training and consulting, software development, land management, NSDI consulting, GIS web services.

### References

- Sustainable Management of Land and Environment in Zanzibar, Mapping consultancy Tanzania, Zanzibar, 2008
- Road Network Reclassification Study, GIS consultancy, Zambia, 2007
- Land management consultancy for ARDI programme (Agriculture Reconstruction and Development project for Iraq), Iraq, 2005
- Surveying Consultancy for Yalo Dalol Road design project, Ethiopia, 2004
- Regional Land Use planning, Environmental management and Land management (ZILEM), Tanzania; Zanzibar, 1992–1996

## Tekla Oyj / Tekla Corporation

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### Overview

Tekla is an international software product company whose model-based software solutions make customers' core processes more effective in building and construction, energy distribution, infrastructure management and water supply. Tekla has customers in more than 80 countries. Tekla Group's net sales for 2008 totalled nearly MEUR 60, and its operating result was approx. MEUR 14. International operations accounted for more than 80% of net sales. Tekla Group currently employs over 450 persons, of whom 40% work outside Finland. Tekla was established in 1966, making it one of the longest operating software companies in Finland.

Tekla's Public Administration segment offers GIS-based solutions for municipal authorities and the companies serving them to efficiently manage and utilize core municipal information, such as land, property, cadastre, maps, land use plans, building control, citizens and business data. The solutions provide a platform for improving customer service and internal

efficiency, and facilitate the provision of e-services to local residents.

### Experience

Tekla has strong experience in municipal and regional sector solutions in Finland and Sweden. Tekla has the ability and knowledge to implement systems supporting the core processes of the local authorities.

### Main services

*Tekla's offering covers the following services related to Tekla's Software products:*

- Installation and integration
- Conversions and data migration
- Training
- Process and product consultation
- Helpdesk
- Software as a Service (SaaS)
- New software products

### References

- In Finland, our software products are used in over 40 municipalities and in Sweden, in 8 municipalities. Sales activities have started in Latvia and Hungary.



## Finnish Environment Institute (SYKE)

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### Overview

SYKE is the center for environmental monitoring, development and research of the environmental administration in Finland. It acts as a national coordinator, providing environmental information and expert services. It manages over a hundred environmental databanks, most of them on GIS. SYKE employs over 600 people. SYKE has departments for: 1) Environmental Research, 2) Environmental Information Management and ICT, 3) Expert Services and 4) Administration.

Its ongoing research programs are: 1) Global Change, 2) Contaminants and risks, 3) Integrated River Basin Management, 4) Marine research, 5) Biodiversity, 6) Environmental Policy and 7) Geographical Information Systems (GIS) and remote sensing. SYKE's GEO Division also provides environmental GIS and Remote Sensing services.

### Experience

SYKE has participated in Development Cooperation for some 15 years. Many of the projects have a component of land use management, GIS, environmental databanks and remote sensing. *The most prominent projects are:*

- Egyptian Antiquities Information System, 2000–2007. Partner Egyptian Supreme Council of Antiquities.

### References

- Resource and Environment Protection in the Timano-Pechora area, Russia 2001–2003
- Development of Environmental Monitoring and Management, Georgia 2007–2009
- Strengthening of Environmental Monitoring System, Albania, 2005–2008
- Strengthening of Environmental Administration and Management, Nepal
- Mapping of land cover and forest resources, Nepal 1993

Development of GIS based registers and mapping systems for historical sites in Egypt. Hardware and software specification, Training of Users. Website [www.eais.org.eg](http://www.eais.org.eg)

- Support to Environment and Sustainable Development in North West, South Africa 2002–2008. Provincial and municipal spatial planning and land use management legislation development and pilot spatial plans, Biodiversity inventory and database. Databases on historical sites. Information Management and GIS strategy development. GIS training.
- Land use expert for Mekong River Environmental Programme, South East Asia/Thailand 2008–ongoing. Land use and allocation plan assessment, biodiversity conservation corridors, land use budgets, Training of partner agency staff in best land use planning, zoning and allocation practices, technologies and tools.

### Main services

GIS development, information systems development, SDI planning and development, monitoring of snow cover, water quality and vegetation using remote sensing techniques, mapping of land cover and land cover change, GIS consultation, implementation of EU directives.

## Finnish Geodetic Institute

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### Overview

Finnish Geodetic Institute (FGI), founded in 1918, is a research institute for the mapping sciences. The Finnish Geodetic Institute carries out basic scientific measurements for Finnish mapping and research on the metrology of geospatial information and also engages in research work in the fields of geodesy, geoinformatics, remote sensing, and navigation and other related sciences. The task of the institute is also to foster the introduction of geodetic, geoinformatics, remote sensing and navigation methods and equipment in the acquisition and processing of geospatial information in particular.



Measuring geodetic baseline in Lithuania.

### Experience

Reference frames, geodetic baselines, gravimetry, geodynamics, airborne imaging and laser scanning, quality of digital elevation models, geo-referencing, geospatial analysis and interoperability, GNSS positioning and personal navigation.

### Main services

Planning and evaluation of geodetic, mapping and navigation methods. Quality control of airborne mapping systems, design of interoperable system for geospatial information, and development of navigation methods.

## Geological Survey of Finland (GTK)

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### Overview

The Geological Survey of Finland is the national geological research centre in Finland and ranks among the most competent geoinstitutions in applied earth sciences in Europe. GTK maintains and develops a proper geoscience information infrastructure to ensure economically, environmentally and socially sustainable development in the use of natural resources. GTK's mandate supports controlled use of earth resources; improves environmental performance and produces useful information for construction and land use planning. In addition to experts in the different geosectors, GTK has a number of highly experienced specialists in the fields of spatial geodata management and GIS techniques.

### Experience

Geological Mapping in Mozambique, 2002–2007: GTK Consortium's task was to carry out geological mapping for creating a comprehensive coverage of geological spatial databases with adjacent data sets like mineral deposits. The outcomes included high quality digital and paper maps on the scales of 1:250 000 and 1:50 000. Geodata Management in Zambia (Evalu-

### References

- Geological Mapping, Geochemical Surveys and Mineral Resources Assessment in Selected Areas of Uganda, 2009–2011;
- Geodata Management in Zambia Geosector Organizations Evaluation and Capacity Building, 2007–2008;
- Mineral Resources Management Capacity Building Project/Geological Mapping (LOT 2 and 3), Mozambique, 2002–2007;
- Geochemical and Industrial Mineral Surveys, Mozambique, 2002–2007;
- Geochemical and Geophysical Surveys, Tanzania, 2003–2007;
- High-resolution airborne geophysical survey for mapping, Tanzania, 2003–2004;
- Implementation of the New Mining Cadastre - SMMRP Sustainable Management of Mineral Resources Project, Nigeria (with GAF AG) 2007;
- Airborne Geophysical Survey and Interpretation, Angola, 2007;
- Geothermal Site Investigations, Uganda, 2004;
- Establishment of a Geolaboratory, Mozambique, 2005–2007.



Field work in Tanzania.

tion and Capacity Building), 2007–2008: The objective of this Project was strengthening of the institutional capacity of the Geological Survey Department (GSD) and the Geology Department of the School of Mines by developing modern Geographical Information System technology facilities and geological data information management.

*The main outputs of this project include:*

- Improved availability and accessibility to digital geological information.
- Improved skills among staff members regarding digital data production and data management.
- Enhanced capacity in digital map production and data digitalisation processes.
- Upgraded IT systems and GIS software.

### Main services

Geological and mineral resource mapping, training for management of geological data, geodata management, visualisation and map production, geochemical surveys and data management, airborne and ground geophysical surveys, environmental and mine closure studies, development of geolaboratories, institutional capacity building for geo-organisations.



# Helsinki University of Technology

## Department of Surveying

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### Experience

The Department of Surveying is one of the original departments of Helsinki University of Technology. The department is responsible for the highest level of education for surveying sciences in Finland. In addition, it is the only comprehensive university unit of the field in the country. In accordance to the field of surveying science, the department has two degree programmes, Geomatics and Real estate economics, which provide high-level undergraduate teaching and scientific post-graduate studies.

### Main services

- Academic Research
- Geodesy
- Photogrammetry and Remote Sensing
- Geoinformation and Cartography
- Real estate studies
- Finance law

#### Academic Master's Programmes

- Master's Programme in Geoinformatics
- Master's Programme in Real Estate Investment and Finance

### References

- 3-D Jabal Haroun/FJHP, 3-D modelling and archaeological documentation, Jordania, 1998–2008.



## National Land Survey of Finland

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Cooperation between Finland and Nepal has been long-standing and successful in land surveying.

### Overview

The National Land Survey of Finland produces and provides information on properties, topography and the environment as well as related services. The National Land Survey (NLS) is responsible for Finland's cadastral system and general mapping assignments. It also promotes the shared use of geographic information. The NLS is a governmental agency subordinate to the Ministry of Agriculture and Forestry and has a staff of 1,800.

### References

- Zanzibar Integrated Land and Environment Management (1991-1997): – Zanzibar's authorities were assisted in the execution of its renewed land and environmental legislation. The land administration component activated the operations of the land administration department and surveying division, in addition to developing the land registration system.
- Updating of the Hydrographic Atlas of the Mekong River (1988-1998): – Operational support and training were given in this project to the member nations of the Mekong River Commission. These countries updated the Mekong's hydrographic maps with the aid of the project and prepared topographical maps for the river shore areas.
- Nepal Topographic Mapping Project (1995-1999): – This project comprised all traditional map-making stages from ground control and aerial photography to five-colour atlas printing. The entire Nepal area was surveyed with modern methods in accordance with scales 1:25 000/50 000.
- Cadastral Mapping and Land Registration Pilot Project in Cambodia (1997-2003): – The long-term goal was to establish the foundation for durable economic and social advancement by developing land administration and adopting the use of modern technology in surveying properties and in land registration. The pilot project ended in 2003, after which the project continued as part of the World Bank's wider land administration project.
- Topographic Mapping of Vientiane Plain (1998-2003): – 1:4000 scale digital maps were prepared for the Vientiane Plain region, approx. 3600 km<sup>2</sup>. The primary purpose of the project was to train the staff of Laos' mapping agency in this sort of production.
- Cooperation Project with the Egyptian Survey Authority (2007-2008): – In the "Twinning" project, the main themes were an information service, the agencies' Internet services, software programs and equipment-related data security as well as the operational presentations of the agencies. Forms Cooperation includes visits by specialists, seminars and training events.

### Experience

There have been many land surveying projects within Finland's development cooperation programme. The NLS has already prepared projects and supervised their implementation on assignment from The Ministry for Foreign Affairs since the 1970s. Implementation is assigned to a Finnish consulting company as a result of competitive bidding. The project is realised under the direction of specialists utilising the staff of the recipient country's organisation.



UNIVERSITY OF HELSINKI

## University of Helsinki,

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Taita spectrometer.

### Overview

The Geoinformatics Research Group within the Department of Geography has a staff of 10 experts consisting of specialists in geographic information systems and remote sensing and development geographers. The field of research and development has been land cover, land use and forest cover mapping and change analysis in relation to environmental change caused by climate change and population growth.

### Experience

In the TAITA project the aim was to develop land use change detection methods using geographic information systems and remote sensing data and methods for East African highlands. The data used was aerial photography as of the 1950s, with digital camera data added by means of GIRG's EnsoMOSAIC imaging system in the early 2000s, and SPOT satellite imagery since the 1980s, 1990s and the current decade. Other geospatial datasets, such as digital elevation models, road and hydrographic network was derived from topographic maps of The Survey of Kenya. The specific focus was on studies exploring the growth of informal settlements, soil erosion and the loss of forest cover in the Taita Hills, SE Kenya.

The TAITATOO was a second phase of the TAITA

project, in which the geographic database compiled during the project is being applied for soil erosion modeling and forest corridor modeling between the fragmented forests of the Taita Hills. Special emphasis is on the research of communities' participation in natural resource management, using participatory GIS methods. The collaboration partners were trained to use GIS and remote sensing in environmental data acquisition and analysis as well as in management.

The department also has experience in working in Amazonia, as some experts of the department participated intensively in the BIODAMAZ project in the Peruvian Amazonia during 2002–2007. The work included elaboration of comprehensive remotely sensed and other spatial data sets over Peruvian Amazonia, the development of Internet-based geographical information systems and map services, and the training of local experts.

### Main services

Geographic Information Systems, Remote Sensing, Aerial photography acquisition and processing, Geographic database production and management, Land use and land cover mapping, Forest inventory, Development studies, Livelihood studies, Participatory GIS, GIS and remote sensing in-service training.

### References

- TAITA – Development of land use change methodology in East African highlands Kenya, 2003–2005, funded by the Academy of Finland (<http://www.helsinki.fi/science/taita/>)
- TAITATOO – Geoinformatics in environmental conservation and community based natural resource management in the Taita Hills, Kenya, 2006–2009, funded by the Academy of Finland
- GIS Training course, GIS applications in environmental monitoring in the Taita Hills, Kenya 2006, organised at RCMRD in Nairobi and funded by the Ministry of Foreign Affairs of Finland.



# University of Joensuu

## Faculty of Forest Sciences

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### Overview

The Faculty of Forest Sciences (formerly Faculty of Forestry, founded in 1982) at the University of Joensuu is an internationally renowned research and education centre which produces highly competent and responsible professionals with excellent management skills for forestry and other environmental management fields for Finland and the rest of the world. Each autumn, about 35 new forestry students, “forstis”, begin their studies, while roughly 500 MSc degrees and 120 DSc degrees have already been completed in the Faculty. The Faculty is an international education and research centre: more than a hundred international students study at the Faculty annually.

### Experience

The Master of Science in European Forestry -programme is jointly managed by six European universities and three other partner organisations. The Faculty of Forest Sciences, University of Joensuu, is currently the coordinator. The selection of students is based on the applicants' performance in their Bachelor's stud-

ies, their abilities with the English language, and their previous international experience. The annual intake is 25 students, most of them come from outside the European Union. During the study period students will visit several countries and depending on the study plan they will study in several partner universities.

One example about joint research project is “Tree seedling production and management of plantation forests, INCO-DC project”. It was coordinated by prof. Timo Pukkala and financed by EU between 1997–2000. Participating countries were Germany, Portugal, Tanzania, Kenya, Zambia, Zimbabwe and Namibia. A number of research papers and four D.Sc. theses were completed during the project.

### Main services

University education, degree and non-degree programmes; research in specific topics; professors and researchers of faculty have long background in tropical and international forestry issues.

### References

- Forestry in Namibia 1850–1990, Namibia, 1992–1997
- Tree seedling production and management of plantation forests, INCO-DC project, Tanzania, Kenya, Zambia, Zimbabwe and Namibia, 1997–2000
- New Technologies to Optimize the Wood Information Basis for Forest Industries – Developing an Integrated Resource Information System, Brazil, 2008–2011
- The International Partnership for Forestry Education (IPFE). The IPFE Secretariat is at present co-hosted by the University of Joensuu in Finland and by the University of British Columbia in Canada, 2007–

## University of Turku

Department of Geography

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### Overview

The University of Turku is an internationally acknowledged, multidisciplinary scientific university. With its 18,000 students and 3,000 employees, it is the second largest university in Finland. The University of Turku supports active cooperation between various fields of science as well as with society and business life.

The University of Turku Laboratory of Computer Cartography, or UTU-LCC, founded in 1995, is an important research facility at the Department of Geography, shared with the Departments of Biology and Geology. It is an interdisciplinary research unit to enable the use of spatial data in different fields of human and natural sciences. UTU-LCC supports research and education in Geoinformatics: Remote Sensing (RS), Geographical Information Systems (GIS), Digital Mapping, Digital Image Processing and Personal Navigation.

### Experience

UTU has multidisciplinary development research and collaboration experience primarily in South-America (e.g. Peru) and Africa (e.g. Tanzania). Main research and collaboration topics include environmental problems, environmental change issues, biodiversity, land use/land cover change, regional development, forest conservation, urban studies and applied geoinformatics (GIS databases, internet map services etc).

UTU has strong emphasis on the use of geoinformation technologies (GIS, remote sensing, image processing, spatial statistics, cartography) in a wide variety of environmental problem-solving cases.



As part of the Zanzibar research activities of UTU, a remote sensing and GIS course for environmental officers was held in Maruhubi, Zanzibar in January 2007.

#### Case examples:

UTU-ART (University of Turku, Amazon research team, [www.sci.utu.fi/projects/amazon/](http://www.sci.utu.fi/projects/amazon/)) is an interdisciplinary research team with activities in tropical America, especially Western Amazonia. It has experience in using remote sensing to detect variation in vegetation and forest patterns, the use of Geographic Information System (GIS) to help synthesize information from different sources and assessing the ecological constraints they pose to land use and biodiversity management. The research has also involved development of tools for communication with spatial information, both in form of published maps and Internet map services.

The Zanzibar research team (<http://sustainablezanzibar.utu.fi/>) is aiming to synthesize information on landscape change dynamics, biodiversity, land use potential and stakeholder preferences into an understanding of the sustainability of Zanzibar landscapes and environment. The team has experience in the use of GIS and remote sensing in vegetation studies, environmental (land cover, land use) change studies and use of GIS in the analysis of social environment and land use values (participatory GIS).

### Main services

Use of Geographical Information Systems (GIS) and Participatory GIS in environmental and social studies, Remote sensing of environment (satellite imagery, aerial photographs), Cartographic expertise (map-making), field surveys (biodiversity, vegetation, land use mapping).

## VTT Technical Research Centre of Finland

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### Overview

VTT Technical Research Centre of Finland provides high-end technology solutions and innovation services. VTT can combine different technologies, create new innovations and a substantial range of world class technologies and applied research services, thus improving its clients' competitiveness and competence.

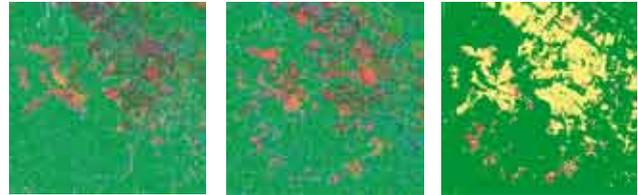
VTT is a non-profit-making research organisation which has 2700 employees. VTT's turnover in 2007 was MEUR 232, of which close to three-quarters came from contract work and joint research programs. Basic governmental funding totalled 33%.

The research in remote sensing and environment information systems at VTT focuses on advanced image interpretation methods to retrieve information from digital satellite images. Our special fields of expertise are remote sensing of the natural environment, particularly forestry applications and sea ice monitoring. Other important areas include security applications and monitoring methods for sea and terrestrial traffic.

Technologically, the main interest at present is in the analysis of multi-source data, very high resolution data,

### References

- Feasibility study on the forest monitoring concept using very high resolution satellite data, Laos, 2009
- SAR Interferometric Techniques in Hill Slope Stability Monitoring for an Environment Security Monitoring System, Malaysia, 2008–2009
- GMES Service Element: Forest Monitoring, French Guyana, 2005–2009
- Multisource information System for Flood Forecasting, Finland, 2008–2011
- Environment monitoring using Earth observation (for Disaster monitoring, Forestry, Maritime application, Traffic monitoring, Repository site monitoring and Season monitoring), Finland, Japan, 2004–2006.



Forest area monitoring in French Guyana. Two radar images and a forest area change map are shown. In the Change map on the right green areas are forest in both datasets, red areas have turned from forest to non-forest, and the yellow areas are non-forest in both datasets.

and imaging radar data. Automatic analysis of ground-based digital photographs to support satellite image analysis represents a new extension of the research interest.

### Experience

VTT has conducted several projects on the mapping of tropical forests in French Guyana and Laos, using optical and radar satellite data. The projects support implementation of the Kyoto protocol and are developing tools for the implementation of the post-Kyoto climate treaty. VTT has also been working in the field of disaster monitoring in several projects, of which the latest are land slide monitoring in Malaysia and flood monitoring in the northern parts of Finland.

### Main services

Research and development services in the field of satellite image analysis and in environment information systems. Provision of pilot services is also possible. When the services are being established, VTT looks for partners that can take care of their operative provision.



NATIONAL LAND SURVEY OF FINLAND



UNIVERSITY OF HELSINKI



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EASTERN FINLAND  
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