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Coordinates

Rs.100 **MONTHLY** RNI: DELENG/2005/15153 No: DL(E)-01/5079/05-07 POSITIONING, NAVIGATION AND BEYOND

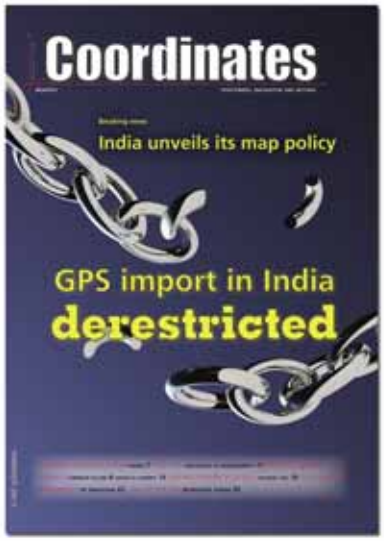
Developing national SDI platform for Greece

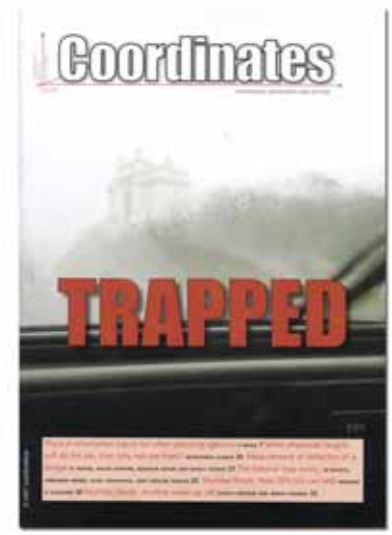
Indian prelude to British cadastral and revenue maps

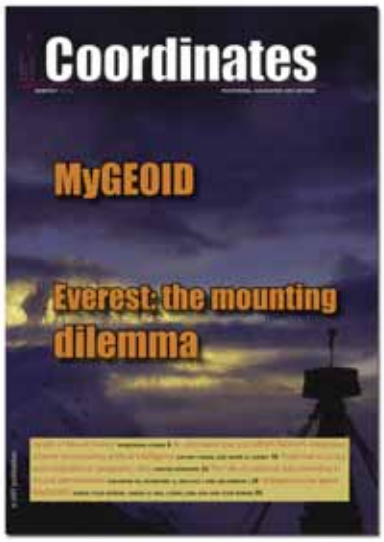
The biggest GPS market in Japan is car navigation

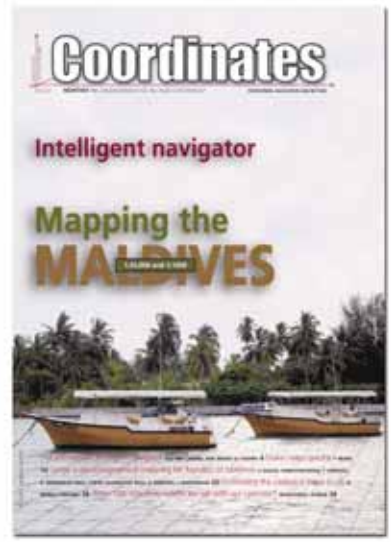
— Hiroshi Nishiguchi

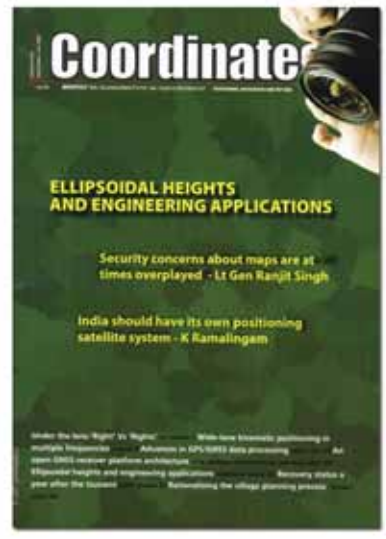
A cGIT publication











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Articles

Columns

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Who owns the information?

Own, control, use and misuse.

That's the story about information.

When search engines like Google, Yahoo and Micorsoft open new vistas of information access on the wagon of Information Technology, many feel the repercussions.

On one hand they indicate an era of 'Information Democracy', on the other hand many feel threatened by the possible fallout.

That's obvious as neither the nature of the information nor the technology by which it is generated and disseminated is neutral.

They serve the intentions and interests of those who own them.

Hence, it is understandable when Google agrees to meet the censored conditions of Chinese government in its Chinese language version of its search engine.

On March 9, 2006 the Government of India told Parliament that steps had been taken to mask some areas of the imagery from Google Earth website that were causing concerns.

Whether such initiatives yield the desire result is yet to be seen.

The debate about the 'right information' and 'rights on information' is secondary.

The struggle is to own it.

Bal Krishna, Editor
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"The biggest GPS market in Japan is car navigation"

says Dr Hiroshi Nishiguchi, Secretary General, Japan GPS Council while discussing the trends in GPS applications and market in Japan

What is Japan GPS Council? What does it do?

The Japan GPS Council (JGPSC) was established in the end of 1992, as a non-profit voluntary body composed of various kinds of industries and civil GPS user community. The Aim of the Council is to secure a favorable environment for proper utilization of the GPS system, and to contribute to the stable use of, and the future worldwide development of the GNSS.

What are the current GPS research trends in Japan?

Indoor positioning and navigation using pseudolite system of the GPS like signals, so that we can expect seamless location based services.

In which direction the GPS market of Japan is moving?

Market creation in the everywhere, whoever and anytime LBS such as Ubiquitous world.

The biggest GPS market in Japan is the Car navigation and its synergy effects market such as VICS (Vehicle Information and Communication Services) which provides the traffic jam information and route guidance.

What are the innovative applications of GPS in Japan?

We can list-up as follows;

(1) Construction machinery control using GPS precision positioning & navigation
(2) Remote controlled (robotics) civil engineering and construction works like TV games
(3) LBS for children security
(4) Telematics
(5) GIS works using Network type RTK-GPS services
(6) Tsunami monitoring system

How do you see the present and future of LBS in Japan?

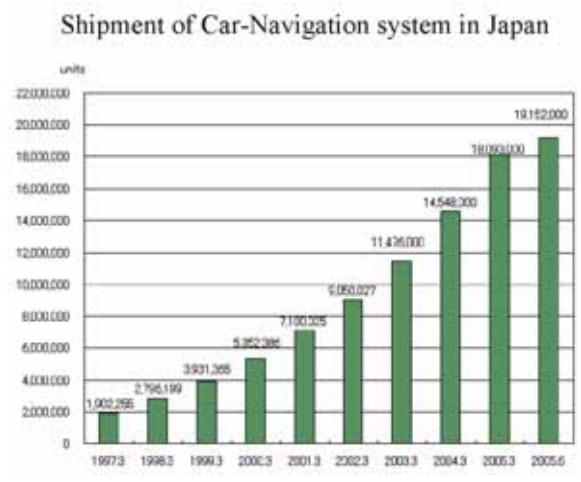
Many applications of LBS emerges in the Japanese market but being still in cradle stage. However, it is no-doubtful the LBS business would be the next big market in Japan as well following Car-navigation. The QZSS will have a key for marketability of the LBS, with the QZSS capability of its improving ability for the satellite visibility, getting better GDOP and TTFF(time to fast fix) augment services.

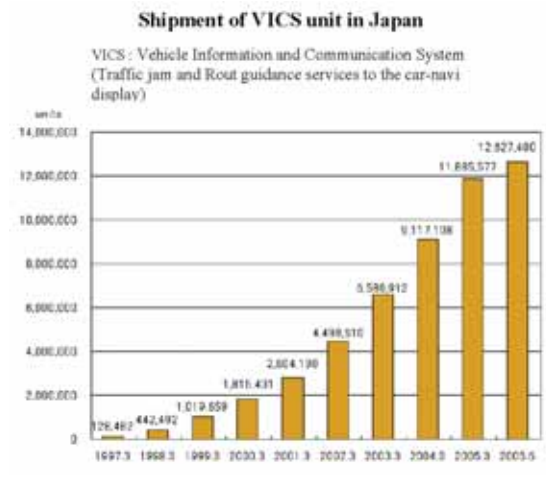
What is the status of Japan's MSAS and QZSS programme?

The MSAS is now under the in-orbit examination, and the QZSS is now under the R & D by governmental organs with coordination and cooperation with the US GPS and the EU's Galileo frequencies.

How do you see the emergence of Galileo?

Galileo will give us the better visibility and availability increasing, together with pay service for integrity. However, as far as concern with





equilibrium, it would be no problem and little impact in marketability for every GNSS applications in Japan. I see the Galileo program is a single purpose of their sovereignty issues for the EU composed countries. Perhaps, it would be difficult for the Galileo vehicle company to find out the business feasibility, unless otherwise getting continuous huge investment and big market for Galileo chip royalty from China, India, Korea and others. We, Japanese market and/or industry have almost no interest in Galileo. There already exist GPS and GLONASS market in Japan

How do you perceive the US monopoly on GPS?

The successive Presidents of the US have promised to the world that the US provides continuously GPS Standard Positioning Services without direct user charges, and sustains the GPS system as the world infrastructure resources.

We would thank the US Government and civil tax payers for its GPS modernization policy and generous contribution to the world peaceful civil GPS users community. It is the fact that the US GPS SPS service policy without direct user charges obviously has been creating civil GNSS markets and businesses. Besides, the US only would be the most trusty to keep peaceful world with their philosophy and characteristics such as their intention to have the world police administrative capability.

Regarding the security issues, Japanese E-911 (E-110/119 in Japan) emergency call system Act is commencing from April 2007.

How conducive are the Government policies for the growth of GPS in Japan?

It is understandable that the Japanese industry leads to create GNSS civilian market with their products and services, and then the Government Officers just respect its fact, so far. At present, most of the Japanese Government recognize importance of the GNSS and look GNSS future wide possibility in the every field. Especially GSI (the Agency of Geographic Survey Institute) have employed many GPS-based precision surveying systems since the earlier stage, 1987. As the result, Japan achieved the establishment of the continuous GPS reference station network throughout Japan, named GEONET(GPS Earth Observation Network) with more than 1,200 GPS reference stations. This GEONET leads and supports the Japanese GIS programs at present and future.

In many countries there are cultural issues that hinders that acceptability of new technologies. Do you see any such cultural issue in Japan?

Yes, we can see easily such cultural issues. However, the cultural issues could become one of the merchandising strategic tools. We can see it in the Japanese dominant of the Car-Navigation market, in contrast with the world.

Do you understand why Japan only enjoys so-growth of business of car-navigation products and related services? It can be seen that is the Japanese culture. Hinders will be candidates to become strong customers. The culture is the marketing resources. I see the market is newly created in the place enabling to make business and growth along with the appropriate product design and marketing activities.

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What does our world really look like?

An attempt is being made by volunteers all over the world to visit the confluence points and document the scenery with pictures and narratives

RAINER MAUTZ

Usually, us human beings tend to cumulate in urban centres, and if we go places, then to those which we consider as worthwhile a visit, such as the Tower of Pisa or Old Faithful Geyser in Yellowstone National Park. Due to our unbalanced focus on certain areas, we have a distorted image of our world – much more jam-packed of houses, roads and people than it actually is.

An approach to sample the world

If we want to have an unbiased view of our earth surface, we need to sample it that independently of any existing human infrastructure, topography and accessibility. One clever idea that realizes true independency is simply to identify an evenly distributed set of sample points by coordinates.

A straightforward approach is to sample all the exact spots where an integer degree of latitude and an integer degree of longitude meet, such as 20°00'00"N 106°00'00"E. Those 64,442 points are referred here as confluence points. Using the WGS84 datum the locations of those points are exactly defined. If we only knew what these sites – at least those 21,541 being on land – look like, the title question could be answered. Considering that pure satellite pictures do not give the true impression of the spot compared to the scene when actually standing on it, taking pictures of all confluences means to go to the confluence points. This is quite an effort, since they form a grid with a cell size of roughly 100 km. by 100 km.

The Confluence project

Fortunately, for the past decade an attempt is being made by volunteers all over the world to visit the confluence points and document the scenery with pictures and narratives. All reports of visits are submitted to the website *www.confluence.org* where they are published. Now, exactly 10 years into the project with several thousand people actively participating, one might guess that all points must have been visited. De facto, only 26.9% of the project goal is fulfilled at the time of writing.

Why is the progress so slow? The answer can be found when recalling that these points ignore our built infrastructure: they let 'confluence hunters' drive into deserts, wade through swamps, argue with land owners and run for miles after their vehicle has got stuck in the sand, thereby always counting down numbers at the displays of their GPS receivers. The time to reach confluence points ranges from 10 visits in 1 day (as I managed to do in Germany, a country with dense infrastructure) up to 1 visit in 10 days for reaching the world's highest confluence at 5835m in Xizang (Tibet).

The disparity of infrastructure, population density, and awareness of the project hampers the fulfilment of the project goal. Currently, there is a huge gap in completeness of the project between different regions in the world. Figure 1 shows the current achievement in all countries. On the top of the list of best documented countries is Luxembourg with its only confluence point (50°N 6°E) being visited 13 times. Even in a larger country such as Germany, its 48 confluence points have been documented more than 5 times on average. On the other end, in areas

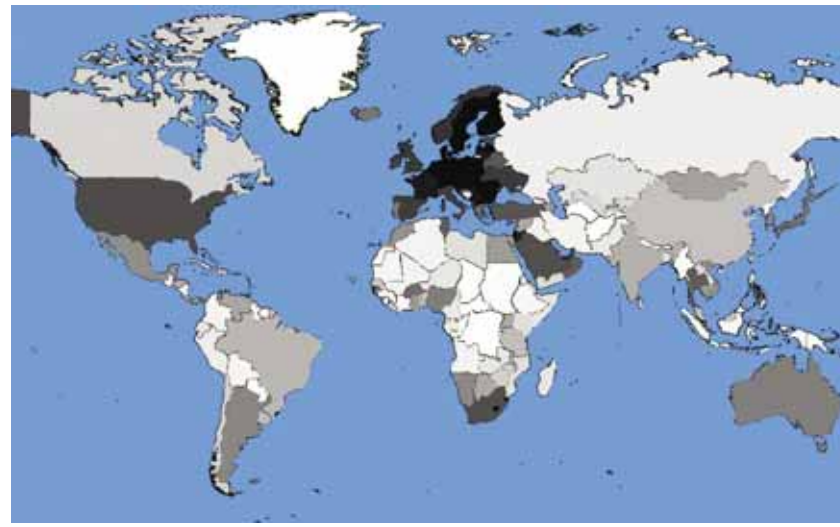

Figure 1: The completeness of confluence point documentations for different countries. The greyscale directly reflects the ratio between the fraction of visited points of a country. White (greyscale 255) indicates that none visits have been done, black (greyscale 0) specifies that all confluence points have been visited.

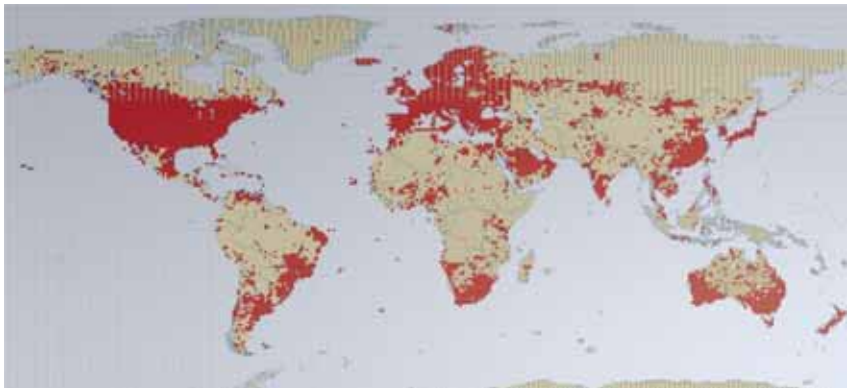

Figure 2: Uneven distribution of visited confluence points: Those marked red have already been documented.

where the people's basic needs such as water, food and health are far from being satisfied, the search for confluence points is not ranked high on the to-do-lists. The Democratic Republic of Congo (Zaire) is leading the list of incompleteness: not a single of the 189 confluence points in Congo has been visited nor even attempted. Clearly, most of the Congolese are not aware of the project and not equipped with the required instruments to survey their nearby confluence points. On the top of everything the access to the sample points is challenged by tropical rain forests and intestine wars. The density of visited confluences for a country however is hardly correlated to the population density (correlation coefficient +0.15), but clearly correlated in the GDP (correlation +0.6) and the number of internet users per 1000 inhabitants (correlation +0.6). Figure 2 shows the locations of visited confluence points – within large countries like China or Russia the density of visits varies significantly. Russia's easy accessible areas in the west and along the industrial belt are almost completed while the most of Siberia which is mostly covered by swamps, uninhabited taiga and tundra is still untouched by confluence hunters.

Challenges in finding confluences

Navigating to confluences can be challenging – physically where a coarse road network demands long hikes or climbs, such as the Tibetan confluence 30°N 90°E where the visitors suffered a physical toll (one of them was rushed to the hospital after the trip) because the confluence hunt involved a 6-day, 75 km pack-horse trip at altitudes continuously above 5000 m without any villages or human infrastructure. Sometimes negotiation skills are required when points are located in restricted areas, such as the last remaining virgin confluence on the contiguous USA (37°N 116°W) that resisted all attempts for visits due to its location in the Nevada nuclear test site, which is very restricted U.S. government property. However, nothing is impossible if there is a strong will – so finally this last land confluence was documented.

I can clearly say that the challenge of finding confluences can be fascinating – if not addictive. From a rational point of view, "confluencing" seems to be pointless, if not foolish. Why should one shoulder so much effort just to get to a pointless place on earth? Well, there are several reasons:

- Often takes you to places that never sees tourists and has untouched wildlife. If the area is populated then friendly people are happy to see you coming because they rarely have visitors.
- Provides a challenge in everyday life. Nowadays, modern societies satisfy most needs causing a desire for further goals. Purposelessness is driven away by the collective aim of the project.
- Provides training skills in orientation, navigation, negotiation, climbing, hiking, problem solving, timing, improvising, organising, geography, transportation and many more.
- Discover the fascinating and intriguing sides of ordinary places not on the "must see" agenda of most travellers and discover the fascinating and intriguing sides of those places which are supposedly uninteresting.
- Last, but not least, participate in the Degree Confluence Project. There are few projects where volunteers from all over the world are unified by a common goal.

After having personally visited 82 confluences in 24 countries I can clearly say that despite the fact that places are very different, each confluence visit involves the following steps:

The planning phase

It is essential to look at the available time budget and estimate how long the whole trip from the highway, country road, track, footpath, cross-country to the point and back will take. Unsuccessful visits are almost always due to the fact that the real trip turns out to last much longer as estimated. Therefore it is useful not to face tight deadlines such as darkness, bus schedules or promises to spouses. A good rule of thumb is to estimate your time on getting there, and then double it. If you finish early, congratulate yourself.

The journey

Problems will always occur despite thorough planning. Facing and solving

Picture 1: 17°N 105°E, drying GPS receiver in southern Laos

Picture 2: 40°N 41°E, fixing a flat tyre in East Anatolia

Picture 4: 31°N 74°E, road control in Punjab

problems should be taken as part of the play. When I tried to get to a remote confluence in Laos' jungle at a rainy day and almost reached the confluence, the GPS receiver quit working. After I had dried the instrument in the sun for two days (picture #1) I started again and made it a successful visit. I had a flat tyre in Turkey (picture #2), my car got stuck a remote part of Iran's desert, and issues with the police had to be solved in Yemen (picture #3) and Pakistan (picture #4). Taking a local guide, being patient with locals and communication with people who know the area are key to success. We shouldn't forget that some places we consider disagreeable are other people's homes.

Standing at the confluence

It is the highlight of any confluence trip, but usually time constraints, weather conditions, animals, or worried landowners keep the visits short. The visit can be intense if the point is near a school in remote China (#picture 5), a river in India (#picture 6) or a Cambodian town where spiders are delicacy (#picture 7).

Reporting the confluence

Submitting a report and pictures to the website can be quite some effort, but is usually rewarded by feedback from the confluence community.

Equidistribution on the sphere

Only when all degree confluences have been visited will a thorough view of our planet's surface be possible. One might argue now that all meridians meet at the poles and that pole areas have a higher density of latitude-longitude intersections than the tropical regions. This is due to the definition of geographical coordinates, which are referenced on the WGS84 datum and its underlying Geodetic Reference System 1980 (GRS80) ellipsoid, see Figure 3. As a consequence the distance between degrees of longitude varies considerably between 111.32 km at the equator to 1.95 km at the 89° latitude circle. The distances of latitude circles however do not vary significantly (between 110.57 km at the equator to 111.69 km between 89° latitude to the poles). Whatever coordinate system is used, it is not possible to equally distribute points on the sphere except in a few special cases called the platonic solids like the Tetrahedron or Dodecahedron. More details see Womersley (2005). For the confluence project this problem is solved by excluding some points near the poles and calling them "secondary" while all others are considered as "primary". Further details can be found on the website of confluence.org.

Picture 3: 14°N 44°E, required police escort in Yemen's highlands

The future

Will the project ever be completed? Considering it took 10 years to visit 25% of the points, a linear prediction would give a positive answer, but would also suggest a completion in the year 2036, which means another 30 years of hunting unvisited points. Well, some variables make this calculation unreliable. The last remaining unvisited point might be hard to conquer (e.g. imagine trying to visit a confluence in a military compound in North Korea) or just unattractive to visit (as most of Antarctica seems to be with currently

Picture 5: 27°N 105°E, curious school kids in Guizhou

Picture 6: 24°N 77°E, women completed laundry at a nearby river.

only 5 out of 1718 primary points visited). On the other hand, the project has gained publicity and attracted a rising number of active members. If the whole world population would participate, I guess that all points can be reached within in a couple of days. A realistic forecast can be made by looking at the past. Figure 4 shows how the project developed over the last 10 years. While the number of total visits is still increasing, there is a downward tendency for the number of first visits of confluence points over the last five years. If the downswing continues, a completion in 30 years is doubtful.

Here is my idea how one can break all records and visit 360 new confluences in one day (350 of them being secondary): circle the South Pole at the 89° latitude circle on a snowmobile. If you take the required pictures of the confluences (being 1.95 km apart) on-the-fly, the 700km journey can be done on an average speed of 30km per hour. But I guess that realisation face a lot of logistical challenges and also involve some costs.

In conclusion I can say that it is currently an open question whether the project goal will be met one day or not. May this article contribute to the awareness of confluences and help to answer this open question someday with: “project completed!”.

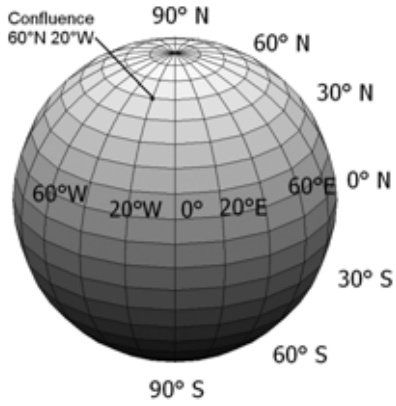

Figure 3: Geographical Coordinates Grid

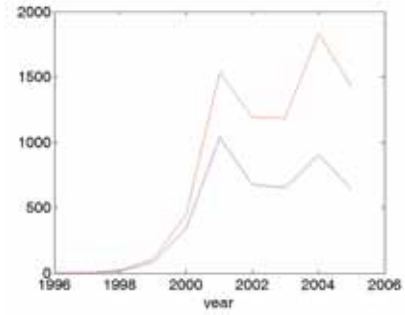

Figure 4: The blue line shows the number of points that have been visited for the first time in a year, the red line shows the number of all visits in that year.

Womersley, R (2005), Distributing points on the sphere Homepage Articles School of Mathematics, UNSW, http://www.maths.unsw.edu.au/school/articles/me100.html

Picture 7: 12°N 105°E, fresh roasted spiders in Skon, Cambodia

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GAGAN update

At present, GAGAN ground segment is under integration test and data collection at INMCC from the INRES.

ARJUN SINGH

GAGAN is an Indian Space Based Augmentation System (SBAS). Airports Authority of India (AAI) and Indian Space Research Organization (ISRO) to provide the seamless navigation service for all the phases of flight over Indian airspace jointly undertake this project. The AAI's efforts towards implementation of operational SBAS can be viewed as the first step towards introduction of modern CNS/ATM system over Indian airspace. This project involves establishing ground-based elements inclusive of eight Indian Reference Station (INRES), one Indian Master control center (INMCC), one Indian Navigation Land Uplink Station (INLUS).

To begin implementing an SBAS over the Indian airspace, Wide Area Augmentation System (WAAS) codes for L1 frequency and L5 frequency were obtained from US Air force (Department of Defense) on November 2001 and March 2005. The assignment of L1 and L5 codes is an indicator of the recognition of the need and seriousness of the Indian implementation of GAGAN as GPS augmentation system.

The implementation of the operational GAGAN will take into account the aspects of interoperability with other Satellite Based Augmentation System (SBAS) like WAAS, EGNOS, and MSAS etc. GAGAN planned to be implemented in three phases.

1. Technology Demonstration System (TDS)
2. Initial Experimental Phase (IEP)
3. Final Operation Phase (FOP)

The TDS is broadly defined to consist of eight numbers of INRES, one INMCC, one INLUS and a space segment. The ionospheric modeling, required communication links and the necessary software for navigation and communication are being developed as additional parallel effort. Eighteen GPS-TEC receivers have been installed at 5x5 degree grid and are downloading the GPS data for the last 18 months. To study the ionospheric behavior more effectively over entire Indian Airspace, Indian universities and R&D labs, which are involved in the development of regional based IONO-TROP model for GAGAN, have suggested nine more stations.

The scope of the TDS is planned to include the addition of a second frequency L5 both in the space and ground segments and procurement of State-of-the-art ground element. The IEP is being implemented concurrently with TDS Phase.

INRES has minimum two identical GPS receivers/ antenna subsystems to receive GPS signal (L1, L2 & L5) and GEO signals (L1&L5) form all the satellite in view. INRES is configured as multiple receiver chains for obtaining the measurement from the GPS and GEO satellites. During TDS phase eight INRES are planned and all have been installed at their respective stations. INRES is located at Delhi, Banglore, Ahmedabad, Kolkata, Jammu, Portblair, Guwahati and Trivendrum. Five stations are within airport operational area and three are outside the airport. These stations are so chosen to provide service coverage over Indian airspace.

INMCC is major subsystem of the GAGAN project and the function of the INMCC is correction and safety subsystem, operation of maintenance subsystem, service monitoring subsystem and data communication subsystems. Using suitable navigation software INMCC process the data received through communication link from the all the INRES. It also estimates the integrity and availability of the GPS satellites and uplinks these parameters via INLUS for broadcast to the user receiver through GEO. The INMCC for GAGAN TDS is located at Kundanhalli Banglore. The installation and integration of this major subsystem has been completed. Testing is in progress.

INLUS ground station will receive messages from INMCC and will transmit the correction to GSAT-4 for broadcast to the user platform. The INLUS also provides GEO satellites ranging information and corrections to GEO satellites clocks. The ground station has been establishes in June 2004 in Kundanhalli and it is collocated with INMCC at Banglore.

The up-linking station with the 11 meters antenna has been developed indigenously and has been installed. The RF equipment required at the up-linking station has been procured and installed indigenously and also design is flexible enough to cater for subsequent phases of the program.

A geo-stationary navigation payload in C band and L1 and L5 frequencies (L band) will be carried on an Indian Geo-stationary satellite i.e. GSAT-4 placed at 82 Degrees East. The Indian payload will fly on GSAT-4 scheduled for launch by December 2006.

The locations were finalized after an elaborate study on multi-path, noise survey and obstruction clearance. A document was prepared for all the INRES and INMCC to check the compliance of the requirements.

At present, GAGAN ground segment is under integration test and data collection at INMCC from the INRES.

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Leica Geosystems also presents an extremely powerful data collection and evaluation solution for tunnel construction – from tunnel guidance to the handover documentation. TMS Tunnelscan is the new system module for tunnel scanning within the Leica TMS product family. *www.leica-geosystems.com*

Real-time direct georeferencing and flight management system

Combining the precision of POS AV of Direct Georeferencing with the Flight Management System expertise of TRACK'AIR POSTrack is the first fully integrated, real-time direct georeferencing and flight management system designed for the airborne geospatial community. Purpose-built to reduce the costs associated with the preparation and implementation of airborne surveys, it minimizes and streamlines mission planning and in-flight operational workload. *www.applanix.com*

Modular GPS receivers and Smart GPS antennas

Trimble announced a new series of Modular GPS Receivers and additions to the Trimble family of Smart GPS Antenna designed to provide contractors with state-of-the-art, future-ready construction GPS positioning solutions. The new product offering provides four levels of GPS operation--Location GPS, Basic, Max and Extreme--to cover a range of user price and performance requirements.

Trimble also introduces two new products as part of its Connected Survey Site model-the Trimble® R8 GNSS system and Trimble NetR5™ reference station receiver with added Global Navigation Satellite System (GNSS) capabilities. The positioning products, with Trimble R-Track™ technology, support GPS L2C and L5 signals as well as GLONASS adding greater flexibility and more robust signal tracking to provide a seamless and streamlined workflow for all of the critical phases of surveying. *www.trimble.com*

Sirf's mini GPS chips designed for mobile phones

Sirf Technologies launched recently two tiny power-efficient chipsets designed to integrate GPS capability and wireless connectivity into mobile handsets. The company has added to its chipset offerings with the GSCi-5000, a stand-alone multimode Assisted GPS architecture, which offers mobile phone manufacturers accurate navigation capabilities. *www.pcmag.com*

Blue Marble releases Flex LM-based network

Blue Marble Geographics announces the release of their new Geographic Map File Translator Version 3.0 with Flex LM-based licensing. The full major update to their vector map file translation software is now available for purchase and download. *www.bluemarblegeo.com*

TACO MobiApps to unveil consignment tracking solutions

TACO MobiApps Telematics Limited (TMT) will introduce consignment tracking solutions (CTS), based on GPS, GSM, CDMA, and GPRS technologies, to address the growing demands of the logistics industry in India. The company's consignment tracking solutions would provide real-time visibility of consignments to the entire value chain of consignor, consignee, logistics service provider and fleet owners by integrating their ERP/back-end with the information available on TMT's 'trako' server.

Smartphones become smarter with Garmin

Garmin International Inc Garmin Mobile(TM) 20 -- an automotive navigation system that delivers Garmin's voice-prompted, turn-by-turn directions using Bluetooth wireless technology on Nokia, Windows Mobile and Treo 650 Smartphones. It provides both data connectivity as well as hands-free capability and is packaged with the GPS 20SM(TM), a highly sensitive GPS receiver and Bluetooth-enabled speaker and microphone.

Business

Ricoh and GlobalSat embed GPS data into digital images

Ricoh Corporation, and GlobalSat Inc have announced a strategic relationship to provide unprecedented GPS accuracy of geo-coded digital images. GlobalSat's BC-337 is a highly portable CompactFlash GPS Receiver, which utilizes SiRF's Star III low-power chipset. When combined with Ricoh's GPS-Ready Pro G3 Digital Camera, high-resolution images are embedded with precise GPS coordinates. *www.ricoh-usa.com*

Joint research programme for 3D topology

Laser-Scan is currently participating in a research programme to deliver database functionality for a 3 Dimensional Topology Model. This research is being conducted under a Phase II SBIR awarded to LSI by the US Army Engineer Research and Development Center's (ERDC) Topographic Engineering Center (TEC). The ERDC is the premier research and development facility for the U.S. Army Corps of Engineers. It consists of seven laboratories at four geographical sites, with over 2,000 employees, $1.2 billion in facilities, and an annual research program approaching $700 million. *www.laser-scan.com*

Washington State Department of Transportation selects Bentley

Bentley Systems, Incorporated announced that the Washington State Department of Transportation (WSDOT) has selected Bentley as its primary provider of software for engineering and surveying practices. WSDOT selected Bentley InRoads software to replace CAiCE as its primary transportation engineering software based on a statewide steering committee review. *www.bentley.com*

Rolta and Orion technology form parternship

Rolta International, Inc., and Orion Technology Inc., provider of web-GIS software and integration services, announced a partnership agreement. Under the terms of the partnership, Rolta International, Inc. will provide implementation services for Orion Technology's OnPoint™ Suite of web-GIS products to Utility and Government organizations. *www.roltaus.com*

Intergraph Z/I Imaging DMC Selected By Wuhan University

Intergraph Corporation announced that Wuhan University, China, the world's largest mapping university, has purchased an Intergraph Z/I Imaging DMC® (Digital Mapping Camera). Leveraging some of the most advanced digital imagery available on the market, the university will be able to quickly and accurately provide small-scale to large-scale digital images to customers. *www.intergraph.com*

Swisscom Mobile selects Sun Microsystems

At the 3GSM World Conference, Sun Microsystems Inc. announced that leading Swiss telecommunications carrier Swisscom Mobile has selected Sun Microsystems to help reduce IT complexity and costs by streamlining access for 1,145 retail stores to the company's customer-oriented applications to better serve customers and help increase revenue. *www.sun.com*

Intermap signs agreement within German Auto Industry

Intermap Technologies Corp. announced that it has signed a second joint development agreement within the German automotive industry for Intelligent Transportation Systems (ITS) applications. The agreement combines the automotive engineering and development expertise from this leading German automotive manufacturer with Intermap's highly accurate geospatial databases. *www.intermap.com*

Boeing awarded $3.5 million from NGA

Boeing has received a $3.5 million follow-on task order from the National Geospatial-Intelligence Agency (NGA) to enhance the digital topographic data collected by the space shuttle Endeavour. This award to Boeing under NGA's Shuttle Radar Topography Mission (SRTM) program brings Boeing's total SRTM contract awards to more than $35 million. *www.webwire.com*

NGA awards $24 million contract to DigitalGlobe

DigitalGlobe has been awarded a $24 million satellite imagery capacity contract modification by the National Geospatial-Intelligence Agency (NGA). This ClearView contract enables the NGA to acquire additional commercial imagery from DigitalGlobe's QuickBird's high-resolution commercial imaging satellite.*www.advancedimagingpro.com/publication/art*

Autodesk launches European mobile LBS program

Autodesk Inc., (UK) announced recently its Autodesk European Location Services Developer Program. This location-based services (LBS) program provides European developers with the resources and support needed to rapidly bring LBS applications and services to market. The LBS market is estimated to reach $200 million EUR by 2007, according to Frost and Sullivan, and wireless carriers around the world are location-enabling their networks to facilitate worldwide demand for LBS services such as social networking, gaming, personal navigation and directions. Modeled on its successful U.S. program, this new program helps developers create LBS services using Autodesk's open standards platform to market their applications worldwide. *www.directionsmag.com*

HP enters the GPS market with ViaMichelin

HP has announced that it is to enter the Sat Nav market with a new device it has launched with ViaMichelin. Using a PDA model originally announced in September last year, HP has decided to use its rx1950 PDA at the core of the system adding a cradle and the software to offer the GPS solution. The new name – the rx1950 Navigator has been bundled with the latest version of ViaMichelin's navigation software and a car cradle to offer the GPS element. HP has been able to make the PDA GPS ready by including the GPS receiver in the car cradle rather than as a bolt on to the unit. *www.hp.co.uk*

CRPF vehicles to have GPS sets

The Government of India has decided to introduce GPS sets in all vehicles carrying security personnel of the Central Reserve Police Force (CRPF) in the country. Initially the GPS sets will be installed in 513 vehicles of the CRPF and later it will be introduced in all vehicles. The ministry has decided to provide 23 mine protective vehicles to the CRPF for counter-insurgency operations. The government has decided to arm its paramilitary forces with hi-tech weapons to fight the Naxals and insurgents. *www.asianage.com*

Lockheed Martin GPS updates enhance system accuracy

Lockheed Martin has upgraded the software processing and modeling for the Air Force's GPS, enhancing the Air Force's ability to monitor GPS satellites and improve system accuracy 10-15 percent for users worldwide. The recently completed update, named the Legacy Accuracy Improvement Initiative (L-AII), doubles the amount of navigation data collected and provided to Air Force operators. *www.lockheedmartin.com*

GPS Power Case extends battery life of Blue Logger by 600%

Alti-tech Engineering, has announced a rechargeable lithium ion (Li-ion) Power Case for the DeLorme Blue Logger GPS. This case is called GPS Power Case and by enclosing your Blue Logger inside it you can get an increased runtime of upto 600% (from 10 to 60 hours). According to Alti-Tech, placing the Blue Logger inside the case doesn't have any effect on GPS signal reception. *www.gpsgazette.com*

Boston police to expand use of GPS tracking

Boston Police Commissioner Kathleen M. O'Toole and Mayor Thomas M. Menino announced that authorities would begin placing electronic ankle bracelets on pre-trial offenders and parolees to track them and to prevent them from committing new crimes. Police say the program, which uses global positioning system technology, does not require legislation. Instead, the department is working with the Massachusetts Probation Service on the initiative, which police say is currently being used on 90 people with good results. *www.boston.com*

Panasonic ToughBook in army camp

The Army Adventure Wing, directorate general of military training, Army Headquarters, has announced that their select team is attempting a national hot air balloon record by ascending a height anywhere between 3,000 to 10,000 feet above sea level for 24 hours continuously. The ToughBook CF-18 to be used by the Army Adventure Wing during this expedition is equipped with wireless communication capabilities and Global Positioning System (GPS) technology. *www.efytimes.com*

GPS services for faster signal acquisition

u-blox AG, the Swiss provider of innovative GPS receiver technology, announced the provision of Assisted GPS ("A-GPS") services that supply instant location information, reducing GPS receivers' Time To First Fix ("TTFF") to just a few seconds. *www.wirelessdevnet.com*

Results of LATAM Survey released

Despite years of build-up and hype, location based services were still in an early stage of slow growth at the beginning of 2005. From about the year 2000, only a handful of operators worldwide had launched location based services for their enterprise and individual subscribers. However, the recent introduction of 3G network technology in many markets (and many more to come) coupled with the emphasis on boosting data revenues, it seems like the stage is finally set for widespread rollouts during 2006 and 2007. This analysis is backed up by the results of a recent survey carried out by Genasys in the Latin American telecoms market. *www.genasys.com*

IBM tests mobile speech applications

IBM has collaborated with two universities to develop several speech-enabled Web applications for mobile phones. The MobileU program allows students to ask "What time is the next bus coming?" into their cell phones. GPS devices inside the buses use General Packet Radio Service (GPRS) to transmit their location to servers on campus and ultimately to students' mobile phones to tell them how long they have to wait. *www.computerworld.com*

GPS chips now to be more affordable

GPS chip sales are soaring as costs fall to more affordable levels. The change is due largely to the development of low-cost GPS chips. GPS chips for most products have fallen in recent years from $50 to less than $10, and the cost for GPS in cell phones is even less. Analysts say that Qualcomm now spends only about $2 to add GPS capabilities to its cell phone chip sets. *http://reed-electronics.com*

GSM radio network across Bangladesh

GrameenPhone Ltd. has selected MapInfo to implement a location intelligence solution to monitor and optimise the performance of its GSM radio network across Bangladesh. GrameenPhone continually strives toward providing better network coverage and quality for its customer base. GrameenPhone increased its network coverage from 55 percent to more than 95 percent of the population within last year. As part of this initiative, the Radio Planning Department at GrameenPhone needed a spatial solution to assist them in monitoring and managing the mobile network quality and coverage across the country. *www.mapinfo.com*

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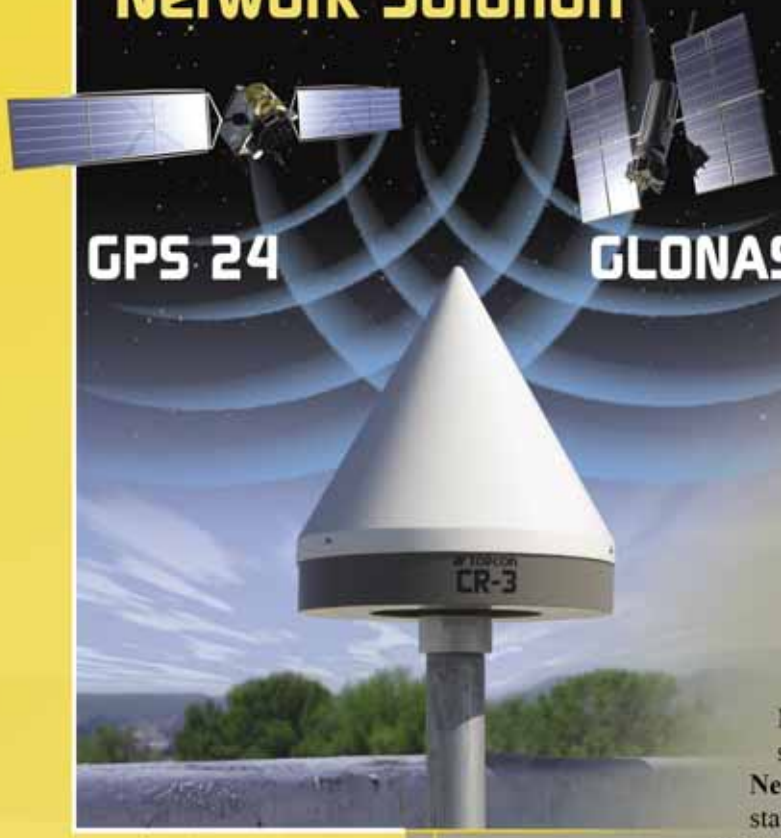

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Multimap Australasia announces online mapping deal

Multimap, one of the online mapping providers, announced the implementation of its online mapping services for the Commonwealth Travel Services Corporation (CTC), at the Travel Distribution Summit in Singapore (14th & 15th February, 2006). Now, customers of one of the largest and most trusted travel and tour operators in Singapore can access content-rich, easy-to-read interactive maps of their hotel destinations. The site enhancement is expected to increase the conversion rate of lookers to bookers, by lowering the barriers to booking online. *www.multimap.com*

OGC(R) approves GML in JPEG 2000 specification

The Open Geospatial Consortium Inc. (OGC) membership has approved the OpenGIS(R) GML in JPEG 2000 for Geographic Imagery (GMLJP2) Implementation Specification. It is available for downloading from www.opengeospatial.org/specs/?page=specs. The Geography Markup Language (GML) is an XML grammar for the encoding of geographic information. JPEG 2000 is a wavelet based image compression standard that provides the ability to include XML data for description of the image within the JPEG 2000 data file. *www.opengeospatial.org*

Country-wide digital aerial photo of the Netherlands

From early September to mid-October of 2005 Aerodata International Surveys recorded digital aerial photos of the Netherlands on their own initiative. The imagery was completely acquired with the company's 90 megapixel UltraCam-D large format digital frame camera, mounted in their fast Fairchild Merlin survey aircraft. This project is unprecedented in the Netherlands, since it is the first time aerial photos of the entire country have been acquired completely digitally. *www.aerodata-surveys.com*

Ordnance Survey focuses on collaboration

Ordnance Survey's presidency of a European geographic committee on behalf of the UK has reinforced ties between national mapping and cadastral agencies across member states. The key focus of Ordnance Survey's six-month tenure chairing the Permanent Committee on Cadastre in the European Union (PCC) was closer collaboration on land use management, sustainable development and other key issues involving geographic information. *www.ordnancesurvey.co.uk*

China builds geographic information database

China has completed a 1:50000 database for the national fundamental GIS, said Lu Xinshe, Director-General, State Bureau of Surveying and Mapping in a press conference recently. This database is a national basic geographic information database that covers all of China with the largest scale and highest precision up to date. *http://english.people.com.cn*

SK and SouthCot tie up for Allah Valley resource mapping

The local governments of Sultan Kudarat and South Cotabato have tied up with a Manila-based environmental consultancy firm for the conduct of resource mapping and community-based resource assessment of the Allah Valley watershed areas. *www.mindanews.com*

Karachi 2020 - Master Plan by August 2006

The Master Plan 2020 for Karachi City is likely to be ready by August this year for which various agencies have been contacted to provide maps/drawing of likely underground passages, a senior official has said. Divisional Coordination Officer Karachi, Fazlur Rehman said all the federal and provincial agencies besides those working in Karachi have agreed to provide their route maps. About 30 per cent land use survey has been completed based on a map prepared by the local consultant using satellite imagery. *www.thepeninsulaqatar.com*

LeadDog releases GIS maps for Tehran

LeadDog Consulting, LLC recently announced the release of a detailed Tehran GIS vector map. LeadDog map products provide accurate base level mapping featuring numerous vector layers and attributes such as detailed streets at 1:10,000 scale, street names, street classifications, extensive points of interest (government offices, commercial building, etc.), neighborhood points, park, water & landmark polygons and railroads. Tehran City Streets is available in all major GIS formats. *www.goleaddog.com*

GIS to aid emergency health services in Hanoi, Vietnam

GIS will be applied to healthcare emergency services during the first quarter of 2006 in Hanoi, capital city of Vietnam. GIS will be used to manage city ambulances and first aid response and provide health units with more and faster information about the location and nature of emergency situations. *http://vietnamnews.vnagency.com.vn*

Risk management atlas in Gujarat, India

The Gujarat State Disaster Management Authority (GSDMA) has come out with a Composite Risk Atlas to help various departments concerned in disaster mitigation planning. The GSDMA had engaged Taru Leading Edge Consultants, a Delhi-based firm with expertise in data collection for disaster mitigation planning, to prepare the atlas, a copy of which was released by Chief Minister Narendra Modi recently in the presence of Chief Secretary Sudhir Mankad and secretaries of various departments concerned. *http://cities.expressindia.com*

PCI Geomatics supports CARTOSAT-1 satellite data

PCI Geomatics announced that it has entered into a memorandum of understanding with Antrix Corporation Ltd. to develop an interface that integrates CARTOSAT-1 satellite data products in Geomatica, PCI Geomatics image-centric geospatial software. Antrix, a corporate arm of the Indian Space Research Organization (ISRO), launched the CARTOSAT-1 satellite on May 5, 2005, to provide stereo data for advanced and large scale mapping applications. *www.pcigeomatics.com*

Japan's new satellite sends its first image

Japan's recently launched Advanced Land Observing Satellite (ALOS) has sent back its first pictures of Earth - Mt Fuji and its surrounding towns. The satellite was launched on January 24, 2006, and it contains three onboard instruments for Earth observation. One instrument is called the Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM). It's capable of taking many 3-D images quickly and accurately. *www.universetoday.com*

ISRO to double remote sensing business

India has set a target to double its business in the global remote sensing space within three years, Indian Space Research Organisation (ISRO) chairman G Madhavan Nair said recently. "My reading is that 15 per cent of the (remote sensing) market is with us now. We have got Resourcesat and Cartosat. We should be able to at least double this business within the next three years," Madhavan Nair told newspersons recently. The size of the global remote sensing market is estimated to be 30-40 million US dollars. Nair also said that ISRO's marketing arm Antrix Corporation has been growing by 25 per cent annually for the last two years. *www.chennaionline.com*

China's mapping satellite in 2008

China expects to launch its first surveying and mapping satellite in 2008, said Lu Xinshe, head of the State Bureau of Surveying and Mapping. After long time preparation and science workers' efforts, conditions are becoming ripe for the country to launch its independently developed high definition, stereoscopic mapping satellite. General design for the satellite has been completed and is now under discussion. The satellite is expected to be launched in 2008. *http://english.people.com.cn/200602/27/eng2006022*

NASA, University scientists uncover lost Maya ruins

Remains of the ancient Maya culture, mysteriously destroyed at the height of its reign in the ninth century, have been hidden in the rainforests of Central America for more than 1,000 years. Now, NASA and university scientists are using space- and aircraft-based "remote-sensing" technology to uncover those ruins, using the chemical signature of the civilization's ancient building materials. *www.nsstc.org*

Cardiff University honours Dr Kasturirangan

Dr K Kasturirangan, Director of National Institute of Advanced Studies, Bangalore and former Chairman of ISRO, has become an Honorary Fellow of the Cardiff University, the United Kingdom. The Honorary Fellowship was conferred on him at the University's graduation ceremony l at Cardiff, an ISRO statement said recently. The conferring of Honorary Fellowship on Dr Kasturirangan is an international recognition for his contribution to space, according to ISRO. *www.newkerala.com*

Double views from ERS mission adding depth to Canadian maps

Unique views of Earth afforded by a pioneering twin ESA radar satellite flight has brought an extra dimension to maps of Canada's newest territory, the results winning praise from the Canadian government. Nunavut is the latest and also largest territory of Canada: located up in the frozen northeast, Nunavut has a population of only around 29 300 but an area the size of Western Europe. The Canadian government is currently refining and updating its geographic information for the entire country and Nunavut in particular, as a way of encouraging its development. For the latest of a series of projects charting this region, Vexcel Canada has completed an additional 21 digital elevation model (DEM) map sheets for the Canadian government agency charged with mapping the nation's topography, or 'lay of the land': the Centre for Topographic Information Sherbrooke (CTIS). Vexcel Canada has now produced complete elevation data for 44 map sheets across Nunavut Territory, meeting stringent specifications from CTIS for Canadian Digital Elevation Data (CDED) of better than 7.5 m vertical accuracy at around 20 m postings. The project was completed under a demanding production schedule and resulted in high-resolution Digital Elevation Models (DEMs) and high praise from the Canadian government. For each of the products completed for CTIS, Vexcel leveraged ERS tandem data and its own EarthView InSAR production software, customised to allow for such large area elevation mapping. The ERS data was provided by ESA, while the Canadian Space Agency (CSA) gave support in scientific and technical testing, as well as methodological development towards producing the tailor-made InSAR DEM software. *www.spaceref.com/news/viewpr.html?pid=1912*

Read news online **www.mycoordinates.org**

“Understand. Then implement.”

says Dr Mahesh Chandra, Managing Director, National Informatics Centre Services Incorporated while sharing the success and challenges in technology implementation in the context of utility mapping project

Tell us about the utility mapping project?

We have seen a rapid growth of cities in recent years with growing demand on land resources and other basic infrastructure. They are under increasing pressure to extend the basic facilities to support the ever-increasing population. The Utility Mapping project was one of the consequences of urban renewal programme of the Government of India. The project was executed by National Informatics Centre (NIC), Government of India and was first implemented for Delhi.

We all know that cities are growing but what we need to understand that the cities should grow in harmony with the requirements of people. While meeting the requirements of the people it needs to be understood that the character of the city should be maintained. And while executing the Delhi utility project at NIC, that was the challenge for me.

What were the challenges you faced while executing Delhi Utility Project?

The utility mapping of Delhi covers the whole area of Delhi (1,483 sq km) on the scale of 1:1000. It has information on natural and human-made resources, including population densities, land uses, transportation corridors, waterways, street patterns, mass-transit patterns, sewer lines, water lines, and other utility lines. It is expected to help better management of the utilities in the urban areas.

As far as challenges are concerned, the first challenge was to get the basic map itself. Second was to organize the field team. Our team worked every square km each for one week for each utility. The team comprised for each area was at least 2 persons and one person from local area. The field team has verified all the ground data. The project needed hundred percent ground verification. At times, ground level realities compelled modifications. The third challenge was to build a team that can think and work together. Fourth and most important was to convince the people and that could be done by proving the credentials of the technology.

What was the time frame?

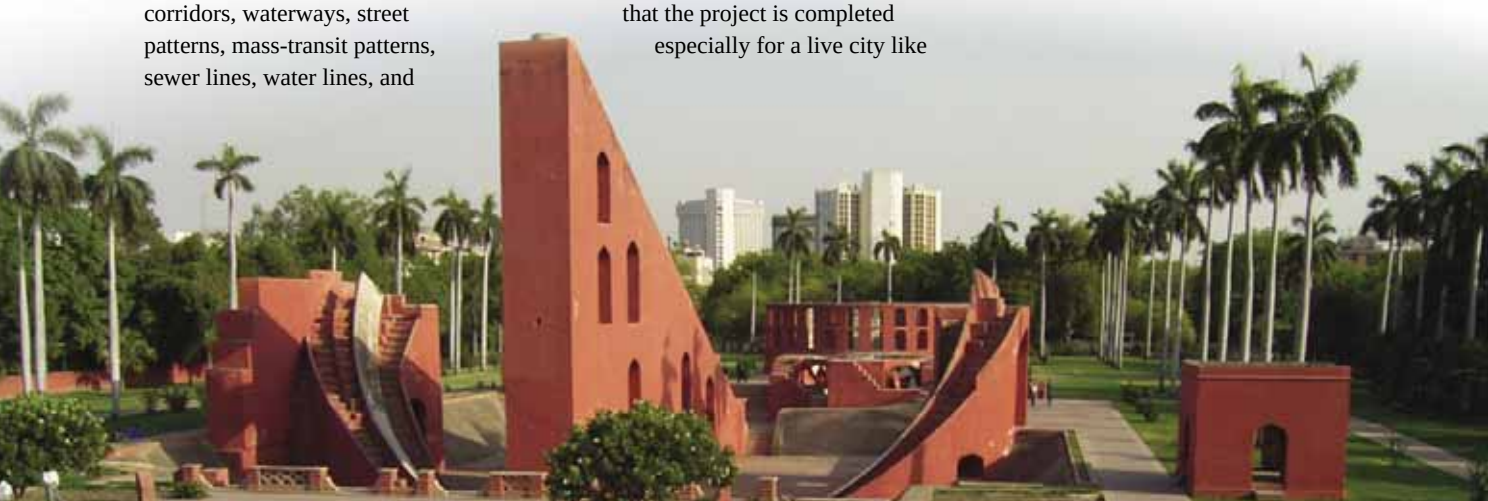
The Delhi project took four years (1998-2002). However, project like this has a long gestation period. The time taken for the projects implementation depends heavily on the cooperation extended by all agencies in sharing information. While Delhi’s utility map took four years, it should not be considered as standard time for such projects. It was more of evolutionary nature where we corrected our course in various stages. Still no one can say that the project is completed especially for a live city like Delhi. It is a continuous process. We have built the basic data, which is secured on NIC server. We may say that over the years a template has been evolved. Procedures have been documented and institutionalized.

What was the role of geomatics technology?

The Delhi utility map covers 900 points earmarked by our team and then verified by a physical ground reality check. This project is based on the latest technology such as GPS, photogrammetry, and GIS-being implemented in India for the first time. Using photogrammetric technique, aerial photographs in pairs (consecutive) were used to form a 3D model. The National Remote Sensing Agency (NRSA) did the aerial surveys and NIC did the photogrammetry part.

What about the cost involved?

It is very difficult to assess the direct cost. Does it include the cost of evolving process, training, experimentation, consultation etc? Moreover, initiating such a project was more of an institution building. The project was started with the grant of 20 million Norwegian krone from the Government of Norway. NIC paid salaries to the project staff.



Is Delhi utility mapping in use?

Yes, utility agencies are using it. Most of the agencies have special cell. I think work culture has changed after this project. Now, if any agency wants to dig any area of Delhi, it can do so by coordinating with other agencies by giving a 15 days notice. Not only it brings some comfort to the citizens but also results in saving of a lot of money which otherwise would have wasted.

Will you replicate the Delhi experience in other cities?

The success in Delhi have encouraged us to replicate the Delhi experience in Ahmedabad, Bangalore, Chennai, Hyderabad, Kolkata and Mumbai. Given the experience of Delhi, we expect that the entire exercise in these cities will comparatively be easier. The basic mapping will be completed in next 18 months and then the actual work will start.

How do you perceive the role of geomatics technologies?

Introduction of geomatics technology is primarily driven by pull and push factors both. No doubt, need and relevance of such technologies were felt but at the same time vendors pushed the technology by creating hype through conference and seminars. I feel initial push was by vendors. It was followed by a demand pull by the users.

What are the challenges in introducing a new technology in system?

In India, most of us are philosophers. We feel we have a right to comment from anything to everything. And here lies a problem. We must understand the technology if we want to implement it in developing country but equally important is to take care of non-technical issues associated with technology implementation.

Processes are cumbersome. If project involves huge transaction of funds, then associated officials are looked at with suspicion. It is advisable if the key professionals restrict themselves to technical evaluation and not involve themselves in financial evaluation. We need to understand that one has to perform in the system. And one has to perform not because of the system but in spite of it. When one comes out of a college, he thinks he is well equipped with knowledge but actually learning starts once a person joins a system. I preferred to maintain a low profile and not created hype about the project. Unnecessary hype leads to avoidable expectations. More important is to work for the mission rather than to struggle for credits.

What motivates you?

I do not know. I think Almighty gives the strength. I have good friends. That also helps but I feel it is the values that you nourish define the course of activities. I took a conscious decision to remain in India and serve the country. I hate those people who left the country for better pastures without realizing the country took an extra effort to provide them proper education. It is our responsibility to return the society something after taking so much from it.

What is NICSI?

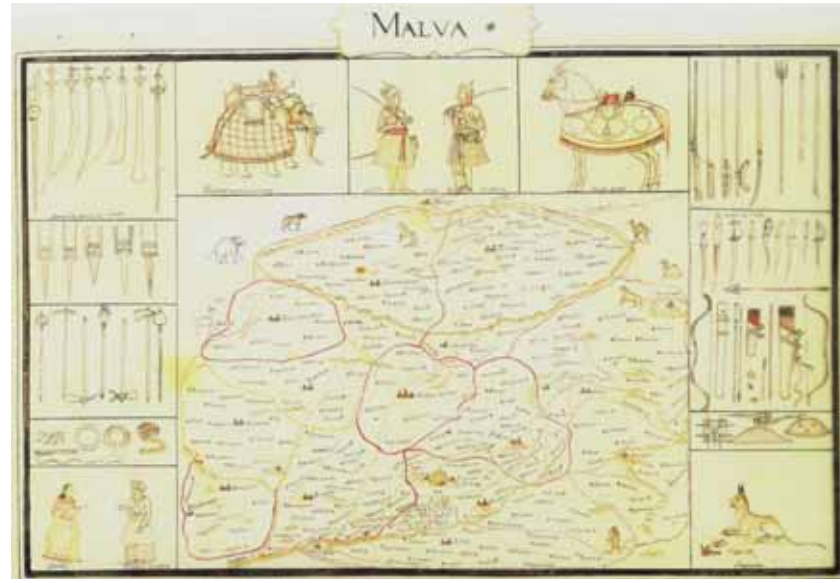
NICSI (National Informatics Centre Services Inc) is a company formed under section 25. It is a commercial arm of NIC. It is non-profit making company hundred per cent owned by President of India.

Dr Mahesh Chandra presently serving as Managing Director, NICSI. He did his PhD in Computer Aided Design. He has published one book and 34 papers in International Journals. **mchandra@nic.in**

Indian prelude to British cadastral and revenue maps

The brief analysis adequately demonstrates that pre-British India had its own systems of cadastral and revenue mapping

PROF B ARUNACHALAM



Raja Todarmal was the minister for revenue in the court of Akbar. Building upon the foundations laid by Sher Shah, Todarmal introduced a system of land reforms, the essence of which was an assessment of the land revenue according to the extent of cultivation, the nature of the soil and the quality of the crops. He set up a scheme of laborious measurement, analysis of possibilities and calculation of prospects. The actual demand was adjusted to meet seasonal price and cultivated area variation. Though at times it broke down and was deployed unevenly within the Moghal Empire, it is the underlying basis of the later day revenue systems. The British became the pupils of the Moghal School, being impressed by the range and thoroughness of the system. In spite of false starts and harsh application in the early days, the British could build up a rural administration not only stable but generally equable and equitable.

The Moghal revenue administration demanded precise measurement of productive cultivated land. A number of units came into force. The llahi gaz, a measure of length and standard gauge was used throughout the Moghal Hindustan in long, middling and short forms, each divided into 24 equal parts and each was called a tussuj, equal to 8,7 or 6 barley-corns. The gaz is equal to two spans of 16 gerths each. There were however variations of the length of the gaz even with Moghal India. The bigha is a land measure of 60*60 gaz. A larger unit was the Kos or Karoh, each consistion of 50 llahi gaz or 400 poles, each of length 12.5 gaz. Thus the kos is a length of 5000 gaz. Abul Fazal states that there were significant variations in the length of the kos in different parts of Moghal India.

Raja Todarmal was not however the first to generate a revenue system available in all parts of the empire. Much before him, others have had their notable contributions in this regard in different parts of the country. Kautilya'sArthasastra in the Maurya period was one of the earliest to recognize the relevance of land revenue collection from productive farmlands, in villages with settled population of farmers. The Sukra neeti talks of recognition of revenue estimation from cultivated land according to the fact the land is watered by tanks and lakes, by rivers, by wells and sluices apart from dry farming rainfed areas and the nature and number of crops raised in each parcel.

An area of significant development of land information for revenue levies is the Tamilnadu agricultural plains. Though Tamil Nadu has been occupied at least since the Neolithic age, early settlements of a shifting character were confined to the Kurinji or the hills, gradually down-migrating over centuries to the pastoral foothills or mullai by early Christian era. The further occupation of the river plains and the agriculturally fertile deltas led to sedentary population living amidst riverine farm country. Peasant technology led to use of irrigation through different methods and raising of more than one seasonal crop, apart from tree crops. By mid-10th century, with the advet of the later Cholas, specially Raja Raja productive cultivated land constituted a major source of land revenue for the upkeep of the Chola mandalam. Farm villages came to be precisely defined. As per Chola stone inscriptions and numerous copper plates, a village came to be defined as comprising wet lands, dry lands, ur (cultivators), village site, houses, houses house gardens, manram (meeting place), wastelands for grazing cattle, tanks, cow pens, hedges, forest land, barren lands,

brackish lands, streams, channels, rivers, Arabic land near rivers, pits of water, trees. (Subbarayalu) Villages were further grouped as brahmadeyas (Brahmin villages), Vellala villages (farmer villages), taniyur, devadana villages (gifted to Brahmins, temples and those who have rendered recognized state service. Hundreds of descriptions are noted in inscriptions and copper plates of temple donations (of land or land income), endorsed by the state that give precise locations and measures of lands donated, together with their boundary limits. Though verbal, these descriptions of individual plots of land give indication of an early system of cadastral plans.

The land measurement units used in Tamil Nadu however differ from those prevalent in the northern plains. The smallest unit used is a viral (finger). 12 virals (9") make a chaan and 24 virals (18") make a muzham (cubit). A muzhakol (cubit pole) is 9 or 12 ft long and is used as a measuring rod. The smallest land plot is a 12 ft. square called a Kuzhi. Hundred Kuzhis make a Kaani and five Kaanis is a veil, somewhat similar to the northern bigha. Land as small in extent as 1/52.4288 millions of a veli was measured in the productive Cauvery valley in the Chola period (equal to 1/500000th of a square foot, (Burton Stein). While the basic cultivated field plot was a veli, and a village was defined as stated in the above para and comprised many farm plots, that were as far as possible rectangular of square in shape, except where natural features like water channels formed the bounding limits. The basic agrarian unit was nadu comprising many villages. With land reclamation in the newer delta fringes, new nadus came into existence, though of lower fertility than the core Chola heartland. The Chola system of land management went on a decline post-fourteenth century, (Heitzman) but the basic framework and structure remained intact to become the basis of the later British cadastral and revenue surveys.

In the well-watered Travancore and Malabar, a compact village was not the agricultural unit. The tarawad of the Namboodri and Nair constituted the land unit, with lzhavas and Tiyars as the main farm labour. The hills and slopes terrain with a network of backwaters and lagoons lent to a hierarchy of land rights of the janmis that were multilayered. The land was held on lesser forms of tenure, and sharecropping was quite common. Land was devoted not only to rice farming but also a variety of tree crops. The traditional system did not undergo any major change with the coming of the Islam, nor did it get disturbed by the arrival of the Portuguese and the Dutch. However, a gradual break-up of the larger tarawads did materialize. Temple lands and garden lands were given patta by the Travancore mahraja since mid eighteenth century. Actual survey by traverses or baseline and offset system did not materialize till independence. A somewhat similar land ownership system evolved in the Lakshadweep with the government pandaram. Lands not being held in private property, but it is the trees that were owned. The middle class Vellala identification of the Tamil country finds its reflection in the Okkaliga and Lingayat land ownership in larger plots in the semi-dry Mysore Maidan.

A major step taken by Shivaji in western Maharashtra for land administration was to have a survey of the lands and then to assess the rents and dues payable by the cultivators. While the land ownership in Deccan was in large land holdings, in Konkan they were in much smaller tillable plots on slopes and valley sides. Land surveys were carried out at different times and basically followed the system of Malik Ambar in Moghal Deccan. The main features of this system were the classification of land according to fertility, ascertainment of their produce, fixing the government share. Collection of rents in kind or money and abolition of intermediate collecting agents. Three fifths of the share of the crop produce was left to the farmer. Using the tagai and istawa principles new lands were brought under the plough and the farmer was subsidized with seeds and cattle. Land revenue varied from year to year dependant on assessment by village officers like Karnams and tatatis, the local Kuikarnis and Patels managing the village administration. However, there are large variations dependant on jagirdars. Salsette (Suburban Bombay) for example had nine different tenure systems within an area of 16 sq miles. When the British took over similar such principles and methods were developed locally in different parts of Central and Northern India, and these with remarkable internal variations are too traced here. In Portuguese Goa, there evolved a communido system unique to itself.

When the British set themselves the task of ground level detailed large and medium scale surveys, they took to precise direct measurement of distance and directions between each night's camp, that took the form of route surveys in traverses, often using Gunther's chain and tape and taking measures along sides and diagonals. This technique of establishing a framework for observation formed the basis of different scales of mapping in a map graticule. Rennell, Dalirymple, Robert Kelly, Buchanan and others did pioneering work in this regard. These surveys were carried by trained local surveyors and collectors and the data gathered were sent to Calcutta. Bombay and Madras. Since the surveyors were appointed by the London office and the cartographers at central office had little control on data sent to them led to great disparities in survey standards, and a chaos. The company management though aware of the chaos did not know how to materialize and the three surveyor generals moved in different directions. Many manuscript maps went missing and field officers often did not get maps.

Using indigenous methods for land measurement and assessment of revenues, based upon a decision of the Company and the Surveyor General at Calcutta to accept the assessment in eastern India as permanent settlement

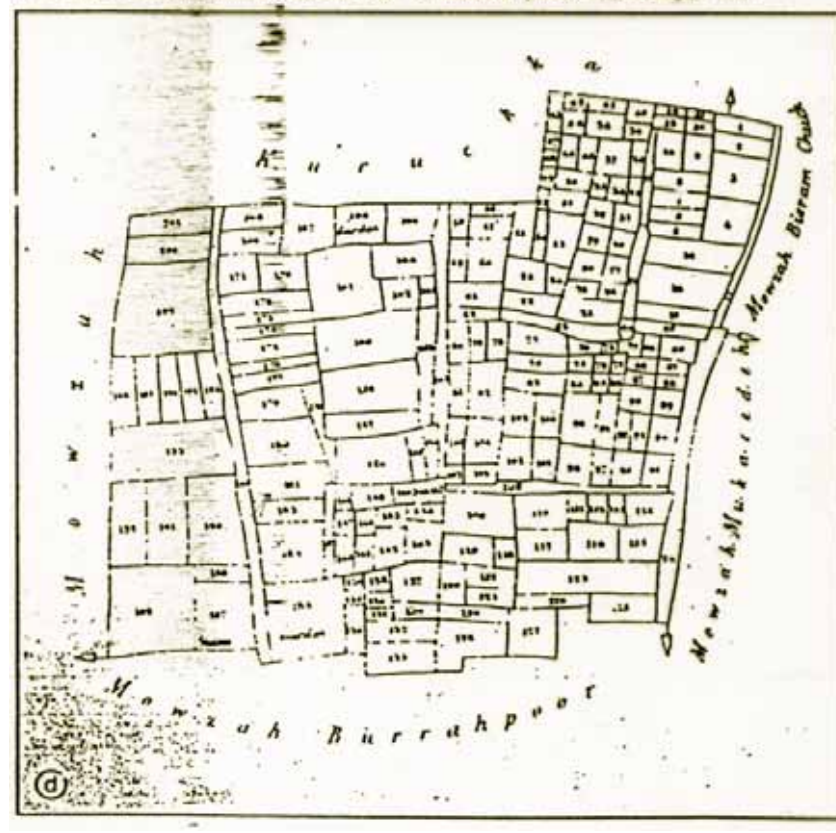
for all time, and there was a need to assess new wastelands newly reclaimed in Sunderbans and 24 paragamas. The local zamindari system facilitated to an extent permanent settlement. In Madras Presidency, Since even the jagirs were not so large zamins, and the land holders were mainly of a ryotwari system, a different guideline was established for the Madras revenue surveys, and these were later introduced to Bombay Presidency in 1772 with little change. This settlement done by the extra-ordinary work of great surveyors like Thomas Munro, Read, Col. Mackenzie and Dickinson became basis for a temporary settlement, with opportunities for constant reviews at intervals. The data base was highly comprehensive, going into the plot size, soil and its taram, slope, water access, crops seasonally, ownership, etc. The Madras Adangal even today is the standard adopted gradually all over the country. The Satbara of Bombay Presidency is of a very similar order. The baffing problem of land survey was the subject of futile experiments in Bengal, but in Madras reached a viable practical solution, dependent on standard supervision. With insufficient resources, the British mapping of India proceeded in a crisis-driven, anarchic manner.

In the early decades of the 19th century, under the regulation of William Lambton and later George Everest, the primary and secondary triangulation networks began taking shape with minimal linear measures and precise angular measures to cover the whole country with a network of triangles, interconnected. The priority given by the Company Directors and the Indian Surveyor-Generals no doubt provided a pivotal role in unification and helped in creating an image of imperial space, unique and precise in the world. This system imposed from above did not contribute in any manner to the build up of a co-ordinates revenue and cadastral survey system in the country at the grass root level, and then building it up. The twain shall never meet, in the decades to follow proceeding on different planes and the Survey of India gradually lost sight of one of its primary tasks leaving it in the hands of talatis, revenue inspectors and Collectors. The cartographic anarchy was complete and Surveyor Generals combined into one group, who unfortunately never realized the importance of ground level surveys.

Now, there is a growing realization and desire to link the triangulation network not only with the topographical map grid, but also bring the cadastral plans into its fold. Having flown high in the regime of map projections, photogrammetry aerial surveys and photos, and the latest in satellite imagery maps of high power of spatial resolution. Survey of India is struggling to come to terms with grass root level linkages. Problems are many: the grid used, the projection for plane table level survey plan the search for control points to merge the two and others. On the front of the cadastral plans, shrinkage due to age of the old handmade paper it is drawn on, subsequent plot level changes and what is worse changes in the physical landscapes by way of erosion or accretion. The job is gigantic and full of challenges!

Having made a brief and spotty review of the cadastral and revenue surveys that had come to stay in different parts of the country, it is time to turn to cadastral plans of villages and towns and revenue maps of villages. It is not very easy to visualize when the first Indian cadastral and revenue survey maps came into being. It can at best be a broad conjecture. Since Pallava and Chola days inscriptions and copper plates of donations reveal a widespread network of agricultural villages, careful demarcations of village fields and land rights and their precise delineations with boundary fixtures by measurements correct to virals. This necessarily leads to believe that cadastral plans and maps of adjoining fields in relation to natural features like rivers, wells, canals and tanks had come into vogue. In all probability, none of them have come down the centuries to us, possibly because they were in palm leaf manuscripts. Yet this land of the farmers of many centuries are not bereft of some, rare, pieces of evidences, and if some concerted work is initiated more such map plans may get revealed. The adjoining map is one such of a field area (not the full village) on the south bands of the Pennar river close to Tirukoilur in Nadu Nadu, that shows the gifted devadana lands to the Siva and Vishnu temples as placed in the natural environment as per inscriptions. The square and rectangular plots of farmlands were of the Chola period imprinted in the later day British cadastral surveys and plans. A map drawn Frank Perlin's collection is again a part of the village field plan belonging to Fasli 1193 (AD1784) on paper in Chitnis Modi script presented to and accepted as a piece of evidence in a civil litigation for land rights between two farmers. The place is south of and close to Pune in Maharashtra, and is known as Vadhana. The plan also provides measurement. The map is reproduced and rendered in English. Belonging to a relatively to a relatively late period, somewhat similar to Moghal land reform methods, this Maratha map, of the Peshwa period reflects the land reform effected by Chhatrapati Shivaji. A cadastral map in a part of native western Nepal, that is dated AD 1830 with distinct boundaries and their revenue estimates is also shown. Just before the British introduced their cadastral survey and map in Maratha land by the beginning of the 18th century, revenue and village locations in the hills within a forest belt of the Sahyadri was a difficult task but the Maratha cartography had an answer in their graphic mapping of valley heads, as shown in Map. Cadastral plots even within urban areas found map expression in local language, as can be seen from Map of Jaiphalwadi, in the heart of the city, which today is a multistoreyed built up area, though strangely bearing the same name. The microland form facets that find a place in elaborate details in extra-ordinary, well conceived cadastral survey details, as contained in Adangal is well expressed in the map of Vanamadevi in coastal Tamil Nadu that I had myself surveyed in 1951. A similar map of a village in Bihar dated 1832 is also shown.

Below. Reduced facsimile of a field map of a revenue village *(mauza)* in Saran Dt., Bihar, prepared by an Indian measurer *(amin)* under the direction of a professional surveyor, c. 1845. Systematic revenue surveys, beginning in 1822, resulted in similar large scale cadastral maps for most of British India. These maps, periodically revised, formed the basis for land revenue assessments. From Phillimore, *op. cit.*, Vol. IV, *1830 to 1842*, map facing p. 176



Drawing his data base from Abul Fazl's Ain-I-Akbaree, the eminent historian, Irfan Habib mapped on the present day map format, the revenue villages of Akbar's subhas as defined by Raja Todarmal. The maps are economic as well as political, and the Moghal Atlas is an authentic land record of Akbar's times. Jean Baptiste Joseph Gentil, the military advisor of the Nawab of Oudh, with the aid of three Indian artists compiled a large Moghal Atlas in 43 tblios of the entire Moghal empire, suhbawise, together with a listing of sarkars and parganas, again the data base being provided by the Ain-I-Akbaree, rather than by direct surveys of the revenue villages. Two of the Indian artists who helped Gentil were Niwasi Lal and Mohan Singh, both Hindus. The Atlas was completed around AD1770. The map beside is an illustration of one such subha. The map are drawn employing indigenous cartographic methods, though they carry scribe-work in French. A unique feature of the Atlas is the wealth of marginal illustrations of life style, people, flora and fauna, war ammunitions and even traditions. The Atlas, held in Paris archives, is a treasure house of the Moghal Period.

Marathas in 18th century excelled in the preparation of area maps of revenue villages for the aid of native rulers. They became quite handy in the first half of the nineteenth century, when the British revenue surveys carried out their work in Konkan and Western Desh. There are many such maps, a few of which are taken for illustration in this paper. The Bavda jagir (Map) in Kolhapur area is in colour, and distinguishes between khalsa and inam (grant) villages and the map is in devnagri script. A revenue map of Vijaydurg is in two scripts; the text is in devnagri but the unique marginal legend in Modi.The legend gives details of the colour code and groups of villages according to revenue control (Map) such as Amal Bavdekar. Two similar maps of South Konkan also exist, one of which depicts forest areas in decorative tree symbols. Interestingly, there are no revenue villages in the forested areas. An interesting map of Bardol state near Solapur in India pargana is an inam group of 30 villages (Map). The map is striking in that distances are estimated through a series of evenly spaced concentric circles around the main place, Bardol, at distances of one Kos each. A revenue village map of North Kanara (Map), used by Cohn Mackenzie during the Anglo-Mysore war of 1799 was prepared by the Marathas in the second half of eighteenth century in Modi script. An interesting feature of this is the extensive depiction of hills, ghats, forests differentiated as per density, variety of vegetable cover. This map delimits revenue villages and names them.

The brief analysis adequately demonstrates that pre-British India had its own systems of cadastral and revenue mapping. What has come to light is but a small fraction. Indian cartographers and revenue officials have much to delve in the past and unearth our own heritage of revenue of revenue measures and systems.

Prof B Arunachalam retired as Professor and Head after forty years of post graduate teaching and research in the Department of Geography, University of Mumbai. He has over 100 research publications in reputed academic journals. He completed research projects through CSIR (HRD) on Lakshadweep traditions of navigation, Mediaeval traditions of cartography and Indigenous traditions of Indian Navigation. He has written books on Indian Ocean Islands (Edited), Delhi, Essays in Maritime Studies, Vol. 1 & 2 (Edited), Maritime Mumbai. (1999-2002) Heritage of Indian Sea-Navigation, M.H.S, Mumbai (2002) Chola Navigation Package MHS Mumbai by the Sea, MHS

This paper was presented at 25th International Cartographic Congress of Indian National Cartographic Association as Todarmal Lecture during 28 Nov - 1 Dec, 2005 at Sagar, MP, India

GML prototype tested for interoperability

The experiment holds the key to addressing the problem of incompatibility between different spatial data sets held by various national mapping agencies

PS Acharya, RN Nanda and A Sindal

A sample data set from Survey of India (SoI)'s conventional digital topographic data has been converted to Open Geo-spatial Consortium (OGC)'s Geography Markup Language (GML) format and tested for interoperability between different leading commercial GIS packages in a recent GML relay conducted in New Delhi on 27 January 2006. An approach for the development of a sample GML prototype was devised by the Working Group on 'Interoperability' chaired by Major General M. Gopal Rao, Surveyor General of India and constituted under the Natural Resources Data Management System (NRDMS) – an R & D Programme of Department of Science & Technology. The experiment holds the key to addressing the problem of incompatibility between different spatial data sets held by various National Mapping Agencies. Overcoming the problem through preprocessing of the data by user agencies has been a tedious, investment-intensive, and time-consuming task ever since integrated databases began to be built to support developmental planning.

As a part of the exercise, a GML application schema has been developed using OGC's GML 2.1.2 core schema for the 'road' theme of the topographic data of the SoI. The core schema provides for the standard ways various feature data sets need to be encoded for creating application schema for the selected theme. The application schemas are in turn used for preparing GML data by populating the schema with the SoI's road data, both geometric coordinates and attributes, using Visual Basic. The application schema consists of different classes falling into the road domain like the distance stones, road structures (e.g. bridges, culverts etc.), and roads with their spatial and attribute properties taken from the National Spatial Data Exchange (NSDE) format of National Spatial Data Infrastructure (NSDI). To support formation of the application schema, a class diagram in the Unified Modelling Language (UML) formalism as prescribed by the ISO 19109 has been prepared. ISO 19109 prescribes standard rules for developing application schemas as per procedures of International Standardization Organisation (ISO). The prototype has been tested and cross-checked for any possible loss of data by graphically displaying the data in Scalable Vector Graphics (SVG).

Validity of the data set has been tested for interoperability by means of a relay conducted on 27 January 2006 at NSDI Office, RK Puram, New Delhi with the participation of vendors who have imported the data directly to their proprietary formats. Outcomes of the test indicate direct portability of the SoI's GML prototype to the individual vendor packages like Oracle Corporation's Oracle Spatial, ESRI's ARC GIS, and Intergraph's Geomedia. Each vendor has displayed and edited the prototype by addition of a few features and then exported the edited data to GML format. Import and export of the data sets from and to GML format have been observed to be possible. The output GML data coming out of the packages partially vary from the original GML application schema provided initially. Efforts are on to study the variations and upgrade the application schema to accommodate more feature types for testing.

Several organizations including Space Application Centre (SAC), Ahmedabad; National Informatics Centre (NIC), New Delhi; Indian Institutes of Technology (IIT), Bombay, Kharagpur, and Delhi; Ministry of Defence (MoD); National Hydrographic Office (NHO), Dehra Dun have contributed to the deliberations of the Working Group leading to the development of the prototype.

GML defines a data encoding in Extensible Markup Language (XML) for geographic data and its attributes and provides a means for encoding such information for storage and transport over the web. It is extensible and supports a wide variety of spatial tasks, from portrayal to analysis. It separates content from presentation and enables the user to use his presentation style at the end of analysis.

The GML prototype and the relays are expected to throw light on the processes involved in the distribution of conventional geo-spatial data in the Indian Spatial Data Infrastructures using OGC standards. A strategy for ensuring interoperability between different data providers could be potentially drawn up based on the outcomes and the insights gained in the study.

(Note: Expressions made in this article are solely of the authors and do not in any way reflect the viewpoints of the organizations they are employed with.)

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Developing national SDI platform for Greece

This paper aims to develop a National SDI model for Greece incorporating theoretical and conceptual aspects

S Alexiadou and A Rajabifard

The Spatial Data Infrastructure (SDI) has emerged to facilitate the access, delivery and share of spatial information. It also results in greater efficiency as limited awareness of existing datasets can lead organizations to duplicate data collection and register. SDI is an initiative that creates an environment in which spatial data stakeholders from different jurisdictions can co-operate and thus improve the management and exchange of data in an efficient and cost-effective manner. An SDI operates on various levels including: organizational, local, state, national, regional, and finally global scale (Figure 1). Each level focuses on different details of data, institutional arrangements and issues.

As part of SDI hierarchy, the National SDI has very important role in building the upper levels of SDI as well as stronger relationship with all the other levels than any other level of SDI, within the SDI hierarchy (Rajabifard, et al, 2003). This is because of its critical position in the SDI hierarchy. A National SDI generates a detailed representation of the country and contributes to the improvement of national economy and security, and to better management of environment and natural resources. Thus, National SDI is a vital platform for sustainable development.

In Greece, spatial data stakeholders keep data in various coverage and scales of the jurisdiction. Also, there is some SDI activity, such as the Hellenic Cadastre (HC). However, legal, institutional and technological arrangements have not yet been fully set, so as to build a proper National SDI model. The lack of coordination among the stakeholders leads to the delay of SDI development. The undefined relationship between different organizations is another key issue that hinders the establishment of an SDI platform.

Current activities

In 2000 the Hellenic Mapping and Cadastral Organization (HEMCO), which is under the Ministry of Environment, Physical Planning and Public Works, proposed the development of the Hellenic SDI, called NaGi2 (National Geographic Information Infrastructure), so as economic, social, environmental and planning activities to be facilitated in Greece. NaGi2 will operate as a distributed network of databases based on a set of interoperable standards. The databases will be electronically connected, and they will provide data from various resources, such as ministries, government organizations and private companies to the widest possible group of users.

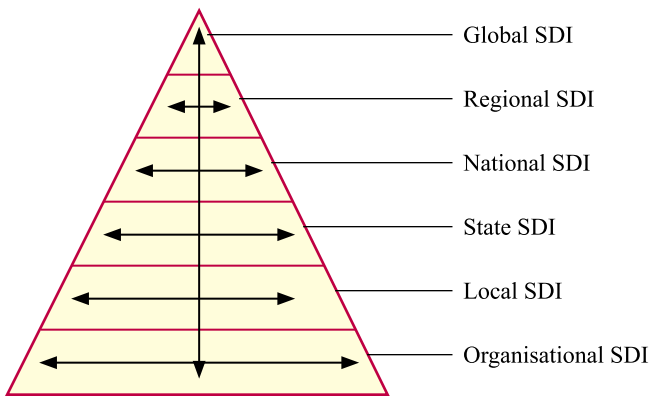

Figure 1: SDI Heiarchy (Rajabifard, et al, 2000)

As it is published in NaGi2 website (www.nagii.gr), the proposed core data layers for the National SDI are the following: i) Geodetic reference system, ii) Cadastre, iii) Soil type, iv) Administrative boundaries, v) Land Use, vi) Land cover, vii) Residential zone boundaries, viii) Cultural inheritance, ix) Place names, x) Transportation network, xi) Demography, xii) Hydrology, xii) DSM, xiv) Geology, xv) Utilities network. Also, metadata categories have been proposed as follow: i) Data accuracy, ii) Data analysis, iii) Scale, iv) Spatial reference system, v) Thematic reference system (classification), vi) Responsible sector for the data, vii) Year of data collection, viii) Last update of the data, ix) Permission of copying the data.

To finance the National SDI, a special scientific committee, called geoinformation society (geoinfo-soc) was formed (Orshoven and Beusen, 2004). These funds are covered by OPIS, a program under the Ministry of National Economy. Moreover, the HellasGIS, a national geographic information association, joined EUROGI in 2002. HelasGIS consists of 200 members of various public and private sectors and its task is to raise awareness of spatial information need within Greece, through seminars, international conferences, publications and research programs.

Issues and factors

The steps to develop an SDI model vary among countries, depending on country's background and needs.

However, it is important countries to follow a roadmap for the SDI implementation. Following, aspects that are essential to be consider for the National SDI development in Greece will be elaborated. Such aspects include the development of SDI vision, the required improvements in capacity of the country, the integration of different spatial datasets, the establishment of partnerships, and the financial support of National SDI.

Development of SDI vision

Vision within the SDI initiative is essential not only for sectors involved to SDI project but for the general public as well, since it helps people to understand government's objectives and work towards them. Since Greece already keeps spatial data in advanced, the vision of a Greek National SDI can be stated as highlighted below.

Vision

To develop an infrastructure that allows spatial data to be available and accessible to public, private sectors and individuals and to promote proper use of integrated spatial data for effective decision-making process.

In order to reach this target, mission development is the primary key, through which the tasks of each involved sector are defined. Thus, the mission of Greek government for the National SDI can be confirmed as highlighted below.

Mission

The establishment of advanced partnership arrangements amongst spatial data users stakeholders and the increase awareness of the importance of integrating built and natural data are essential.

Capacity building

Currently, HEMCO is responsible for coordinating activities relevant to National SDI development in Greece, and it will tender out to academia and private sector necessary subprojects. Figure 2 illustrates the current situation.

The fact that HEMCO is the responsible organization for the National SDI is logical in some aspect, since this organization is responsible for the HC project as well. However, since National SDI encompasses not only built data, as HEMCO keeps, but also natural data and needs high political support, a national level agency or committee is required to coordinate that initiative. HEMCO is an organization, under the auspices of Ministry of Environment, Physical Planning and Public Works. For that reason an SDI Coordinating Council is proposed at national level being responsible for National SDI in Greece (Figure 3).

The proposed SDI Coordinating Council will provide the leadership required to implement and maintain the SDI initiative. Its priority will be to promote the use of spatial information in a way that underpins sustainable development. Within its responsibilities will be the production of national strategic plans for the management of SDI activities and annual reports detailing the progress of the project. In addition, the SDI Coordinating Council will determine custodianship and promote partnerships. All these activities will be implemented in line with the government's broad development plan.

The SDI Coordinating Council will consist of the members and the advisors. Each of the members will be responsible for expressing their jurisdiction's views and plans

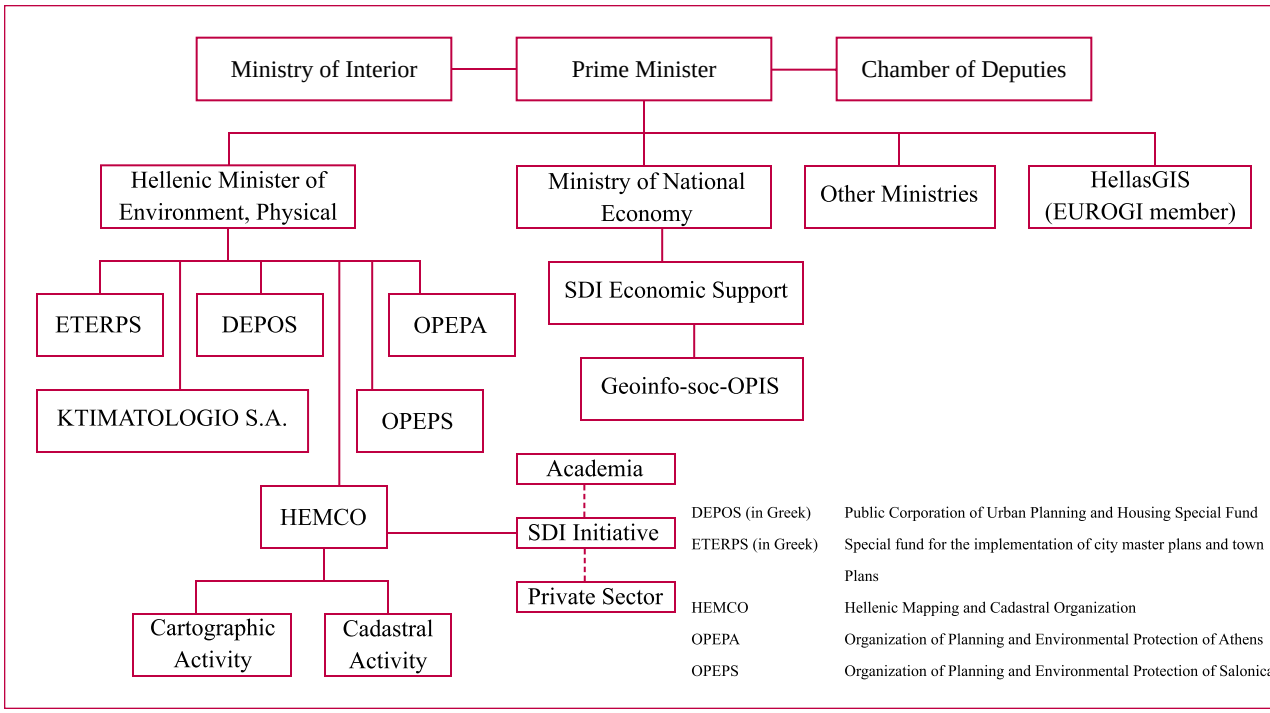

Fig 2: Current Institutional Capacity for National SDI Implementation in Greece

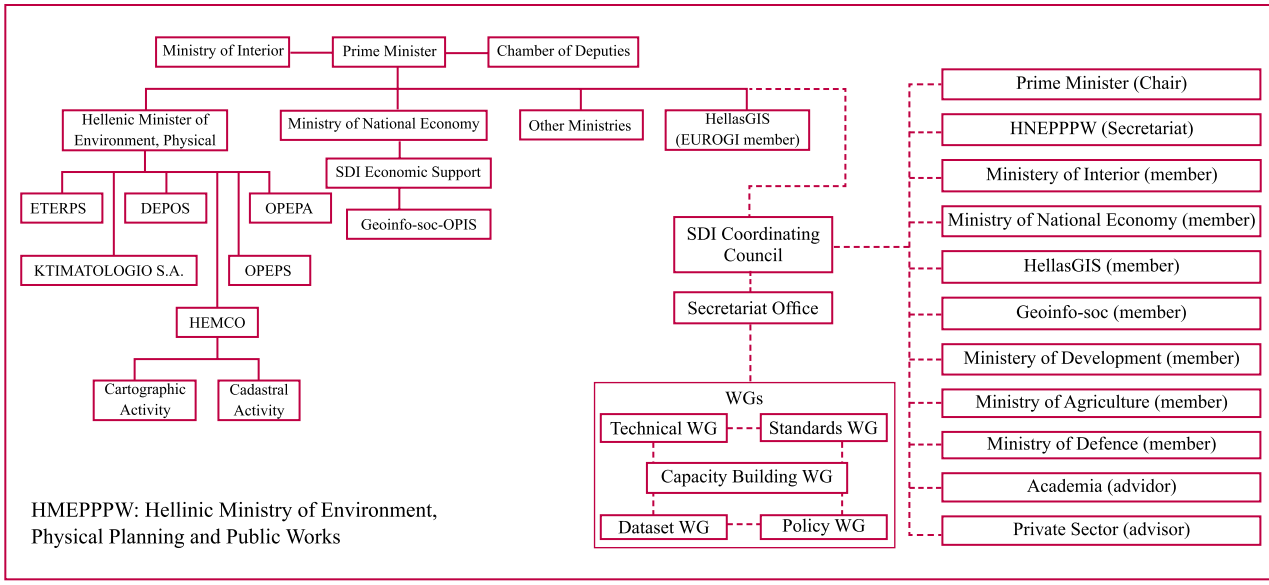

Fig 3: Proposed political structure for National development, in Greece

at the Council and promoting SDI activities within their jurisdictions. Moving to the upper levels of the SDI Coordinating Council, the Ministry of Environmental, Physical Planning and Public Works can act as a secretariat and sometimes as chair as well. The Ministry is able to set HEMCO as the holder for that position, since HEMCO is under its auspices. In this approach, HEMCO will have such a responsible task desirable to its personnel knowledge. The Prime Minister of Greece will act as the chair of the SDI Coordinating Council. The PM will ensure effective coordination and foster partnerships for expansion, since during 2004 Olympic Games preparation, the PM proved effective in tackling the difficulties caused by poor coordination (Potsiou and Ioannidis 2002).

Finally, under the proposed SDI Coordinating Council is the secretariat office, which will manage the necessary Working Groups (WGs). These WGs should be formed in respect of the SDI components and requirements. Members of these groups will be people from academia and industry, having as supervisor a person, member of the SDI Coordinating Council, expert in the field of the WG. The main responsibility of WGs is to manage their tasks and provide proposals to the Council. The structure of the WGs should be flexible to any change and reform, since they exist only to meet country's needs.

The proposed SDI Coordinating Council provides an overall view of the political support required for National SDI development. It is not the final structure, but the first step. Detailed structure can be achieved within each group with further development of the current proposed one.

Additionally to the institutional arrangements, it is important to focus on improving individual capacity during the development of SDI. This can be achieved by increasing the level of awareness, through seminars, trainings and workshops relevant to SDI and LA concepts and applications. Also, focal point should be the upgrading of educational system in national level. Currently, in Greece, a lot of LA courses are offered in universities and technical institutes. Subjects relevant to SDI have to be taught as well. Keeping people's knowledge current helps them to adapt with technology and support the evolving SDI concept.

Integration of spatial datasets

In Greece, although cadastral and topographic datasets are kept in advanced, these datasets are developed and managed separately. This is an obstacle in tackling situations that require integration of these datasets, such as the risk management, land cover and use, planning and archaeological protection. The main difficulties for the integration of both datasets are institutional and cultural structures, as highlighted by Rajabifard and Williamson (2005). However, technical part has to be handled with the same level of responsibility, since various Greek organizations, produce their data in different projection systems, which could lead to problems integrating the datasets. Within the National SDI platform, policies and standards will be implemented, so as to foster the integration of various resource data. Moreover, it is essential that the Greek community is made aware of the importance of integrating these two datasets, in order to complete the SDI project quicker and achieve better land management.

Partnerships

In order to achieve successful SDI, good coordination amongst and within all relevant responsible sectors is essential. Partnerships should be dynamic, reflecting the dynamic relationship among the SDI components. Sound partnerships, also, facilitate the data exchange and sharing, therefore reducing effort and production costs. However, it is difficult to achieve thriving partnerships because of diverse

priorities among the organizations, lack of awareness of partnerships importance, limited technical components and poor legal framework.

Successful SDI can be achieved through the accurate definition of the roles and responsibilities within the partnerships, as proposed by Grant and Williamson (2003). Proper policies and legal framework will also foster the collaboration among Greek stakeholders. Vital to achieve effective partnerships is that the involved sectors have to understand its importance.

Funding model

The funding model has a significant role in a National SDI. It is vital for a jurisdiction to clarify the purpose of the need of a funding model, which in turn should be able to respond to the country's economic resources (e.g. national and international organizations). In terms of the Greek National SDI, OPIS will control the funding of SDI initiative. Its main target is to manage European Union (EU) funds relevant to geographic information activity and define public and private contribution in the budget (OPIS, 2001).

Although the OPIS is well organized, pricing policy is also essential to be implemented in Greece, since it affects the funding process. Moreover, cost-benefits analysis is essential to be applied and compare the returns with the investment. The profit gained from National SDI should not be only economic, but also social, technical and environmental.

SDI model and components for Greek national SDI

SDI Conceptual Model

The need to integrate large-scale data such as cadastre, road network, street addresses and political boundaries with medium to large national natural resources has been increasing over the last years (Williamson, et al. 2005). The constant development of mapping techniques and the growth of Land Administration Systems (LASs) promote the need of large-scale data in National SDI. Therefore, the SDI conceptual model that will be discussed proposes the integration of SDI and LA. As it is presented in Figure 4, which has been adopted from the Centre for Spatial Data Infrastructures and Land Administration from the University of Melbourne, the integration of SDI and LA sectors results in achieving sustainable development objectives.

There are two principal SDI development models: the product-based model and the process-based model (Rajabifard and Williamson, 2001). These models explain the formation of SDI in two different ways. According to the authors, the first model focuses on linking various databases, in order to form the SDI, whilst the second model details the framework that fosters the management of datasets and applications and facilitates the communication channels. Based on these descriptions we can infer that both models are interlinking to each other, since datasets itself and the management of spatial information are mutually vital for the development of SDI.

The Greek National SDI model should follow the process-based approach, which focuses on management and communication among datasets kept by various stakeholders. This model is proposed because the National SDI will be more than a tool for linking the available databases. It will go beyond that stage by creating an environment able to facilitate the sharing, exchange and management of data among

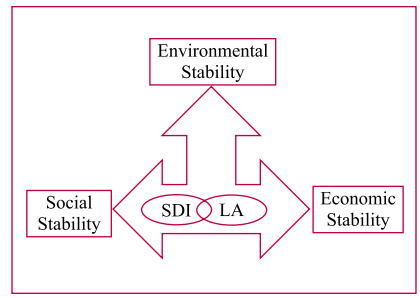

Fig 4: Integration of SDI and LA to achieve Sustainable Development

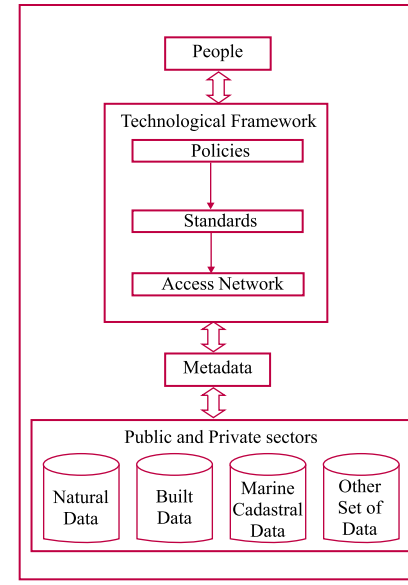

Fig5: Conceptual SDI Model for Greece

different stakeholders. In this approach – and considering the NaGi2 definition (section "Current Initiatives in Spatial Data Infrastructures") – the appropriate components for the National SDI in Greece would be: i) Access network, ii) Policies, iii) Standards, iv) Metadata, v) Data and vi) Users. Figure 5 presents the proposed conceptual SDI model. The model has been adopted from Rajabifard and Williamson (2001). It illustrates the dynamic relationship that National SDI components have.

Technological framework

The Technological Framework that proposed within the National SDI model and through which users will access the located datasets, consists of three components: i) Policies, ii) Standards and iii) Access Network.

Access Network

Since the development in technology forces people to use the Internet for accessing and delivering data, the establishment of a complete access network is required within the National SDI. A Technical WG that has been proposed under the SDI Coordinating Council will develop the technical architecture for the access network in line with the development plan of and the available resources within the Greek government. Moreover,

the access network of the HC can be used as a foundation. This is an opportunity to improve that network, allowing more services beyond land information activities.

Standards

As countries worldwide develop National SDIs, the need for standards is becoming a basic requirement. Standards are useful for producing, sharing, accessing and using data. They, also, ensure compatibility between data from different resources (e.g. built and natural datasets).

Since Greek National SDI will be node within the European SDI, it would be beneficial to comply with European standards (ISO/TC211, CEN/TC287 - 278, and OGC). Therefore it is not required for Greece to create new standards. If European standards are followed, there will not be issues of interoperability within the Regional SDI.

Policies

Policies, within the environment of SDI should be able to address reliability, testability, verifiability, accessibility, usability, interoperability and maintenance of spatial data (Wallace, 2005). So far, policy making within Greece is incomplete (Orshoven and Beusen, 2004). However, the need for detailed policy on accessing data and particularly sensitive data (e.g. military buildings, culturally protected areas, personal data) is necessary in building of National SDI. A Policy WG that has been proposed under the SDI Coordinating Council will set policy that will cover public, private sector and academia and support privacy, security, confidentiality and intellectual property rights within the jurisdiction. Each organization should be responsible to respect and enforce that policy. Moreover, the development of national guideline policy documents, which will be supported by legislation and be available both to stakeholders and users of spatial data, will significantly foster the success of SDI.

Datasets

Metadata

Metadata provides information about stakeholder of the data, so users know where they should acquire the data. It presents information about the date of data creation, any potential update of data, its accuracy, geographic extent and coordination system and other technical description. With this information users can assess whether or not the data is suitable for their applications.

For the Greek SDI, based on the proposed metadata by Information Society (section “Current Initiatives in Spatial Data Infrastructures”), users are able to get information about the technical characteristics of the data and their stakeholders and therefore to judge whether the data is appropriate for their needs. Thus, the list is complete and it does not require any change.

Data

The number of the core data layers within the SDI varies among different National SDIs, and depends on the geography of the country, the strategies of SDI Coordinating Council and the Regional SDI that the National belongs to. Regarding the Greek National SDI, the number of proposed core data by Information Society, is fifteen (section “Current Initiatives in Spatial Data Infrastructures”). According to ETeMII (2001) (European Territorial Management Information Infrastructure), the proposed core data for both Regional and National SDIs are the following six: i) Geodetic reference system, ii) Ortho-imagery, iii) Topographic mapping, iv) Units of property rights, v) Addresses, vi) Units of administration

Although Information Society’s proposal includes all the layers of the ETeMII’s list, none of them contain offshore data as a core layer. Having in mind that Greece has a very long coastline, marine cadastre should be considered as one of the core layers in National SDI. Therefore, the conceptual National SDI model, proposed in this paper, contains marine data as core dataset (Figure 5). In this approach, sustainable development will be promoted in advance.

People

Another important SDI component is the people. This includes private companies, public organizations, academia, and individuals, who provide data or need it to develop applications or produce other data. Their relationship is vital, since all these groups are required in order to have, integrate and utilize data effectively. Moreover, people are the driving force of SDI development, because of the very strong relationship they have with all the other components of SDI platform. For instance, people establish the access network and set policies and standards according to which they access data. Thus, SDI initiative starts and ends with people and their desires drive the evolution of SDI concept. Therefore, all residents of Greece should be allowed to access the data.

SDI implementation plan

The SDI roadmap is important for the implementation of National SDI, because without following any action schedule the project will not be successful. The development of such a plan depends upon socio-economic, technological and political conditions of the country. Since SDI development is by nature a long-term project and a country’s status is always evolving, SDI implementation plan should encompass dynamic approach of the required actions. Considering the current status of Greece, a roadmap for the country’s National SDI is proposed (Figure 6). Within the SDI development, if it is feasible, some activities can be implemented in parallel. A specific duration is difficult to be given, because of the evolving nature of the SDI platform.

A major priority for the Greek

jurisdiction is the formation of the SDI Coordinating Council, since it will have leading role in National SDI. In this stage, the appropriate WGs will be created and memberships and responsibilities will be delegated to proper sectors. Next step is to define the SDI vision and mission, so as the country to have a clear target to achieve. Since one of the main tasks of the Council is to determine strategies, the SDI strategies action follows. By clarifying the strategies, the country saves time and money from unnecessary activities.

While the selection of the Council members takes place, the government is able to develop and propose organizational structures able to support the establishment and maintenance of SDI. Within this task the capacity building will be reformed, so as the involved sectors to get improved and qualified, to support the SDI project.

The SDI conceptual design can be developed after the formation of SDI Coordinating Council, because at that time the responsibilities would have been allocated and each member will have clearly defined task. After the half part of this stage, the country has clear idea of what they will implement and therefore, the development of the SDI implementation plan can begin.

Then, the actual implementation phase follows. It consists of pilot projects to be completed in the early stage of the phase. These foster the smooth execution of the project, acting as a test for proposed methods and plans. During the pilot projects implementation, they are assessed and the jurisdictional major projects will start. These can be either short-term or long-term projects. Regarding the deliverables during the SDI implementation, these will be annual reports relevant to the activities that take place in each phase.

In addition, the government has to develop a benchmarking strategy to monitor SDI progress with corresponding activities in Europe. Indicators, such as the level of awareness, capacity in the community and system availability can be used in this process. Also, the maintenance of the overall platform is very important, in order to have a functioning SDI. A clear maintenance and support strategy is needed. SDI maintenance is difficult and challenging and requires effort and finance. The country has to maintain and upgrade the institutional structure as well as the SDI components.

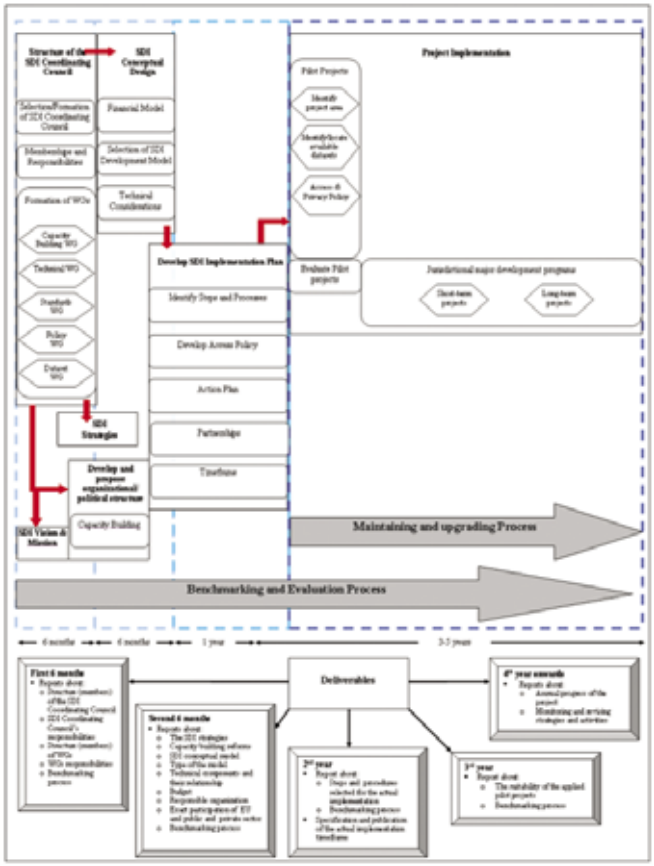

Fig 6: SDI Roadmap

Conclusion

This paper evaluated the current situation in spatial activity in Greece, discussed the major issues for the development of a Greek National SDI and proposed a National SDI conceptual model and its components. Finally, it proposed a roadmap for a complete and consistent implementation of the National SDI platform.

Acknowledgments

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The complete paper, with detailed references is available at ***www.mycoordinates.org***

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Spatial and dynamic modeling techniques: An outlook

The paper takes a look at the decision support tools that have been developed to address land resource applications and challenges ahead

NOVALINE JACOB AND KRISHNAN R

Traditionally GIS are considered to perform four basic functions on spatial data; input, storage, analysis and output. Of these, analysis has received least attention in commercial systems. Typically, a variety of map description and manipulation functions are defined by commercial vendors as being "Spatial analysis", but they have little bearing on the use of this term in the Regional Science Community. A large set of techniques like Operations Research methods, Multi-Objective Decision-Making methods, Multi Criteria Decision Making methods like Analytical Hierarchy Process, Compromise Programming, Fuzzy logic techniques etc. have to be included in these packages.

The currently available spatial decision support models are predominantly based on Boolean logic, which gives no room for imprecision in information, human cognition, perception and thought processes. The emergence of Fuzzy logic provides a framework under which these can be handled. While Fuzzy expert systems have been developed, fuzzy spatial analysis is still a very new area. Modeling has three broad aspects: (a) To explain a phenomenon (b) To predict a trend or future (c) to act as a tool of discovery. The first two have had a long history, but several new tools like Cellular Automata, Diffusion models, Random field models, Multi Agents etc. have emerged.

The authors have worked on many of these techniques and have addressed various land resource related application problems. This paper provides an analysis of various decision-making techniques, which would help GIS to evolve from a mere manipulation tool to a more analytical tool.

Decision-making tools and applications

Spatial problems could be a simple single objective problem involving multiple criteria in the analysis like landslide hazard zonation, site selection for check dam etc. Or it could be a complex multi objective problem involving multiple criteria like land use planning.

Also, real–world spatial problems requires optimization at various stages. Traditional Optimization problems are non-spatial in nature. Optimization in spatial domain can be done by integrating optimization techniques with GIS. There are also problems, which requires prediction of dynamic process like land degradation process, land use change or settlement dynamics and are often complex in nature and has been addressed with Cellular Automata, a dynamic spatial modeling tool.

Multi-criteria decision making

Multi criteria decision-making (MCDM) problems involve a set of alternatives that are evaluated on the basis of a set of evaluation criteria. The multi criteria decision analysis has recently received considerable attention in GIS. Alternate approaches to GIS-based multi criteria analysis have been suggested to overcome the problem of weighting and data integration. Analytical Hierarchy Process (AHP) was used as a weighting strategy and Compromise Programming (CP) technique was used for data integration.

Analytical Hierarchy Process

Combining different factors, some exclusionary and some expedient, requires a weighting factor. AHP is an approach that can be used to determine the relative importance of a set of activities or criteria through pair wise comparison approach.

Compromise Programming

Another important problem in GIS is how to efficiently integrate data from various sources. Weighted linear additive model is the one that is widely used for data integration and is done with the help of algebraic functions available in any

commercial GIS package. In this, a total compensation between criteria is assumed, meaning that a decrease of one unit on one criterion can be totally compensated by an equivalent gain on any other criteria. Compromise Programming technique, is a method to arrive at non-compensatory solution. It measures the deviations from the ideal point in each data layer and a min max rule is applied wherein minimum of the maximum weighted deviations are sought for getting a composite layer. The best compromise solution is defined as that which is at the minimum distance from the theoretical ideal.

These methods have been used to solve problems like landslide hazard zonation and site selection for water harvesting structures.

Multi-ojective multi-criteria decision making

Combination of Analytical Hierarchy Process and Compromise Programming techniques worked well in solving Single Objective Multi-Criteria problems like Site Selection for Water Harvesting Structure, Landslide Hazard Zonation. But such a combination cannot be effectively used for solving Multi-Objective Multi-Criteria problems. It is multi-objective in the sense one has to perform site suitability analysis for multiple objectives which include individual crops or land use practice like agro forestry, silvipasture, etc. Multiple criteria like land use, slope, soil, landform, groundwater prospects, etc, are involved in analyzing each objective.

Though the Multi-Objective Multi-Criteria Decision-Making problem can be broken into several single objective multi criteria decision making problem, solving this problem by applying combination of Analytical Hierarchy Process and Compromise Programming techniques is not going to be straight forward and effective. Moreover only absolute suitability within an objective can be addressed using MCDM techniques.

In Multi-Objective Multi-Criteria Decision-Making problems, what is needed is the relative suitability for different objectives. We propose a Fuzzy classification approach in GIS for solving Multi-Objective Multi-Criteria Decision-Making problem.

Fuzzy Classification in GIS

Fuzzy Classification in GIS approach not only solves a multi-objective multi-criteria decision-making problem, but also overcomes the information loss seen in classical set theory-based decision-making. The task of rating land suitability is to classify areas into land use classes according to their land characteristics. By representing areas as vectors in a feature space, one can use the distance between feature vector corresponding to an area and a land use class as a measure of their similarity. The similarity indicates the extent to which the area belongs to the land use class. This technique has been used to suggest alternate land use / crop. It is also possible to use the stored fuzzy membership grades for database queries like: Find the second most suitable crop for a particular area; List all the areas which are suitable for both soya bean and sugarcane and find the suitability value etc.

Optimization technique

A big vacuum exists in the field of Spatial Modeling with regard to inclusion of socio-economic data. There are inherent problems in incorporating socio-economic data, which is non-spatial, with the spatial land-related data. Until socio-economic data is involved in the model, whatever we do will remain in the air and never gets practiced in the ground. An attempt has been made to use socio-economic data to generate optimum agriculture development plans, by integrating Linear Programming (LP) with GIS.

Identification of optimal crop that maximizes productivity or maximizes employment or minimizes water use, subject to constraints like, labor availability, finance, market price, water use, self requirement has been attempted to derive agriculture development plans. Integrating LP with GIS involves issues like spatialization of LP results and also taking the constraints' coefficients by performing preliminary analysis in GIS. Optimal proportion of area for land use transformation after satisfying the constraints is obtained from LP. LP does not provide a spatial representation for the suggested land use allocations. It would only say how much hectares of each land use should be changed, but would have no indications on which specific hectares should be altered. Spatial mapping of LP results was done by performing land suitability analysis in GIS.

Dynamic Spatial Modeling

Most current GIS techniques have limitations in modeling changes in the landscape over time, but the integration of Cellular Automata (CA) and GIS has demonstrated considerable potential . More sophisticated CA model has been built by improving the state-based cellular automata with suitability constraints, determined using the land degradation driver variables, for simulating land degradation scenarios.

Traditionally, CA simulation only uses a binary value to address the status of conversion based on the calculation of probability. The probability of conversion is calculated based on some kind of neighborhood function. Usually, the probability is further compared with a random value to decide whether a cell is converted or not (1 for converted and 0 for non-converted). In our model, the status of cell has a continuous suitability value between 0 and 1 to represent the stepwise selection or conversion process. A cell will not be suddenly selected or converted.

A stochastic disturbance term is added to represent unknown errors during the simulation. This can allow the generated patterns to be closer to reality. Suitability values

are converted into probability values by introducing a stochastic disturbance parameter. Thus this rule defines the probability of site selection in terms of land suitability.

The model developed for simulating the spatial dynamic process can be used as a planning tool to test the effects of different land use change scenarios. Cellular Automata are seen not only as a framework for dynamic spatial modeling, but as a paradigm for thinking about complex spatial-temporal phenomena and an experimental laboratory for testing ideas.

Challenges

In spite of the proven abilities and increasingly widespread adoption of Decision Support Systems, there are number of areas where significant improvements can be made.

Fuzzy Logic methods in GIS

Fuzzy logic methods can be used as a representational and reasoning device in GIS. Geographical data has a number of properties, which present challenges to spatial modeling process. These include complex definitions of locations, multidimensionality, and the inherent fuzziness in many features and their relationships. There are two issues that can be addressed.

(i) Representation issues: The database needs to be able to hold information about features whose location and or extent are not known precisely.

(ii) Analysis issue: The expert performing spatial analysis may prefer to work with natural and expressive queries such as –

What are the areas which are NEAR to the town, SOUTH of the river and SUITABLE for agriculture?

Data Mining

Modeling as a source of discovery was earlier called Exploratory modeling. But today it has come to be known as Data Mining. Data Mining tries to discover patterns that are not apparent or that are not looked for specifically. While there is a close interaction between statistics and Data Mining, the latter in some sense automates the statistical process. A variety of tools have been proposed for Data Mining. These include Neural Networks, Genetic Algorithms, Classification and Regression Trees (CART), Clustering, Rule Induction etc. Again Data Mining is today closely linked to Business environments and simple databases. The use of Data Mining along with a GIS will call for the adaptation of the above tools for spatial data handling.

Multi Agent Systems

Often, differential equations are used in dynamic modeling. The Cellular Automata / Multi Agent approach (CA/MA) can also be used for dynamic modeling and differs in many respect from sets of differential equation, both in the treatment of the data and in the working of the model. There is a conceptual shift from mathematical descriptions of a dynamic model to rule-based specifications of the behavior of individual agents. This is beneficial because rule-based specifications are often probably closer to the mental model people have of the systems, and because data from field studies may be more directly mapped into agents behavioral rules than into system level equations. Models of differential equation may include hypotheses about the behavior of the elements at the micro level, but they define rules that are applied at the macro/global level. On the contrary, the information in a CA/MA model is treated at the local level from which global pattern evolves. Comparing the MA approach to CA also helps to illustrate its specificities. As in the case of CA, the evolution of a cell is defined in a MA approach by a set of transition rules handling local criteria. Within CA/MA framework each cell can be in one of the several states (land use class), which can change over time. Change dynamics are determined by the set of rules that define the state of each cell at the next time step, based on the state of a cell itself and the states of the neighboring cells. The difference between CA and MA is mainly in the characterization of the cells. Whereas each cell is defined by its state relatively to a single qualitative variable in a CA application, it has a broader possibility of characterization in a MA approach. The state of each cell is multi-dimensional and refers both to qualitative variables (type of land use, for example) and quantitative ones (population, for example). Therefore Multi Agents are the most appropriate modeling technique to model multi-dimensional dynamic phenomenon. Multi Agents are seen to be as an efficient technique to build Collaborative Decision-Making systems as well and its potential in this field has to be explored.

Conclusion

There is an ever-increasing demand to automatically derive information and make decisions out of the huge volumes of data available. This requires development and integration of efficient tools in GIS to enable it to evolve into an Analytical GIS. The authors have studied and worked on many of these analytical decision-making techniques for various land resource applications. It goes without saying that, further research in this direction is challenging and worth pursuing.

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National GPS programme for earthquake hazard assessment

Department of Science and Technology, Government of India has launched a National Programme on GPS for geodetic studies and monitoring the crustal deformations

MANORANJAN MOHANTY

The GPS technology is being used extensively all over the world to generate useful data for different purposes. The Department of Science and Technology, Government of India has evolved a programme on GPS to study crustal deformation processes with the following objectives :

i. To establish the rate of movement of the tectonic plates relative to each other.
ii. To establish the strain rates in different tectonic domains of India and to constrain strain partitioning in discrete tectonic domains/ blocks and identify the area of higher strain build up/ release.

Participating organisations

- Survey of India, Dehradun
- CSIR Centre for Mathematical Modeling and Computer Simulation, Bangalore (CMMACS).
- Wadia Institute of Himalayan Geology, Dehradun (WIHG)
- Indian Institute of Technology, Mumbai (IITM)
- Indian Institute of Technology, Kanpur (IITK)
- Indian Institute of Geomagnetism, Mumbai (IIG)
- Centre for Earth Science Studies, Trivandrum (CESS)
- G B Pant Institute of Himalayan Ecology & Development, Almorah (GBPIHED)
- National Geophysical Research Institute, Hyderabad (NGRI)
- India Meteorological Department (IMD), New Delhi
- GND University, Amritsar
- Cochin University, Cochin
- Indian Institute of Astrophyiscs, Bangalore (IIA)
- Geological Survey of India (GSI)
- Tezpur University, Tezpur
- Mizoram University, Aizawl
- Manipur University, Imphal
- Nagaland University, Kohima
- Gauwahati University, Gauwahati
- M S University, Vadodora
- Regional Research Laboratory, Bhopal

Status and achievements

The implementation of the National GPS Programme for Earthquake Hazard Assessment, as recommended by the GPS Expert Group, has been taken up by the DST since 1998. An extensive network of permanent, semi-permanent and field GPS stations is being established by the participating organizations, and a National GPS data centre has been established at Survey of India (SoI), Dehradun. Specifications of the GPS instrumentation for this purpose have also been formulated. A Committee has been constituted for overseeing the programme. A brief report on these activities is given below:

Establishment of permanent stations

So far, the DST has set up 35 Permanent GPS Stations all over the country in collaboration with Scientific organizations and Universities . Necessary efforts are also being put to set up few more permanent stations . Recently a permanent station has been set up at Portblair with the help of NGRI, Hyderabad and India Meterological Department. It is also proposed to set up few permanent stations in Gujarat and Rajasthan area since very few permanent stations are available in these areas. Met packages are being installed at some permanent GPS stations to facilitate the above studies and optimize the scientific outcome.

National GPS Data Centre

Considering the importance of management of a huge volume of GPS data collected from different GPS-related projects, a National GPS Data Centre has been set up at Survey of India, Dehradun. Continuous GPS data from all the permanent stations as mentioned above are being sent to the data center at SoI. The SoI is also planning to make the data available to all authorized users through ftp/ internet, so as to reduce response time for data delivery and eliminate avoidable manpower costs.

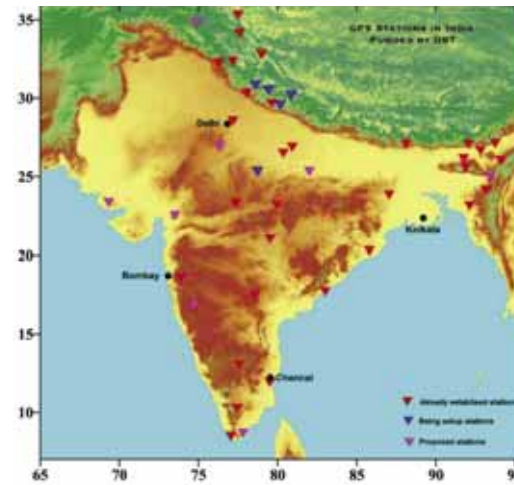

Figure 1: Permanent GPS stations network set up under the programme (As on 31st Dec 2004)

Campaign Mode Studies supported in Project mode

Sl. No.	Region	Institution
1.	North-Western Himalayas	WIHG Dehradun; C- MMACS, Bangalore
2.	Shillong Plateau	CMMACS, Bangalore; Tezpur University; Central Seismic Observatory, Shillong
3.	Darjeeling-Sikkim Himalayas	GB Pant Institute, Gangtok; CMMACS, Bangalore
4.	Indo-Burmese Arc	Manipur University, Imphal NGRI, Hyderabad; Aizwal University
5.	Bhuj region	IIT Mumbai; IIG Mumbai; MS University, Baroda
6.	Western Maharastra	IIT Mumbai; IIG Mumbai; NGRI Hyderabad
7.	Meghalaya-Assam-Arunachal Region	Tezpur University, Guwahati University
8.	Son Narmada Lineament & Central India	Regional Research laboratory, Bhopal; IIT Kanpur; MS University, Baroda
9.	Kumaun & Garhwal Himalaya	GB Pant Institute, Almora; CMMACS, Bangalore
10.	Southern India	CMMACS, Bangalore; Cochin University
11.	Palghat gap region	CESS Trivandrum

Transformation Parameters

The reference frame for GPS is World Geodetic System-1984 (WGS-84). GPS measurement at terrestrial sites therefore give coordinates on WGS-84 Datum. This datum is different from that of the Indian Geodetic datum i.e., Everest Datum. All SoI topographical maps are based on this datum. In order to make optimum use of GPS-based coordinate system, it has become essential to determine transformation parameters for conversion of coordinate of points from WGS-84 Datum to Everest Datum, and vice versa.

In view of the importance of this task, DST had sanctioned a project entitled "Determination of Transformation Parameters between Everest Datum and World Geodetic System-1984 (WGS-84 Datum)" to the SoI. The SoI has already completed GPS measurements at 272 old GT stations for this purpose. The transformation parameters between WGS-84 and Everest datum have been successfully determined for the entire country including Lakshadweep and Andaman & Nicober Islands, except for the state of Jammu and Kashmir region due to insurgency problem. The SoI is planning to carry out GPS observation in Jammu and Kashmir with the help of Military.

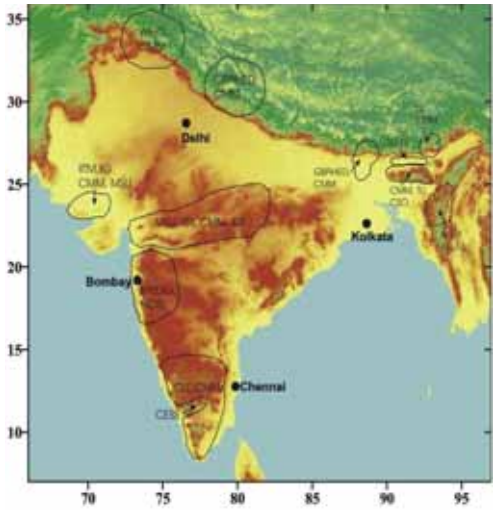

Fig-2: Different GPS Field Campaigns

Crustal deformation studies

The 26th December 2004, earthquake was the biggest event in Indian history that killed thousands of people by creating a big Tsunami. It was also the largest Seismic event to strike in the era of modern GPS Technology. The recent findings of the GPS data indicate that the area of 4500 km-radius experienced clearly measurable surface displacements.

Just immediate after the earthquake, few pilot projects were supported for carrying out GPS observations in the Andaman & Nicobar Islands. The SoI, (Dehradun), NGRI (Hyderabad), CMMACS (Bangalore) and CESS (Trivandrum) carried out some campaign mode studies in Andaman and Nicobar Islands.

GPS measurements by Survey of India during March 2004 and January 2005 at twelve sites in the Andaman-Nicobar Islands which provided a comprehensive and reliable estimates of coseismic movements, slip on rupture and rupture characteristics of 26 December 2004 giant Sumatra earthquake. It has been reported by NGRI, Hyderabad that there was a coseismic horizontal ground displacement of 1.5-5.0 m in the SW to WSW direction in Andaman Islands, 4.0-6.5 m in SW direction in Nicobar Islands, coseismic uplift of 0.5-1.0 m in the North Andaman Island, subsidence of less than 1 m in Middle, South and Little Andaman Islands and subsidence of 1.1-2.8 m in Nicobar Islands occurred. Recently, a permanent GPS station has been set up at Port Blair to continuously monitor the movement of the Andaman and Nicober Island. Similar results have also been reported by CMMACS (Bangalore) and CESS (Trivandrum)

Manpower development

Considering the need of suitable manpower in GPS technology, efforts are made by the Seismology

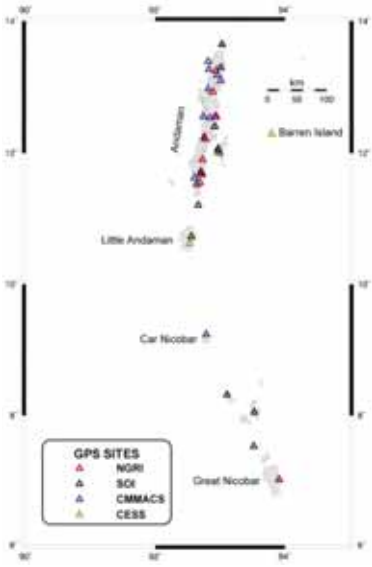

Fig.3: Existing GPS sites by various institutes for monitoring postseismic deformation.

Division, DST to organize short term courses, workshops and training programmes. As a result of this, 5 training programmes/short term courses have already been organized at WIHG Dehradun, IIT Bombay, and CMMACS Bangalore in which nearly 100 persons from various Universities and research institutes have been trained.

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MARK YOUR CALENDAR

April 2006

National Workshop on Role of Geodesy in Surveying Practices
10 - 11 April, 2006, Geodetic & Research Branch, Survey of India, Dehradun
gandrb@vsnl.net

IEEE/ION PLANS 2006
25- 27 April, San Diego, CA United States
http://www.PLANS2006.org

Geo-Siberia 2006
26-28 April in Novosibirsk, Russia
http://www.sibfair.ru/en/exhibition.php?id=533

May 2006

The North American Defense Geospatial Intelligence Conference
8-10 May, USA
dgi@wbresearch.com

4th Taipei International Conference on Digital Earth
25- 26 May, Taiwan, Taipei
derc@mail.pccu.edu.tw
http://deconf.pccu.edu.tw/

June 2006

Geoinformatics for Rural Development
5 - 8 June, Hyderabad, India
ivm@ieee.org

International Conference in GIS and Health
27-29 June, Hong Kong
chankw1@hkuoc.hk
http;//geog.hku.hk/HealthGIS2006

July 2006

ISPRS Commission I Symposium: "Paris 2006: From Sensors to Imagery"
03 - 06 July, Paris, France
isprs2006@colloquium.fr
www.colloquium.fr/sfpt2006

3rd Annual Meeting (AOGS 2006)
10-14 July, Singapore
http://asiaoceania-conference.org/

COAST - GIS 06
13-17 July Wollongong and Sydney, Australia
www.uow.edu.au/science/eesc/conferences/coastgis06

IGNSS 2006 Symposium on GPS/GNSS
17-21 July ,Gold Coast, Australia
http://www.ignss.org/conf2006/index.php

August 2006

International Workshop on 3D Geoinformation
7-8 August, Kuala Lumpur Malaysia
alias@fksg.utm.my
www.fksg.utm.my/3dgeoinfo2006

26th ESRI User Conference and 4th Survey and GIS Summit
07- 11 August, San Diego, CA, USA
uc@esri.com
www.esri.com

Digital Earth 2006
27-30 Aug
www.digitalearth06.org.nz
james@eventdynamics.co.nz

September 2006

WALIS Forum
14 - 15 September Perth Convention Centre, Australia
davidls@walis.wa.gov.au
www.walis.wa.gov.au

17th UNRCC for Asia and the Pacific/ 12th Meeting of the PCGIAP
18-22 September, Bangkok
http://www.gsi.go.jp/PCGIAP/

ION GNSS 2006
26 - 29 September, Fort Worth TX, USA
www.ion.org/meetings#gnss

October 2006

Intergeo 2006
10 -12October, Munich, Germany
ofreier@hinte-messe.de
http://www.intergeo.de

XXIII International FIG Congress Back
15-20, Germany, Munich
http://www.fig2006.de/index2.html
Office@fig2006.de

The 12th IAIN World Congress 2006
18-20 October, Jeju, Korea
http:// 203.230.240.83/

Geoinformatics 2006
20-21 October, Wuhan, China
lilyshi@lmars.whu.edu.cn

The 12th IAIN World Congress 2006
18-20 November, Korea
jkinpr@mail.hhu.ac.kr

November 2006

GSDI-9 - Geospatial Information: tool for reducing poverty
03-11 November, Santiago de Chile, Chile
gsdi9@igm.cl
http://www.igm.cl/gsdi9

Trimble Dimensions
05 - 08 November, Las Vegas NV
http://www.trimble.com

Galileo Update

GIOVE A Transmits Loud And Clear

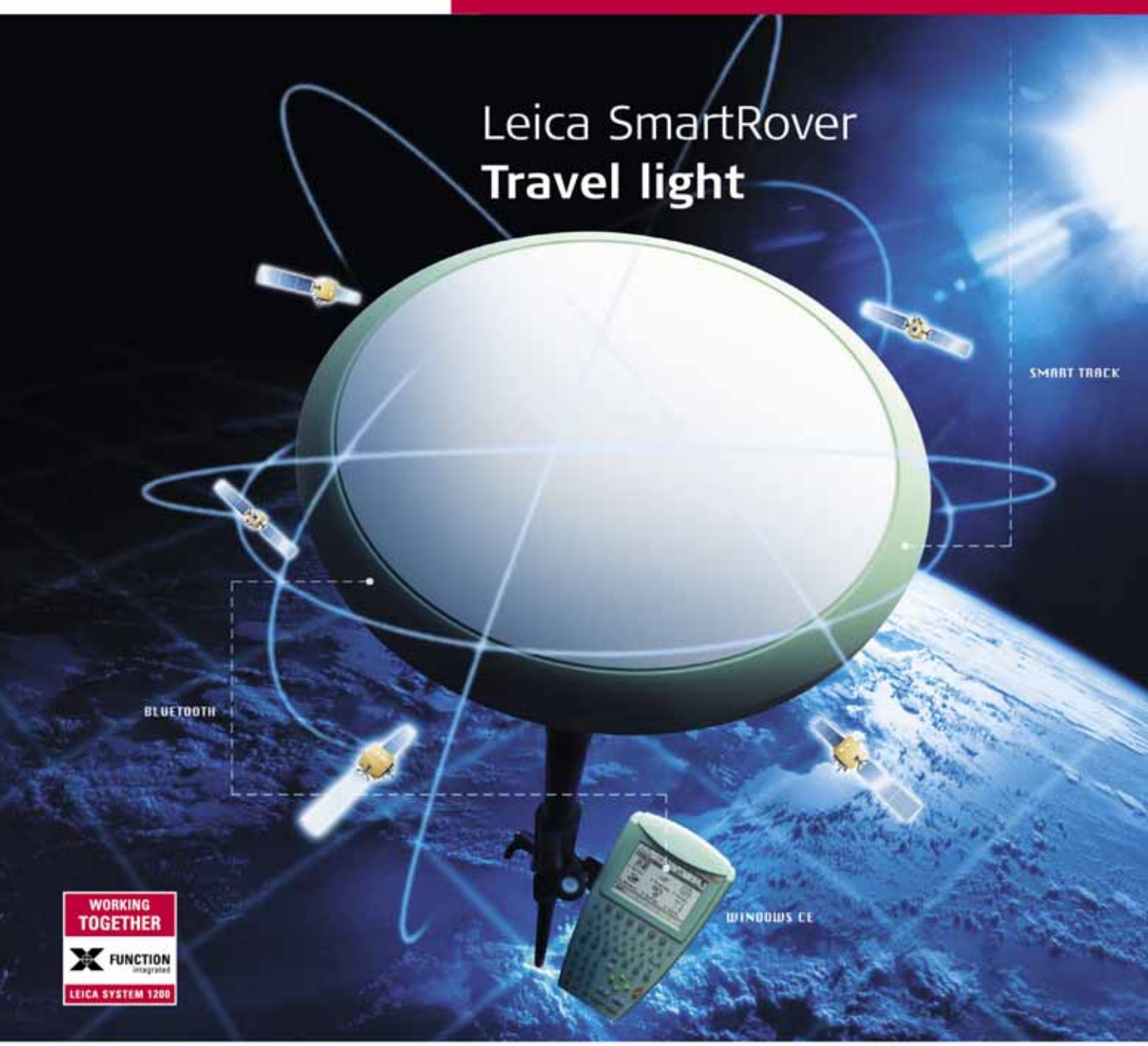
After launch and platform commissioning, GIOVE A started signal transmission on 12 January and the quality of these signals is now being checked. This checking process is employing several facilities, including the Navigation Laboratory at ESA's European Space Research and Technology Centre (ESTEC), in the Netherlands, the ESA ground station at Redu, in Belgium, and the Rutherford Appleton Laboratory (RAL) Chilbolton Observatory in the United Kingdom.

Chilbolton's 25 metre antenna makes it possible to acquire the signals from GIOVE A and verify they conform to the Galileo system's design specification. Each time the satellite is visible from Chilbolton, the large antenna is activated and tracks the satellite. GIOVE A orbits at an altitude of 23 260 kilometres, making a complete journey around the Earth in 14 hours and 22 minutes.

The GIOVE A mission also represents an opportunity for the testing of a key element of the future Galileo system, the user receivers. The first Galileo experimental receivers, manufactured by Septentrio of Belgium, were installed at the Redu and Chilbolton In Orbit Test Stations and at the Guildford, United Kingdom, premises of Surrey Satellite Technology Limited (SSTL), the manufacturer of the satellite and now in charge of its control in orbit.

Alcatel Demonstrates Emergency Service Based On Galileo Precursor EGNOS

Alcatel Alenia Space announced that it will demonstrate the first emergency service based on EGNOS, a precursor of Galileo. The integrated end-to-end Location-Based Solution (LBS), designed under the coordination of Alcatel Alenia Space, enables the Civil Security forces and Fire Brigades to locate emergency calls from mobile phones and efficiently guide the intervention team. Using EGNOS-enhanced accurate positioning integrated with the telecom network and the emergency control centre application, the service improves the speed and efficiency of the rescue, increases the team safety and optimizes the resources needed for overall incident management.



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