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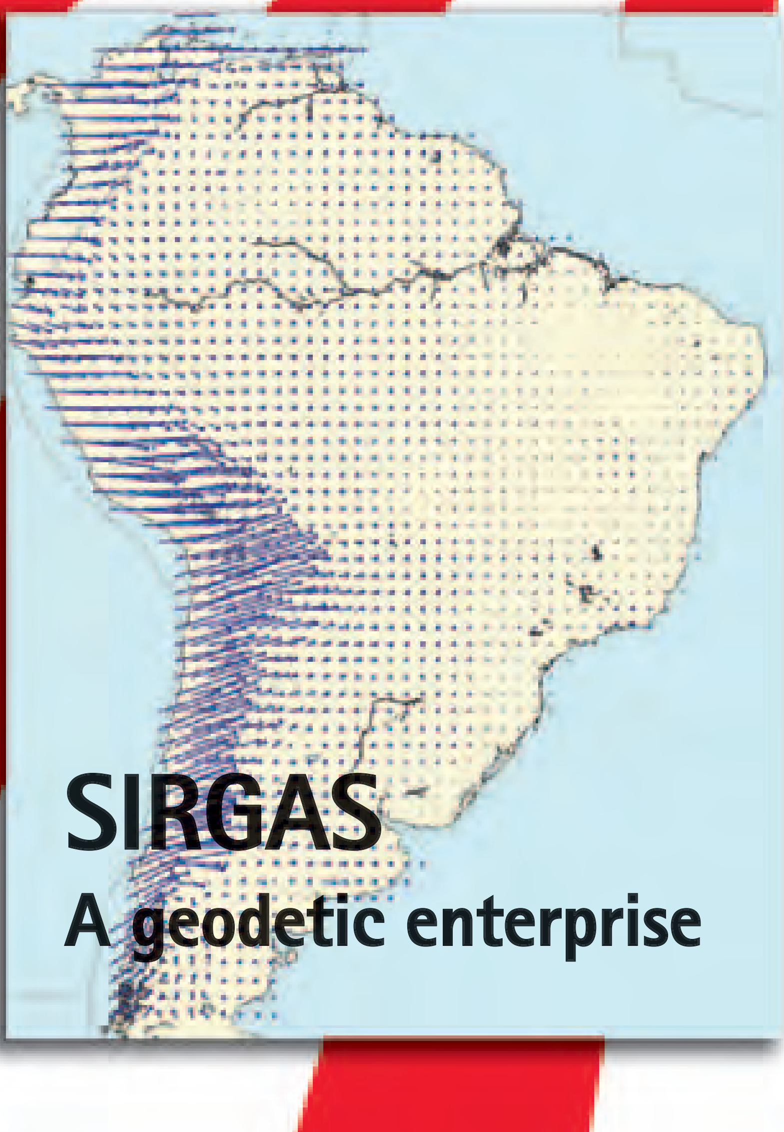
POSITIONING, NAVIGATION AND BEYOND

A yen for regional navigation



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On the moon, together

Conquering a technology is always important.

Owning it adds an arsenal to the might of the nation.

Hence, there is a rivalry to own it. Exclusively.

Ironically, at times the technology itself becomes a victim.

When purely technological research that needs more collaborative approach suffers due to non technological reasons.

Fortunately, in the area of space technology, an era of collaborative endeavors appears to have started.

Such efforts not only reduce duplication but also enable better utilization of resources available.

So, on May 9, 2006 when NASA and ISRO collaborated on Chandrayan I, it makes sense.

It makes more sense because this relationship has been shrouded by the clouds of nuclear sanctions.

Conquering barriers are even more important.

Bal Krishna, Editor
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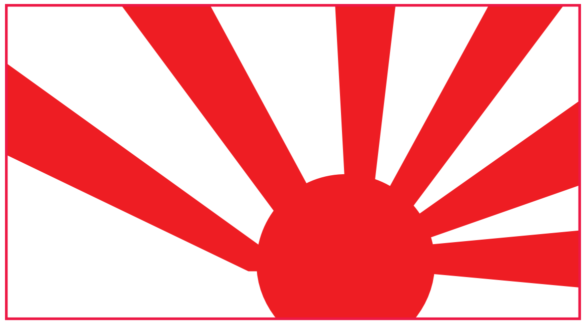
A yen for regional navigation

An update on Japanese Regional Navigation Satellite System

Hideto (Duke) Takahashi



In the 1970s, the US Department of Defense began GPS development as a military force enhancer. In 1983, President Reagan offered GPS civil services to the world, free of direct charges, as a result of the KAL007 disaster. This global offer sparked widespread civil use of GPS and significant investment in civil GPS technologies, to include GPS civil augmenting satellites (e.g. US Wide Area Augmentation System (WAAS), European Geostationary Navigation Overlay System (EGNOS) and the Japanese Multi-functional Transport Satellite (MTSAT)) and GPS civil user equipment to support a broad range of applications from transportation to agriculture.

From an International Civil Aviation Organization (ICAO) perspective, ICAO document A32-19 establishes and affirms the fundamental legal principles governing the use of Global Navigation Satellite Systems (GNSS) by ICAO contracting States. A key theme of A32-19 is preservation of State authority and responsibility for the provision of air navigation services in their sovereign airspace. Specific State requirements are further clarified in principle number four of A32-19. This principle specifically states that: "Every State providing GNSS services…shall ensure the continuity, availability, integrity, accuracy and reliability of such services…including effective arrangements to minimize the operational impact of system malfunctions or failure and to achieve expeditious service recovery".

GPS is becoming a mainstay of everyday life in Japan; the Government of Japan (GOJ) is responsible for providing air navigation services in sovereign airspace; it is difficult to receive GPS signals in Japan due to mountainous terrain, and tall buildings. These provided incentives for the GOJ to investigate the practicality of developing a standalone GPS-compatible system capable of independently satisfying position, velocity and time requirements for Japan and throughout the Asian region.

Real-World Issues

Cost

A regional solution for meeting Japanese position, velocity and timing needs will require resources and long-term investment.

The US has invested billons of dollars to design, develop and implement a GPS "system". This investment goes well beyond building and launching satellites. The critical "brains" of GPS (the ground control segment with its Master Control Station, Monitoring Stations, Control Stations, Processors, Software, Communications, Security, etc.) assures the satellites perform and the "overall system" enables reliable position, velocity and time within SPS specifications. Then, there is the upfront and recurring cost of things that are not generally seen, such as the papers and guidance directions provided by the scientific community; development of interfaces, compatibilities, documentation, standardization, upgrades, training, etc.

The other critical cost dynamic is sustaining a space-based system once it is operational. Replenishing satellites, coordinating launcher availability, schedules, risk mitigation (in the event of a launch failure), or an anomalous event causing the disruption of satellite signals. requires an enormous amount of planning, knowledge, investment and most importantly experience.

Time Scale

If Japan is going to seriously consider fielding an independent GPS-compatible system, then the system is needed as soon as possible--not 10-15 years from now. Once again, practical experience is critical to select the best systems and subsystems, take advantage of approved standards, documentation, international guidelines, and employ proven risk mitigation techniques, etc. The net result is that the time to field an independent GPS-compatible system should be reduced.

Equipment compatibility

GPS user equipment has a well established manufacturing base. Those making GPS receivers and GPS "engines" have the knowledge, experience and wherewithal to provide useable equipment. If an independent GPS-compatible Japanese system is going to be embraced and provide benefits for all users, then user equipment must be readily available and affordable.

If the manufacturers have to "invent" new user equipment technology and components to accommodate a Japanese regional system, there is an established process to support the "invention" in Japan. Part of this process (particularly for aviation applications) involves the development of manufacturing standards and recommended practices. Standards and recommended practices can literally take years to develop and be accepted by the international community. Standards and recommended practices, associated research and development, testing, component design, interfaces, etc. require investment on the part of those manufacturers planning to produce user equipment. These costs will be recovered by those manufacturers producing the user equipment.

The net result of an "invention requirement" for GPS-compatible Japanese user equipment: getting user equipment to the marketplace will be delayed and equipment will likely not be readily available; and GPS-compatible Japanese user equipment costs will be increased--likely higher than today's GPS equipment.

Opportunities

GPS was fully funded by the US Department of Defense (DoD) and the US Department of Transport (DoT) to satisfy position, velocity and time requirements as well as "other" military missions. The point is that the fundamental GPS 'bus' being used by the US DoD can accommodate additional payloads besides the navigation payload.

Japanese GPS-compatible regional satellite system will not necessarily have the same requirements as the US DoD GPS satellites. This affords the opportunity to explore the inclusion of other payloads on-board the fundamental GPS 'bus'--such as communication and weather packages. These payloads could be used to generate revenues to offset the overall cost to the GOJ for the design, development, deployment, operation and maintenance of a Japanese GPS-compatible regional satellite system.

Ownership

Additional payloads and the opportunity to generate revenue, begs the question regarding who should own and operate a Japanese GPS-compatible regional satellite system.

The US government owns and operates GPS. However, a strong and practical argument can be made to allocate ownership and operation of a Japanese GPS-compatible regional satellite system to a commercial enterprise. This argument is essentially business based--upfront investment costs, revenue generation, return on investments and overall system sustainment. Counter arguments to the business based argument focus on States' responsibilities, and subsequent liabilities as well as continuity of the commercial enterprise. For instance, should a Japanese GPS-compatible regional satellite system be used to support aviation navigation, then principle number four of A32-19 (described earlier) applies.

However, it is quite possible that a cooperative government-industry arrangement could be established in order to accommodate Japanese government responsibilities for assuring GNSS services while offsetting government spending by taking advantage of commercial investments.

Options

Real-world issues as highlighted in the previous section have established a path for the Japanese decision makers to follow when formulating an approach for developing a GPS-compatible Regional Satellite System capable of serving Japan as well as all of Asia. The significance and importance of these issues such as:

- Cost: initial and long-term commitments
- Time: GPS is here today--we need an independent and complementary system now
- Compatibility: GPS is being used today, more of the same is better and smarter
- Opportunities: GPS is a bus--it can carry other payloads
- Ownership: government, industry or both--it is a question

were viewed differently by Japanese government and industry representatives. These differences of opinion had a positive effect because they resulted in several program options for a Japanese GPS-compatible regional satellite system. In the end, these options provided a basis for moving forward with a comprehensive Japanese program.

A brief overview of two viable options will be provided prior to discussing the current status of the Japanese program.

Option A: Japanese Regional Navigation Satellite System (JRANS)

In September 2000, the JRANS concept was developed by a Japanese industry partnership of ITOCHU Corporation, NEC Corporation and TOSHIBA Corporation. JRANS conceptual briefings were provided to several Japanese government representatives as well as US government and industry personnel working with GPS.

Based on the positive feedback from these initial briefings, ITOCHU and NEC TOSHIBA Space Systems, Ltd. ("NTSpace", a joint venture between NEC and TOSHIBA formed in April 2001 to merge their respective space business) continued working and discussing the JRANS concept with Japanese and US government and industry personnel. The JRANS concept and developmental approach was further refined to satisfy current and future operational requirements and assure full compatibility and interoperability with GPS. Highlights of the JRANS concept are:

- Fully complementary, interoperability and compatibility with GPS
- Capable of autonomous navigation and complementary / regional backup for GPS
- Satellite coverage will be regional (i.e. over Asia, see figure 1.)
- Free of direct user charges (like GPS)
- Private sector can participate and provide commercial services

The proposed JRANS program is a

two-phase build-up of quasi-zenith orbit (QZO), then another quasi-zenith and geostationary orbiting satellites (QZO and GEO), see figure 1.

For a satellite navigation receiver to calculate a solution, four satellite signals in view with good geometry must be received to determine latitude, longitude, altitude and time. Satellite signals are "line-of sight" transmissions and can be easily blocked by high terrain, buildings, etc. This blocking of the signals is referred to as masking. Use of GPS in Japan can be difficult because of this masking situation. Natural geographic features, such as mountainous terrain and manmade features, such as tall buildings often render GPS services unavailable in the most critical of situations.

The advantage of a fully populated (7 satellite) constellation is having four satellites in view, at high mask angles, broadcasting GPS-type information, being controlled by Japan, and in coordination with the U.S. under the bilateral security treaty.

Having four Japanese GPS-compatible satellites in view at higher elevations is particularly beneficial for those operating in mountainous areas and "urban canyons", as illustrated by Figure 2:

For GNSS users in Asia, there will also be a significant improvement in overall end state user performance as a result of better geometric dilution of precision (GDOP). Recall, GDOP is all geometric factors that degrade the accuracy of position fixes derived from externally referenced navigation systems.

Specifically, for a user in Tokyo Japan, using only GPS, the GDOP for a 10 degree mask angle is 2.39; the GDOP for a 30 degree mask angle is 6.88. That same user, at the same location, using GPS and JRANS together would have a GDOP of 1.80 at a 10 degree mask angle and a GDOP of 3.59 with a 30 degree mask angle. Given that a 30 degree mask angle is typical for Japanese urban areas (Figure 2), the improvement (from a GDOP

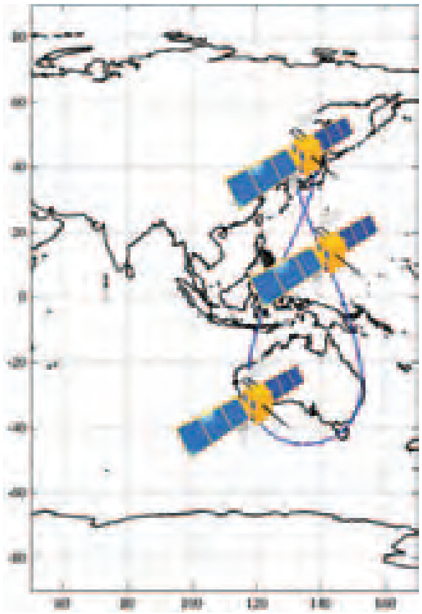


Figure 1.-1 JRANS: Phase 1--three Satellites Quasi-Zenith Orbit

of 6.88 with GPS only to 3.59 with GPS and JRANS) will improve the overall performance accuracy thereby increasing the utility of satellite-based position, velocity and time.

When one takes into consideration both JRANS signals and GPS signals, the combined benefits for an end state user--in terms of available satellite signals--are quite significant, as illustrated in Figure 5:

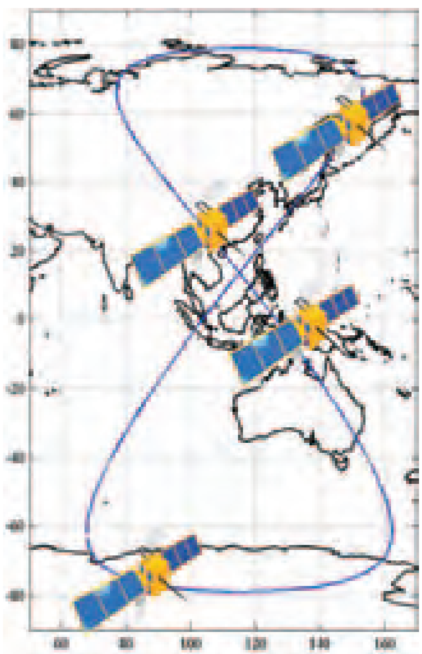


Figure 1.-2 JRANS: Phase 2—four Satellites QZO and GEO

Option B: QZSS

The Quasi-Zenith Satellite System (QZSS) option is actually the first phase of JRANS, as mentioned above, three satellites in quasi-zenith orbit (Figure 1).

In June 2002, the GOJ's Council for Science and Technology Policy of the Cabinet Office gave the go-ahead to begin working on QZSS research and development. The government role can be classified as research and development. The plan is to design and develop the first three QZSS satellites and the budget (US$52M in FY2003 and US$77M in FY2004) has

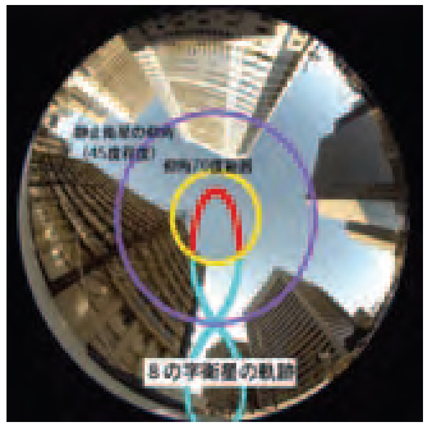


Figure 2: An example of masking in the urban canyon

been approved respectively. Several Japanese government agencies are involved in this first phase, to include:

- MEXT (Ministry of Education, Culture, Sports, Science and Technology): Experimental satellite positioning technology
- MIC (Ministry of Internal Affairs and Communications): Precise timing control and communication
- METI (Ministry of Economy, Trade and Industry): Key technologies for advanced satellite bus
- MLIT (Ministry of Land, Infrastructure and Transportation): High-accuracy DGPS augmentation system

A notional QZSS development schedule has been prepared and is expected to be used for planning and budgeting purposes. Overall,

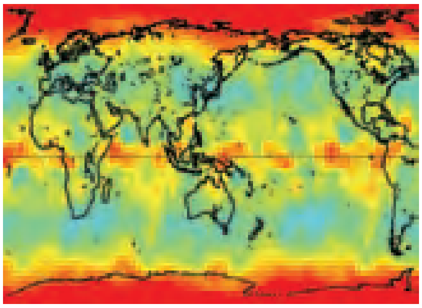


Figure 3: GDOP: GPS Only

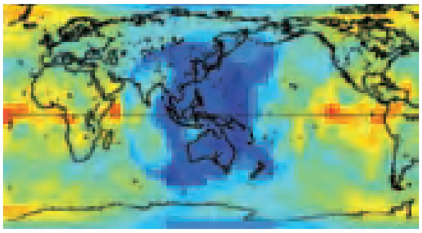
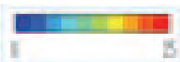


Figure 4: GDOP: GPS and JRANS



GDOP Scale

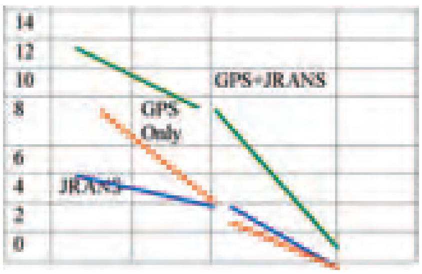


Figure 5: Satellites in View

the GOJ is planning to invest approximately JPY50B (US$430Mn) in research and development funding for QZSS during the period 2003-2009. The notional schedule is:

- FY 2003: Definition Phase (US$50Mn budget approved)
- FY 2004: Research & Development Phase (US$74Mn budget approved)
- FY 2005-2008: Engineering & Manufacturing Phase
- FY 2009: 1st Satellite Launch

From a commercial perspective, and in addition to the basic navigation functions that will be fully compatible with GPS, QZSS can provide communication services, broadcasting services and differential GPS services. In November 2002, in response to these commercial opportunities, Japanese industry jointly formed the Advanced Satellite Business Corporation (ASBC) to conduct the feasibility study for determining the opportunities of using QZSS to provide commercial services, such as S-band communications and broadcasting for mobile users.

Current status

As indicated in the previous section, the GOJ has committed resources to begin the design and development of a GPS-compatible Regional Satellite System capable of serving Japan as well as all of Asia. It is also evident that the design and development road will be lengthy without support from the US.

Both Japanese government and industry recognize the importance of working cooperatively with US government and industry. As early as April 2002 at the CGSIC 39th meeting in Springfield, Virginia, ITOCHU and NTSpace have been making public presentations regarding Japanese planning efforts and opportunities for US-Japanese government and commercial cooperation.

From a government-to-government perspective, on 22 September, 1998 a US-Japan GPS partnership was forged when President William Clinton and Prime Minister Keizou Obuchi issued a joint statement regarding cooperation in the use of the GPS standard positioning service. Taking the statement, US-Japan GPS Plenary Meetings have been held to further harmonize joint activities. In addition, the Plenary agreed to form a Joint Technical Working Group to further the close cooperation between the US and Japan The Working Group goals are essentially to:

- Assure maximum QZSS interoperability with GPS
- Optimize the QZSS design to maximize GPS-QZSS performance in Asia
- Increase commercial opportunities for GPS-QZSS applications

Future outlook for Asia

GPS reliance cannot be denied; neither can the significance of GPS for a broad spectrum of Asian users. In general, the aviation community appears to have a well established set of performance requirements for satellite-based navigation and are actively pursuing the development and implementation of civil augmentation systems. However, these “wide area coverage” augmentation systems:

- US: Wide Area Augmentation Systems (WAAS)
- Europe: European Geostationary Navigation Overlay System (EGNOS)
- Japan: MTSAT Satellite-base Augmentation System (MSAS)
- India: GPS/GLONASS and Geostationary Augmented Navigation (GAGAN)
- Australia: Ground-based Regional Augmentation System (GRAS)

All have one thing in common: the US GPS. If GPS signals “go away” then the utility of these augmentation systems will be close to zero.

The Japanese government and industry personnel have carefully studied the significance of GPS on our daily lives, considered critical enabling issues, such as cost, time, GPS compatibility, additional business opportunities, and public/private ownership.

A decision was made to move forward with a GPS-compatible regional system capable of providing independent, satellite-based position, velocity and time services while taking advantage of the broad range of benefits available from GPS signals and the current GPS industry.

Most importantly for all of Asia, is that (in the near future) a combined US GPS and a standalone Japanese Regional Navigation Satellite System (RNSS) will provide a robust foundation for current and future generations of GPS users!

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Rural infrastructure in India New thrust areas

Development of Infrastructure in rural areas is a thrust area to create values through engineering consultancy

PAWAN KUMAR

Rural development may be defined as structural changes in the socio-economic situation to achieve improved living standard of low-income population residing in rural areas and making the process of their development self sustained. It includes economic development with close integration among various sections and sectors; and economic growth specifically directed to the rural poor. In fact, it requires area based development as well as beneficiary oriented programmes. That's why rural development is one of the main and important tasks of development planning in India.

Development of rural areas is slow due to improper and inadequate provision of infrastructure with compare to urban areas. That's why rural share in GDP is always less. The contribution of urban and rural shares of GDP can be illustrated in table 1.

During 1990-91, the urban sector contribution in per capita GDP was 3.62 times more than the rural sector. The planning and development of human settlements and provision of required infrastructure are much better in urban areas. Rural population migrates near by Primate City due to more employment opportunities and better facilities. Similarly, the limited capacity of rural economy to accommodate the increasing population disregards the labour force as surplus to migrate large cities. Thus there is a need to encourage reverse migration to rural areas through proper development of rural infrastructure and basic amenities by creation of income generation avenues, improving the quality of life, etc.

Rural infrastructure : New thrust areas

Rural infrastructure is not only a key component of rural development but also an important ingredient in ensuring any sustainable poverty reduction programme. The proper development of infrastructure in rural areas improves rural economy and quality of life. It promotes better productivity, increased agricultural incomes, adequate employment, etc.

Bharat Nirman

The UPA Government has launched " Bharat Nirman" time bound business plan for action in rural infrastructure for next four years. Under Bharat Nirman, action is proposed in the following areas:

- Irrigation
- Rural Roads
- Rural Housing
- Rural Water Supply
- Rural Electrification
- Rural Telecommunication Connectivity, etc.

Bharat Nirman

The Task Ahead: The following bold targets are set to be achieved by 2009:

i. To connect 66,800 habitations with population over 1000(over 500 in hill, tribal and desert areas) with all weather roads.
ii. To construct 1,46,000Km of new rural roads
iii. To upgrade and modernize 1,94,000Km of existing rural roads
iv. Out of total investment of Rs. 1,74,000 crore envisaged under Bharat Nirman, investment on rural roads estimated at Rs. 48,000 crore.

The Government has also decided to provide corpus of Rs. 8000 crore to Rural Infrastructure Development Fund (RIDF).

Table No.1: Urban and Rural shares of GDP

S.N.	Year	GDP at factor costs at Current prices (Rs. Billion)			Per capita GDP in Rs.		Ratio of Urban and Rural per capita GDP
		Urban	**Rural**	**Total**	**Urban**	**Rural**	
1	1950-51	27	67	94	422	225	1.97
2.	1980-81	673	759	1433	4222	1449	2.91
3.	1990-91	2355	1570	3925	10844	2297	3.62

Source: Planning Commission, Task Force Reports on Urban Development, 1983 Mulkh Raj, Urbanization, Infrastructure and Besieged Growth Potential (Mimeo), 1993

Bharat Nirman through Pradhan Mantri Gram Sadak Yojana

Rural connectivity is one of the major goals of Bharat Nirman. In India, there are more than 6 lakh villages located in different terrains e.g. plain, hilly, deserts, swamps, costal region, mountainous region, back water areas, tribal pockets, etc. The climatic condition also varies from place to place to a great extent. Due to improper planning, some villages are having multi road connection while others are deprived of even single road connection.

In Pradhan Mantri Gram Sadak Yojna (PMGSY) has been decided to give one and only connection to each village. It is centrally sponsored programme with 100% financial assistance. All PMGSY roads are guaranteed defect free by the contractors for a period of 5 years and maintained by him under a contract. Funds for the maintenance contract are provided from the State Budget. After the period of 5 years, the roads will be transferred to the District Panchayat for further maintenance.

PMGSY achievements can be summerised as follows:

- 53,000 Km. of new rural roads constructed
- 27,000 Km. of rural roads upgraded and modernized
- 37,000 habitations provided all weather connectivity opening access for agricultural produce
- Rs. 15,117 crore invested up to January 2006
- Monitoring the quality of road works through independent technical experts at the state and national level.

Rural electrification

Out of the estimated 80,000 villages yet to be electrified, the 10th Five Year Plan (2002-2007) proposes to electrify 62,000 villages through grid supply. The remaining 18,000 remote villages are proposed to be electrified by 2011-2012 through the use of decentralized non- conventional source of energy. The rural electrification programme has been included as a component of Pradhan Mantri Gramodaya Yojana(PMGY) and is being encouraged to pool resources from other schemes under Minimum Need Programme (MNP) and Rural Infrastructure Development Fund(RIDF) to meet objective of 100 % electrification.

A new scheme called Accelerated Rural Electrification Programme (AREP) has been launched. The participation of Decentralized Power Producers, PRIs, Rural Co-operatives, NGO, etc. will be encouraged. The Ministry of Power is pushing the concept of Rural Electricity Supply Companies (RESCOs) involving the private sector players by leasing out solar panel based light systems to village homes.

The development and implementation of various rural infrastructure projects help to create values for the rural society. Similarly, involvement of Public as well as Private companies, NGO, etc. require the technical and managerial experts of engineering consultancy in rural areas.

Bharat Nirman through Indira Awas Yojana

Indira Awaas Yojana (IAY) targets rural families below poverty line who are either totally houseless or live in unserviceable kutcha houses. It is an effort to provide an identity and sense of security to rural poor households. Under the scheme, a maximum assistance of Rs. 25,000/- per house for plain areas and Rs. 27,500/- per house for hilly/difficult areas is given to BPL family to construct. Assistance is also provided for up gradation of kutcha houses @ Rs. 12,500/- per unit. . 60% of the houses are to be for SC/ST beneficiaries. Rural housing is one of the major goals of Bharat Nirman.The target of IAY in Bharat Nirman is as follows;

- To construct 60 lakh houses over the next 4 years(2006-2010)
- Investment in Rural housing will be about Rs. 12, 000 crore

IAY: Achievements:

- Allocation for IAY has increased fro Rs. 2750 crore(2005-06) to Rs, 2920 crote(2006-07).
- About 9.6 lakh houses have been constructed so far in current year(2005-06).
- About 139 lakh houses have been constructed under IAY all over the country since inception of the scheme upto January 2006.
- An amount of Rs. 25,500 crores have been invested so far in IAY.

There is provision of free electricirty connection to be provided to IAY houses under Rajiv Ganghi Gram Vidutikaran Yojana.

Planned urbanization with rural ambiance

The formation of cluster of rural settlements, which acts as a viable planning unit, is linked to the nearest towns then receives the needed growth impulses and makes it-self integrated with the town economy. It emphasizes the importance of urban infrastructure in rural areas. Based on it, Planned Urbanization with Rural Ambiances (PURA), as propagated by Dr. A.P.J. Abdul Kalam, the President of India, in his vision 2020, argues the following connectivity for the cluster of villages:

i. Physical Connectivity (roads, transport facilities, etc.)
ii. Economic Connectivity (Banks, Commercial organizations, etc.)
iii. Knowledge Connectivity (School, colleges, vocational education, etc.)
iv. Societal Connectivity (Hospital, recreational facilities, place of worship, etc) and
v. Electronic Connectivity (Phone, internet, cable, etc.)

Location

The location of PURA would be in the vicinity of a growing city and having high potential of development such as availability of local resources, skills, adequate water & power, good connectivity to transport networks, potential for employment generation, goods market, etc.

Land Acquisition

PURA Development Agency (PDA) would be set up as a status of Development Authority with a mandate to perform municipal functions. PDA would adopt land pooling, partially pooling and partly acquisition, land acquisition, etc. to get land for the projects.

Plan Preparation

PDA would prepare Economic Plan, Structure Plan and Implementation Plan for the projects.

- Economic Plan:
  Identification of local resources and skills, key investors as anchors, ascertain industry ancilliarization / outsourcing, etc.
- Structure Plan:
  - Utility Infrastructure: Water Supply, Sewerage, Drainage, Low Cost Sanitation, Power, Transport, Solid Waste Management, etc.
  - Social Infrastructure: Health, Education, Community Halls, Parks, Play Grounds, etc.
  - Commercial Infrastructure: Shopping Centre, Markets, Theatres, Trade Centre, etc.
- Implementation Plan: PDA would prepare implementation plan to implement various provisions of PURA. The Chief Executive of PDA would be a professional on 5-year contract to supervise the works.

PURA would be a viable infrastructure project in rural areas since infrastructure is less expensive in rural areas and small towns than in large cities.

Rural development plans by the panchayat

The 73rd Constitutional Amendment Act, 1992 has provision for the establishment of panchayat at village level. The Eleventh Schedule (Article 243-G) of the same has listed 29 items for consideration in development plans. Panchayats have power to prepare plans for economic and social development and implement schemes for such development in their respective areas.

Economic aspects in rural development plan

Various items as per Eleventh Schedule such as:
Item No. 1: Agricultural Productivity
Item No. 2: Land Improvement
Item No. 3: Minor Irrigation
Item No. 4: Animal Husbandry
Item No. 5: Fisheries
Item No. 7: Minor Forest Products, etc. are related to economic development of rural area and hence they should be incorporated in development plan.

Social aspects In rural development plan

These aim at welfare of the people,, provision of better education facilities, health services, recreational facilities, etc. and change in social attitudes of the people.
Item No. 10: Rural Housing
Item No. 11: Drinking Water
Item No. 14: Rural Electrification
Item No. 17: Education
Item No. 18: Technical and Vocational Education
Item No. 19: Adult and Non-formal Education
Item No. 24: Family Welfare
Item No. 25: Women and Child Development, etc. are mostly related to social development of the rural areas and should be a part of development plan.

Spatial aspects in rural development plan

The development of rural area basically depends on location of various economic and social activities, their integration and proper linkages within and outside the areas. Similarly, anticipated development activities, set up of organizational framework at different level, etc. also affect the size of existing settlements, emergence of new settlements and overall development of the area. Item No. 13 (Transport and Communication), Item No. 8 (Small Scale Industries), Item No. 9 (Village and Cotton Industry), etc. decides the location of various functional units. Hence, development plan of any rural area need to take care of all these aspects for proper and balanced development.

It is mandatory for State Government to constitute District Planning Committees (DPCs) to consolidate plans prepared by panchayats and municipalities. The preparation of development plans certainly requires engineering consultancy to create values. Engineering consultancy explore the potential of the districts, priority of various plans and schemes, financial details, environmental sustainability, viability of the projects, etc. for achieving integrated planning and development of rural and urban areas of the district.

Rural building centres and industrial extension services

The then Ministry of Urban Development and Employment, Government of India, initiated building center movement in 1988 has spread out with establishment of more than 650 building centers in the country. The scheme has been implemented through HUDCO with the following objectives:

- Technology transfer from lab to land by disseminating of information on Cost Effective and Environment Friendly (CEEF) construction in rural and urban areas
- Skill up gradation of work force.
- Creating a pool of trained rural / urban construction work force for construction industries and building activities.

Rural Building Centres (RBCs) may be established in rural areas having the same goals and objectives. The engineering consultancy can play important role to create values in these areas. The active participation of Government and Non-Governmental Organizations through RBCs can prepare and implement infrastructure projects. Rural consultancy and synergy with various government departments and agencies at district level can integrate various development projects.

Industrial Extension service aims at providing complete technical, economic and managerial consultancy services in small scale and cottage industries. The industrial extension service is provided through Small Industries Service Institutions (SISIs) which are State level agencies. The same my be located in different parts of rural areas to assist and supervise the minor and major infrastructure projects and serve as common service facilities centers.

Concluding remarks

Development of Infrastructure in rural areas is a thrust area to create values through engineering consultancy. Engineering consultancy can provide technical, managerial and on-site consultancy from conceptualization to final implementation of the projects. Various infrastructure projects under Bharat Nirman have become lifeline to new markets, new business, new incomes, and above all, to new opportunities. Even a narrow road can be a highway to prosperity. Similarly each infrastructure project has its own advantages particularly rural connectivity Yojana ensure that every village in India has access to markets, to services, to opportunities, indeed, to prosperity.

PURA would be considered as a model for infrastructure development in rural area for developing modern habitat having high quality water supply and sanitation, full range of connectivity, provision for future expansion, etc. PDA would encourage establishment of employment generating industries such as herbal, diary, poultry, meat processing and animal husbandry, food processing, etc. In connection with preparation of Draft District Development Plan, DPC shall have regard to matters of common interest between panchayats and municipalities including spatial planning, sharing of physical and natural resources, development of infrastrcutre and conservation of environment, etc. Similarly, DPC may also co-ordinate various schmes and programme at district level such as Minimum Needs Programme (MNP), Integrated Rural Development Programme (IRDP), National Rural Employment Programme (NREP), Rural Landless Employment Generation Programme (RLEGP), Jawahar Rojgar Yojana (JRY), Drought Prone Area Development Programme, etc. to derive maximum benefits for rural development.The emphasis on establishment of rural building centers and small industries service institutions in various parts of rural area by the Government may help to cater engineering consultancy to create values for rural India.

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Galileo update

Galileo – the European Programme for Global Navigation Services for civil purposes is an initiative led by European Union. We provide regular updates to our readers on the Galileo programme.

Galileo to be scaled down?

The Financial Times claims the EU may be forced to operate the Galileo constellation with fewer than the currently proposed 30 satellites. The FT quotes Philippe Busquin, a former European research commissioner who now oversees the Galileo project as a member of the European Parliament as saying: 'It's not clear that we really need 30 satellites. We could certainly make Galileo a success with 24 or 25.' Jack Metthey, a director handling research in the European Commission, also describes the Galileo budget situation as 'very, very tight', adding: 'Having less satellites would certainly help address the money issue." However, it is acknowledged that a reduction in the number of satellites could undermine the quality of the system, by reducing coverage and precision, two of Galileo's trump cards as a 21st-Century constellation. *www.rin.org.uk*

Galileo 'on track'

On 19 April, the Financial Times reported that funding constraints could lead to a reduction in the number of satellites in the Galileo constellation. But on 21 April the Austrian Vice Chancellor, Hubert Gorbach, reported during a meeting of EU ministers that 'This very important satellite programme . . is fully on course'. Austria currently holds presidency of the EU. Two European Commissioners at the Graz meeting also expressed surprise; Commissioners for Science & Research and Enterprise & Industry were reported to be unaware of any such problems. In January 2006, ESA signed a E1 billion contract with Galileo Industries to build 4 satellites and the terrestrial infrastructure for Galileo. The total cost is estimated at E3.4 billion and the system should be operational from 2010. *www.rin.org.uk*

Galileo Masters - UK Challenge 2006

The Galileo Masters - UK Challenge 2006 is opening up opportunities for small companies, researchers, academics and entrepreneurs across the UK to come forward with location- and positioning-based applications, services and technology which will have an impact on how we live and work today - or in the future. Last year's Galileo Masters UK Challenge was a resounding success - it saw over 240 innovative ideas put forward for the competition, and the UK contributed to almost 40% of the ideas from across Europe. The 2006 Competition will run from 1 May to 30 June. *www.galileomasters.co.uk*

Workshop on tools and facilities for Galileo receivers

In late March 2006 a workshop on tools and facilities for Galileo receivers was held at ESA's European Space Research and Technology Centre (ESTEC), Noordwijk, The Netherlands. The workshop was organised jointly by the European Space Agency (ESA) and the Galileo Joint Undertaking (GJU), with the support of the European Union's Sixth Framework Programme for Research & Technological Development (FP6). The workshop provided an open forum where those involved in receiver development can share their experience. *www.esa.int*

India's Telephone Coordinates

Since my first educational trip to New Delhi in 1951, I have witnessed the telephone numbering system change from 5 to 8. Since 2002, they have changed thrice, e.g., first to 2527-1234, next to 3097-1234, and then to 3297-1234. Also, there are city codes varying from 2 to 4 digits and I wonder whether India will soon start having "village" codes, as each village gets new phone lines.

30 years ago, I saw chaotic traffic congestion problems while entering our village from an interstate highway. I studied the "problem" and I found a possible solution. I submitted the same. After its implementation, motorists face a traffic jam ONLY when there is an accident. Hence, during my visit to India in January 2003, I thought of a "realizable" solution to the periodic, but troubling changes in India's telephone coordinates. As I studied the numbers and the changes for the country as a whole, I noticed that all over the digits in city codes and phone numbers total to TEN. Based on this "fact", I could immediately come up with a solution. I submitted a new numbering system based on a 10-digit format consisting of 3-digit "area" codes and 7-digit phone numbers. Nobody paid any attention.

Now, after witnessing three changes in phone numbers in a Delhi suburb, I have an "updated" version of my proposed new telephone coordinates. I am sure that Indian experts (with India's complete picture in view) would be able to improve my proposal to "fit" it better. I will be presenting the proposal in the next issue of COORDINATES. It will have full potential to set India's telephone coordinates for decades.

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SIRGAS — a geodetic enterprise

A unique reference frame for the American continent was established by two extremely successful geodetic observation campaigns, SIRGAS95 and SIRGAS2000. The general outlines for the future tasks are presented in this paper

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SIRGAS (Sistema de Referencia Geocéntrico para las Américas) is a joint project of South, Central and North American countries in cooperation with some international institutions for the establishment and maintenance of a geocentric reference frame for practical and scientific use. A unique reference frame for the American continent was established by two extremely successful geodetic observation campaigns, SIRGAS95 and SIRGAS2000. It provides the basis for the requirements of modern geodesy, and is one of the most important enterprises within geodetic science. At present, its goals aim at the complete integration of all American countries, the maintenance and processing of a continuously observing stations network in the continent, and the adoption of a unified vertical system (height datum). The general outlines for the future tasks are presented in this paper.

SIRGAS history, structure and present situation

SIRGAS was established during an international meeting in Asunción, Paraguay, in October 1993 by representatives of most of the South American countries, the International Association of Geodesy (IAG), the Pan American Institute of Geography and History (PAIGH), and the National Imagery and Mapping Agency (NIMA), now National Geospatial-Intelligence Agency (NGA), as the "Sistema de Referencia Geocéntrico para América del Sur" (South American Geocentric Reference System) Project. The main objectives were

- to define and establish a geocentric reference system for the continent,
- to define and establish a geocentric datum,
- to define and establish a unified vertical datum.

The project structure includes an Executive Committee, made up by the representatives of all participating countries and international institutions, a Directive Board, a Scientific Council, and three Working Groups: WGI "Reference Systems", WGII "Geocentric Datum", WGIII "Vertical Datum". The objectives, responsibilities and activities of each of these entities are established by the Project Statutes, which have been approved in 2003. In 2000 the project was extended to Central and South America. As a consequence it was renamed "Geocentric Reference System for the Americas" keeping the acronym SIRGAS. In 2001 the United Nations Regional Cartographic Conference for the Americas (UNRCC-A) recommended the countries in the region to adopt SIRGAS2000 as their national geodetic reference frames.

Working Group I: Reference System

The objectives of WGI are clearly stated by the SIRGAS statute and encompass the definition of a tri-dimensional geocentric reference system for the Americas, as well as its realization and maintenance through a reference frame materialized by a set of stations coordinates and velocities. The first SIRGAS observation campaign was performed from May 26th to June 4th 1995. A total of 58 stations in the South American continent and neighboring areas were measured simultaneously by GPS observations (Figure 1) establishing one of the most precise continental geodetic networks all over the world. The observations were processed by two analysis centers at DGFI, Germany, and DMA, USA and combined for a unique solution in the International Terrestrial Reference Frame 1994 (ITRF 94), reference epoch 1995.4. The precision of three-dimensional coordinates is about ± 5 mm for each component. The final results were reported at the IAG Scientific Assembly in Rio de Janeiro, August 1997 (SIRGAS 1997).

The second SIRGAS observation campaign was performed from May 10th to 19th 2000. In South America 56 points of the first campaign were measured again. The network was densified in some countries and extended to Central and North American countries by 85 new stations. In addition 43 points at tide gauges were included in order to connect the existing height datums to the geocentric reference system. Altogether the network consists thus of 184 stations all over the American continent (Figure 2). The data were processed by three processing centers at IBGE, DGFI and the Bavarian Commission of Geodesy (BEK), Germany. The final combined station coordinates refer to ITRF2000, reference epoch 2000.4 (Drewes et al. 2005).

In the meantime, a network of continuously operating GPS receivers has been installed by SIRGAS in Central and South America. It is operational since 1996 and nowadays involves more than 80 stations. The Regional Network Associate Analysis Center (RNAAC) for SIRGAS – one of the regional analysis centers belonging to the International GNSS Service (IGS) – computes the network coordinates and velocities (Seemüller 2004). A set of station coordinates is

Figure 1: SIRGAS95 stations and GPS receiver types

computed every week. Linear station velocities are derived by accumulating several years of weekly solutions, the latest including all data up to end of 2005 (Figure 3). The DGFI is in charge of processing the IGS RNAAC-SIR.

A station velocity field was derived by finite element and least squares collocation approaches (Figure 4, Drewes and Heidbach 2005) from the SIRGAS coordinate changes 1995 to 2000, the continuously observing GPS stations of the IGS RNAAC-SIR, and the geodynamics projects Central and South America (CASA), South America – Nazca Plate Motion Project (SNAPP), Central Andes Project (CAP), and South America Geodynamic Activities (SAGA).

As a result of the SIRGAS WGI activities, the Americas have got a geocentric reference system materialized in accordance with the uppermost geodetic standards. SIRGAS satisfies the highest demands of modern geodesy and provides the fundamental layer for America's Spatial Database Infrastructure.

A WGI action plan for the coming years was discussed during the SIRGAS meeting, held in Aguascalientes, Mexico, December 2004. The general consensus was to drive WGI efforts toward the consolidation of the SIRGAS network of continuously operational GPS stations as the cornerstone for the reference frame maintenance. The following issues were appointed as WGI priority:

- to improve the performance of presently operational stations,
- to improve data transfer to data centers,
- to encourage and to support the installation of new stations, and
- to install processing centers in American countries.

In addition, the SIRGAS executive committee encouraged WGI for conducting a pilot project on ionospheric mapping in South America, based on dual-frequency GPS observations belonging to the continuously operational SIRGAS network. A cooperative project between Brazilian and Argentinean universities, aimed to regional ionosphere mapping, is currently being discussed.

The first assignment for accomplishing the action plan was to identify the main problems that affect the network performance. These problems may be summarized as follows:

- Difficulties for data accessing on time (within three weeks after observation),
- Lack of information about changes in the observing configuration (receiver, antenna, antenna height, etc.),
- Lack of information about the reason for no data,
- Lack of information about new stations in the IGS RNAAC-SIR region,
- Bad or very slow internet connections, and
- No data transfer during the South American vacation period (December and January).

Actions for mitigating these problems are currently being discussed by WGI.

WGI is conducting a pilot project to establish processing centers in the region, to carry out a task analogous to that currently performed by the IGS RNAAC-SIR. Preliminary, the UNLP, Argentina, the IBGE, Brazil, and INEGI, Mexico, were identified as potential candidates to carry out this task. These institutions agreed to compute different parts of the network and to deliver normal equations from their weekly solutions to DGFI. During a test period of two years DGFI will continue to be in charge of the IGS RNAAC-SIR.

Figure 2: SIRGAS2000 stations

Working Group II: Geocentric Datum

The objectives of the WGII are

- to define, realize and maintain the geodetic datum in the member countries consistent with the SIRGAS reference frame (see WGI),
- to promote the connection and transformation of the national geodetic networks to the geocentric datum,
- to support the definition, realization and adoption of a unified vertical reference system in the member countries (see WGIII),

The realization of the objectives is done using the SIRGAS stations in each country as a national reference frame. These are the stations included in the GPS campaigns 1995 and 2000 as well as the continuously observing GPS receivers of the IGS RNAAC-SIR. The present status of those sites is given in Table 1.

Some countries adopted officially the SIRGAS reference system soon after the first campaign in 1995 and derived transformation parameters from the old geodetic datums to SIRGAS. Others are still in the procedure of adoption. The reference epoch is different due to the adopted coordinates of SIRGAS95 or SIRGAS2000, respectively. Table 2 shows the status in December 2005.

Working Group III: Vertical Datum

The classical height systems in South America were established using the mean sea level as a reference level. Their realization was carried out by 10 to 20-year observations at individual tide gauges over different periods. The vertical control was extended over each country using mainly spirit levelling methods, but in general the levelled heights have not been corrected by the gravity effects. Therefore, these systems present large discrepancies between neighbouring countries (Figure 5), they do not permit data exchange neither in continental nor in global scale, and they are not able to support practical height determination with GNSS techniques. The unique alternative is to define a new vertical reference system that solves the mentioned problems, allows its continuous improvement and serves as a complement to the geometrical SIRGAS system. With this purpose, during the IAG Scientific Assembly held in Rio de Janeiro in 1997, the Working Group III "Vertical Datum" was created.

The main objectives of WGIII are to define a modern unified vertical reference system for South America, to establish the corresponding reference frame, and to transform the existing classical height datums to the new system. According to its recommendations the new vertical system is composed by (Drewes et al. 2002):

- Two types of heights: normal heights as a physical component, and ellipsoidal heights as a geometrical component,
- the corresponding reference surfaces: the quasigeoid for the normal heights, and the ellipsoid for the ellipsoidal heights,
- a reference frame, i.e., a set of fundamental stations to realize it, and
- its maintenance through time to control its possible deformations.

The realization of this new vertical system was carried out by the

Figure 3: Velocities of the IGS RNAAC-SIR stations and ITRF2000

SIRGAS2000 campaign (Figure 2). It covered the stations of SIRGAS95, the principal tide gauges of the participating countries, including those serving as reference for the classical height datums, some stations at the borders to connect the levelling networks between neighbouring countries and additional primary vertical control points (Luz et al. 2002). The stations shall be connected by spirit levelling with the reference tide gauges and their geopotential numbers shall be known.

The geometrical component of the new vertical system has been accomplished by adopting the SIRGAS system as the official geodetic reference frame in the South American countries The ellipsoidal heights refer to the SIRGAS datum, i.e., the GRS80 ellipsoid (SIRGAS 1997). The realisation of the physical component (normal heights and quasigeoid) implies, among others, the computation of geopotential numbers in a continental adjustment, the determination of a unified quasigeoid model for the region, and the transformation of the existing height systems to the new one. Regarding the first task, the countries have been requested to control their first order levelling networks, to check the existing gravity data, and to calculate geopotential numbers. The second task, the quasigeoid computation, must be performed jointly by all countries using global gravity data from the satellite missions (CHAMP, GRACE) and terrestrial (aerial and marine) gravity measurements.

The new adjustment of the first order levelling networks in terms of geopotential numbers is to remove the existing inconsistencies due to omitting the Earth's gravity field effects and the constraints of the vertical networks by forcing more than one tide gauge to zero height. To get a minimum constraint solution only one geopotential value (W_0) shall be used as reference level for the adjustment of the entire continental levelling network. Although W_0 can be arbitrarily selected (e. g., the-actual or theoretical- equipotential surface passing through a specified tide gauge mark, or the average of the potential values at different tide gauges, or along the coast line) WGIII recommends the adoption of a globally defined reference level. It should follow the Gauss-Listing definition, i.e., W_0 shall be the geopotential averaged over the global (ideal) ocean surface in a totally undisturbed state: the geoid (Mather 1978). Since geoid and quasigeoid are identical in oceanic regions, it is not necessary to distinguish between these two surfaces to determine W_0.

According to above, W_0 has been calculated using different mean sea surface (MSS) models and diverse global gravity models (GGM) (Sánchez 2005) by means of (e.g. Torge 2001):

$$W = \frac{1}{2}\,\omega^2 r^2 \cos^2(90^0 - \theta) + \frac{GM}{r}\left[1+\sum_{n=1}^{\infty}\left(\frac{a}{r}\right)^n \sum_{m=0}^{n}\left(C_{nm}\cos m\lambda + S_{nm}\sin m\lambda\right)P_{nm}(\cos\theta)\right] \quad \text{.............(1)}$$

and satisfying the condition:

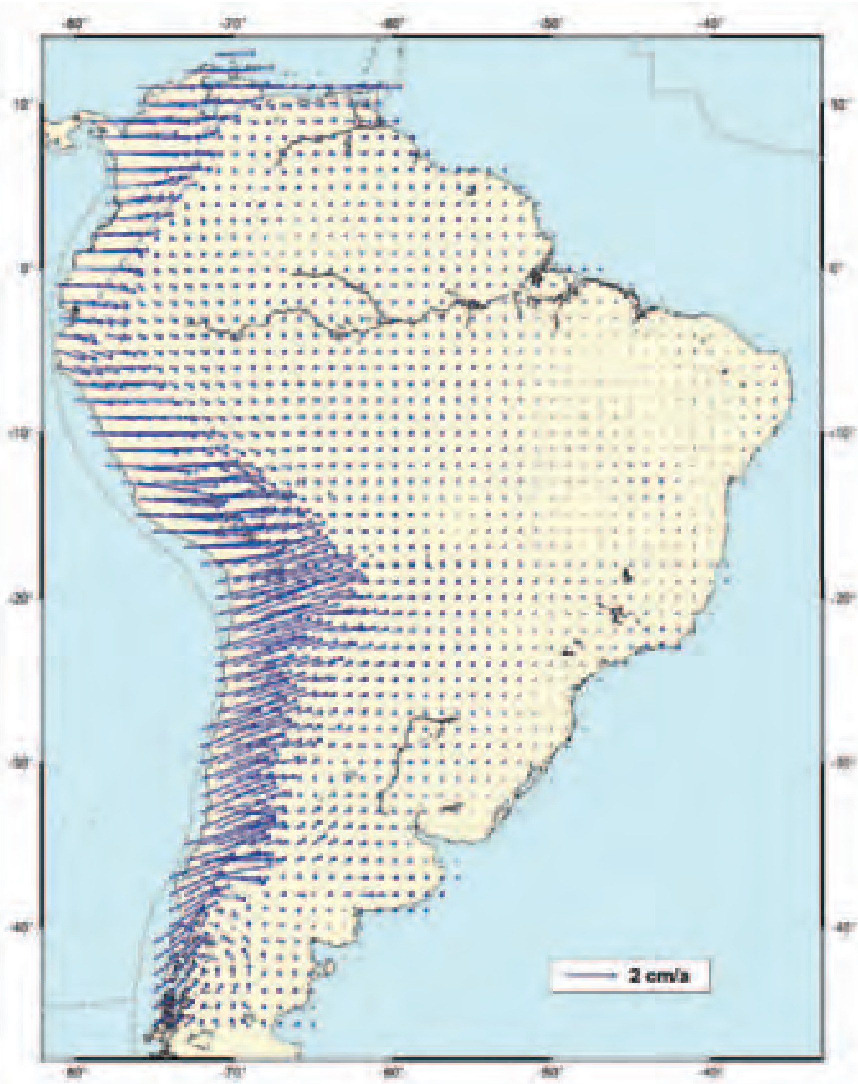
$$\int_{S_0} (W - W_0)^2 \, dS_0 = \min \quad \text{.............(2)}$$

S_0 represents the global ocean surface, (r, θ, λ) are the spherical coordinates of each point describing the mean sea surface, GM is the geocentric gravitational constant, ω is the angular velocity of the Earth's rotation, C_{nm}, S_{nm} are the GGM's spherical harmonic coefficients and P_{nm} are the fully normalized polynoms of Legendre.

In the applied procedure, Equation 1 is evaluated by introducing (r, θ, λ) for all the open ocean surface (MSS heights) in 1° x 1° block values. Then, W_0 (Equation 2) is determined by averaging the individual W block values using cosφ as a weight. The reference value recommended by WGIII is W_0 = 62 636 853,4 m^2s^{-2}. The corresponding specifications are (Sánchez 2005):

MSS model: T/P derived MSS heights at the epoch 2000.0,

Figure 4: Deformation of the South American crust estimated from finite element and collocation methods



Extension: φ = 60° N … φ = 60°S, Spatial resolution: 1° x 1°

GGM: EIGEN-CG03C (Förste et al. 2005), n = 120, reference epoch 2000.0

Const.: GM = 398 600,4415 x $10^9 m^3 s^{-2}$

ω = 7 292 115 x 10^{-11} rad s^{-1}

The proposed W_0 value differs from previous computations (e.g., Bursa et al. 2004) by ~3 $m^2 s^{-2}$.

The reasons for this disagreement are being studied.

The unification of classical height datums into a global system is feasible by combining high resolution gravity field models, precise geometrical coordinates, and physical heights derived from levelling and terrestrial gravity data. The relationship between the global reference level W_0 and the local height datums W_i (Figure 6) is given by (e.g., Rapp 1994, Heck 2004):

$$\delta W_i = W_0 - W_i \quad \text{or} \quad \delta H_i = \frac{\delta W_i}{\gamma} = h - H_i^N - \xi \qquad \text{................(3)}$$

being γ the normal gravity of the evaluation point on the Earth's surface, H^N its normal height referred to the datum *i*, *h* the ellipsoidal height, and ξ the height anomaly.

Similarly, the discrepancies between two vertical datums *i,j* would be:

$$\delta W_{ij} = W_i - W_j \quad \text{or} \quad \delta H_{ij} = \frac{\delta W_i}{\gamma} - \frac{\delta W_j}{\gamma} = H_j^N - H_i^N \qquad \text{......................(4)}$$

According to this, the proposed methodology to unify the South American classical height datums into the new vertical system is

a) Determination of δW_i^{TG} (δH_i^{TG}) at the main tide gauges (including reference gauge site) in each country (or datum zone).
b) Determination of δW_i^{SSTop} (δH_i^{SSTop}) at the marine areas surrounding the tide gauges included in *a*).
c) Determination of δW_i^{RF} (δH_i^{RF}) at the reference frame stations (SIRGAS2000 points).
d) Determination of δW_{ij} (δH_{ij}) by connecting precisely neighbouring levelling networks.
e) Combination of the different solutions given by *a), b), c),* and

Figure 5: Discrepancies between neighbouring vertical networks obtained from spirit levelling in South America

d) by least squares adjustment.

The procedure has to be iterated until the required reliability (*1 mm-level*) is achieved. It implies

also the adoption of a reference epoch (t_0) and the determination of changes to h, H^N, ξ, and *SSTop* over time, i.e.:

$$\delta H_i^{TG}(t_k) = h^{TG}(t_k) - H_i^{TG}(t_k) - \xi(t_k);$$
$$\delta H_i^{SSTop}(t_k) = h^{SSTop}(t_k) - \xi(t_k)$$

$$\delta H_i^{RF}(t_k) = h^{RF}(t_k) - H_i^{RF}(t_k) - \xi(t_k)$$
$$\delta H_{ij}(t_k) = H_i(t_k) - H_i(t_k) \quad \ldots\ldots\ldots\ldots\ldots(5)$$

with:

$$h(t_k) = h(t_0) + \frac{\partial h}{\partial t}(t_k - t_0);$$

$$H(t_0) + \frac{\partial H}{\partial t}(t_k - t_0);$$

$$\zeta(t_k) = \zeta(t_0) + \frac{\partial \zeta}{\partial t}(t_k - t_0) \ldots\ldots\ldots\ldots\ldots(6)$$

Once each country had readjusted its levelling networks, δW_i^{TG}, δW_i^{RF}, and δW_{ij} can be determined and the continental adjustment of the geopotential numbers will be feasible. The time dependence of heights (h, H^N) and SSTop is being estimated by analysing tide gauge records, satellite altimetry data and continuous GNSS positioning.

As a first approximation, the discrepancies δH_i^{TG} from the existing South American height datums with respect to the proposed vertical system W_0 are estimated by means of Equation 3 (Figure 7). The actual gravity potential Wi at each tide gauge is computed using Equation 1 at [φ, λ, h-H^N] and the EIGEN-CG03C model, n = 360 (Förste et al. 2005). Since the geometrical coordinates refer to the SIRGAS datum (i.e. GRS80), γ is derived from the GRS80 ellipsoid, and ζ takes into account the degree zero terms arising from the different *GM* values and the difference between U_0 and W_0. All height coordinates are in a tide-free system.

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Table 1: SIRGAS stations in the member countries

Country (Island)	SIRGAS 1995	SIRGAS 2000	IGS RNAAC -SIR
Antarctic	1	1	3
Argentina	10	20	14
Barbados	-	-	1
Bermuda	-	1	1
Bolivia	6	9	-
Brazil	11	21	21
Canada	-	13	-
Chile	7	20	8
Colombia	5	8	15
Cuba	-	-	1
Ecuador	3	7	2
El Salvador	-	-	1
Fr. Guiana	1	1	1
Guatemala	-	4	1
Guyana	-	2	-
Honduras	-	1	3
Jamaica	-	1	1
Mexico	-	15	17
Nicaragua	-	2	2
Paraguay	2	1	-
Puerto Rico	-	1	1
Saint Croix	-	1	1
Peru	4	10	1
Trinidad & Tobago	-	2	-
Uruguay	3	8	-
USA	-	24	4
Venezuela	5	11	1
Total	**58**	**184**	**100**

Table 2: Adoption of the SIRGAS reference frame by the South American countries

Country	System Name	Datum	Reference epoch	Status
Argentina	POSGAR94	WGS84	1993.8	Will adopt
Bolivia	SIRGAS	SIRGAS95	1995.4	Will adopt
Brazil	SIRGAS2000	SIRGAS2000	2000.4	Adopted
Chile	SIRGAS-CHILE	SIRGAS2000	2002.0	Adopted
Colombia	MAGNA-SIRGAS	SIRGAS95	1995.4	Adopted
Ecuador	SIRGAS	SIRGAS95	1995.4	Adopted
Peru	PERU'96	SIRGAS95	1995.4	Adopted
Uruguay	SIRGAS ROU 98	SIRGAS95	1995.4	Adopted
Venezuela	SIRGAS-REGVEN	SIRGAS95	1995.4	Adopted

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Figure 6: Relationship between classical height datums and a global vertical reference system

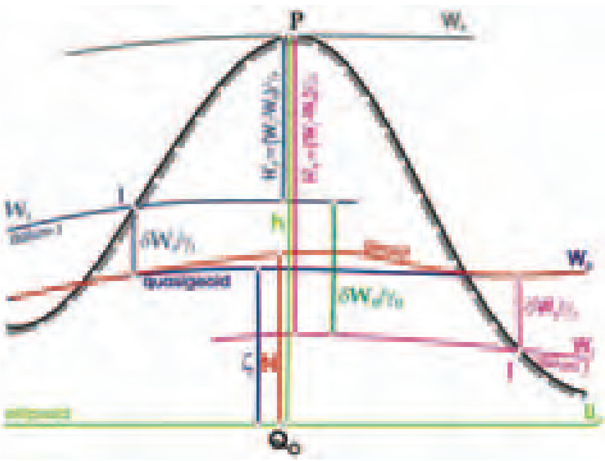
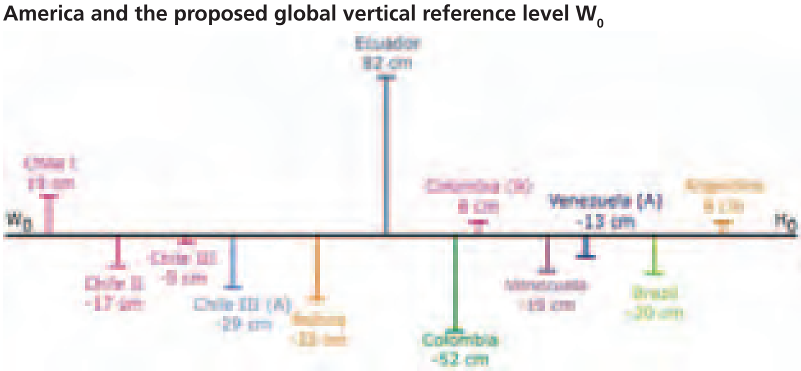
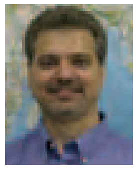


Figure 7: Discrepancies between the individual classical height datums in South America and the proposed global vertical reference level W_0





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The first years of George Everest

The last issue detailed the celebrations that took place for the anniversary of the birth of Sir George Everest but what do we know of the man? His is a household name because of its link to the mountain but many who are not surveyors either (a) think it is a made-up name for the mountain or (b) are not aware that the mountain was named after a person. I have come across many including such as geography teachers who thought it was a made-up name but we will come to the controversy over the name for the mountain in a later issue.

George Everest was born on 4 July 1790 but the actual location is uncertain. We know that his family had two homes at the time, one at Greenwich where George's father was a solicitor, and the other near Crickhowell, South Wales where his father was a Justice of the Peace Deputy Lieutenant of the County of Brecon. Such positions would have meant that the family had to spend large parts of the year in Brecon and it could have been there that George was born. It is known that he was baptised in Greenwich on 27 January 1791, when he was some six months old. Various investigations have failed to find proof of where the birth took place.

Mary Everest Boole, niece to Sir George Everest

George had four brothers and one sister but of these one died young three did not marry and only his brother Thomas Roupall married. It was Thomas whose daughter Mary was to marry George Boole, the inventor of Boolean algebra which is the basis of the logic of a modern computer. [1]. As George Everest was to become a Fellow of the Royal Society (FRS) so were George Boole and two of his sons Charles Hinton and Geoffrey Taylor so together it was a very illustrious scientific family.

Going backwards the Everest family can be traced in the Greenwich area East of London to at least the late 1600s [2]. This was at about the same time that the imposing Observatory was being built on the hill overlooking the River Thames and Greenwich and the first observations were made there on 16 September 1676 under the direction of John Flamsteed, the first Astronomer Royal. In the 1600s the family were butchers but in 1736 John Everest, one of the direct ancestors of George Everest, started practising law – a profession later followed by one of his sons William Tristram. William did not marry until he was 39 and was to become the father or George.

As far as is known, George had quite an ordinary education for the time and the Greenwich area then was a busy naval area because of its Thames side location and nearness to the North Sea. It would also have been quite a rough area for children to be brought up in which no doubt is what led George to get into lots of mischief and become difficult to control. As a result at the age of 14 he was sent to the Royal Military Academy at Woolwich to be a gentleman cadet in the Royal Artillery. His father, because of his profession, would have had all the right contacts to get his son to the Academy since it required high ranking nomination to get acceptance

The Academy had close links with the Honorable East India Company with which many of the cadets found employment on completing the course. George was to follow this route and by early 1806 and within a week of his16th birthday was landing in India. He did not return to England until 1826 by which time both his parents had died as had his elder brother.

1. MacHale D. George Boole. His life and work. 1985. Boole Press. Dublin.
2. Smith J R Everest. The Man and the Mountain. 1999. Whittles Publishing Scotland.

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Errata: *Coordinates vol II issue 4, p26*. There was an error at the end of the first para, where it says death of Everest. It should, of course, read birth. i.e. 1790 to 1990. The error is regretted.

KCS TraceME

GPS/GPRS/GSM Module

Distributors welcome!

The KCS TraceME/TrackME GPRS/GPS Module enables you to remotely track & trace a variety of objects, e.g. cars, trucks, containers or ships. Its small, lightweight aluminum design makes it easy to install and together with the extended position logging, it's ideal for use in fleet management, anti-theft and M2M applications.
Furthermore, the numerous I/O connections allow monitoring and control of a range of external hardware. For surveillance and security purposes, a tiny camera is available, so you can see what's going on at a glance... anywhere, anytime!

Key Features

- Extremely small and lightweight
- Ultra low power consumption
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  - Solar panel with small battery
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- Excellent GPS accuracy
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Product Summary

Equipped with a state-of-the-art GPS receiver, the KCS TraceME/TrackME Module provides reliable and accurate navigational data. All communication is handled rapidly and effectively by a GPRS/GSM modem (dual/tri-band version available) through a GPRS network or, if not available, by means of a GSM network. In areas with no GPRS/GSM coverage, position-data and events are stored in memory. As soon as communication is restored, all information is transmitted.
A unique feature is the user-configuration menu, which controls events like sending position-information and switching of external hardware. Changing this configuration is possible remotely or on-site. Virtually every parameter can be controlled, to adjust the TraceME/TrackME Module exactly to your needs!

Applications

- Fleet management
- Public transport
- Railway industry
- Logistics
- M2M
- Security and surveillance
- Remote control and diagnostics
- Vehicle immobilisation

Evaluation Kit / Support

- KCS TraceME evalution kit
  Order code EVAL01

WWW.TRACEME.TV

Bridging SDI design gaps

This paper aims to address different issues connected to the integration of multi-source data sets in order to better serve different communities through their SDI initiatives and also a better management and sharing of their spatial data

HOSSEIN MOHAMMADI, ABBAS RAJABIFARD, ANDREW BINNS AND IAN P. WILLIAMSON

With applying modern technologies to generating spatial data, the amount of spatial data is increasing dramatically and huge amounts of data sets are being created and stored by different agencies.

Despite the growth of spatial datasets and the expansion of their use in different applications and new emerging services, they are being acquired and maintained by different organizations under different policies and even by organizations from different political and administrative levels. In such organizational arrangement, the spatial data providers produce and manage their own datasets without considering the reuse and integration of the datasets by other users, so most of the datasets have been produced and managed for a single purpose.

In this regard, there is a great deal of reports, stating different aspects of multi-source built and natural datasets integration. They have highlighted the heterogeneity and inconsistency of the initiatives and activities in different dimensions and most of them have attempted to address these impediments by documenting the technical inconsistencies (Fonseca, 2005; Young, 2005; Taylor, 2004; Hakimpour, 2003). Nevertheless, in many cases the technical inconsistency arises from non-technical problems and occurs as result of other marginal issues; belong to social, institutional, legal and political inconsistencies of different custodians and relevant organizations.

Over the last decade these needs are being addressed and overcome by establishing spatial data infrastructures (SDI) where one of its key objectives is to facilitate the integration of multi-source datasets, and specifically cadastral (built) and topographic (natural) spatial data (Rajabifard and Williamson, 2004).

With this in mind, this paper aims to discuss the key elements of integration in order to better understand and describe the technical, jurisdictional, institutional, legal and land policy perspective surrounding the foundation datasets (cadastral and topographic) in a National SDI initiative. The paper is based on a research which will investigate the justification for integrating these two forms of spatial data in support of sustainable environment and develop a model and framework capable of being used in diverse jurisdictions.

Spatial Data Integration

Spatial services commonly rely on more than one data source and it springs from their multi-criteria nature. As a consequence, integration of datasets is the primary and most common task in most, if not all, of the spatial data services. In this regard the technical integration of spatial data has received more attention; nevertheless, non-technical issues seem to be more problematic. This includes the legal, policy, social, and institutional issues (Figure 1) which cause inconsistency in integration.

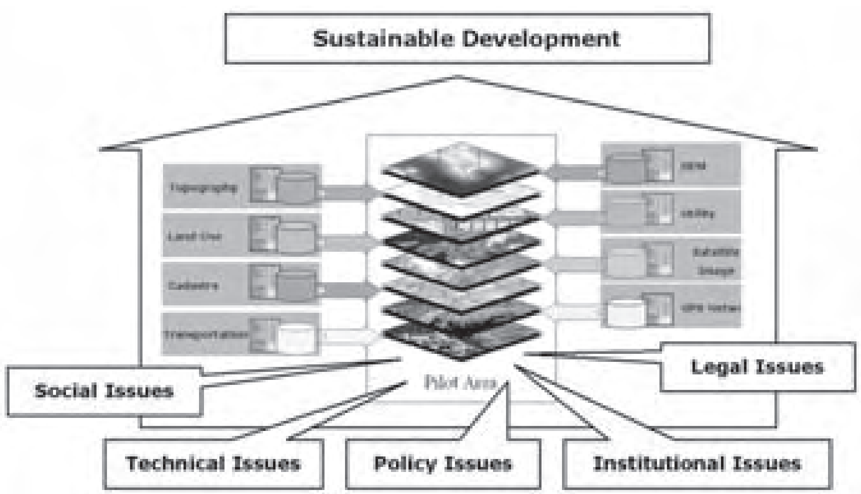
The approach of the current research is to better understand and describe all aspects of issues surrounding the foundation datasets within National SDI initiatives in order to provide an efficient framework for integration by taking both technical and non-technical issues into account.

The importance of the research on integration of multi-source spatial datasets has been highlighted in numerous publications, declarations and resolutions and in particular UN resolutions. Rajabifard and Williamson (2004) have promulgated the integration of built and natural datasets within National SDI initiatives as a major concern in the success of National SDI. Resolution 15 of the 14th UN Regional Cartographic Conference for Asia-Pacific (UNRCC-AP), calls for issues in the integration of cadastral and topographic datasets to be investigated (UNRCC-AP, 1997). The UN Bogor Declaration (1999) urges the creation of National Spatial Data Infrastructure to ensure integration and highlights the homogeneity of the topographical and cadastral datasets (as two core spatial datasets) to achieve the integration to their maximum potential. These declarations also highlight the need for sharing of integrated data among nations, particularly to address common ecological problems in alignment with sustainability objectives.

Data integration to meet sustainable development objectives

A perception is growing among government and businesses that the community is demanding they help build a better society for all. There is increased pressure for organisations to become more sustainable (Vandenberg, 2002). A society which is not geographically aware, or "spatially enabled", is deprived of the ability to develop comprehensive socio-economic concepts and plans, and effective implementation (Williamson et al 2005). The quality of decision making and policy development relies

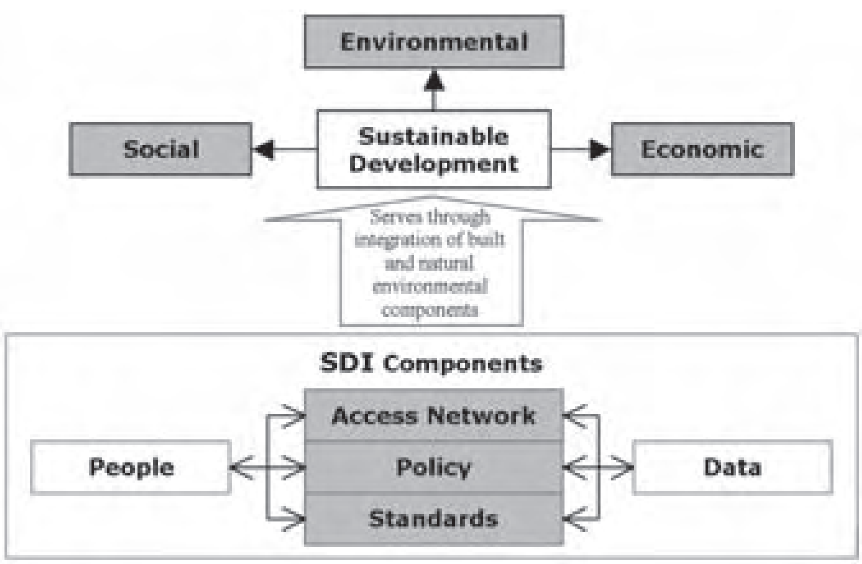
Figure 1. Issues related to the data integration



greatly on having all the necessary spatial information about the natural and built environments. Meeting sustainable development objectives (social, economical and environmental) is possible through a comprehensive understanding of all aspects of the developing and changing environment and it entails merging all built and natural components of the environment to simulate and control the changes.

Good governance of spatial data depends heavily on an enabling platform to manage datasets, facilitate collaborations between data stakeholders (provider, user, value added reseller), and develop the policies, standards and data access facilities through addressing policy, legal, institutional and technical considerations. A Spatial Data Infrastructure aids sustainable development to achieve a better perception of the changing environment and control and manage the impacts of the different environmental elements (Figure 2). This aim is done by understanding the environments and built and natural components, their changes and by controlling these elements through monitoring changes and their impacts.

Figure 2. SDI serves sustainable development objectives (Adopted from Rajabifard and Williamson, 2001)



Some major international concerns connected to sustainable development are equal access to resources, land management, environmental protection, water rights, indigenous and minorities land rights, and emergency management which can only be addressed by accessing integrated spatial datasets within any regional content.

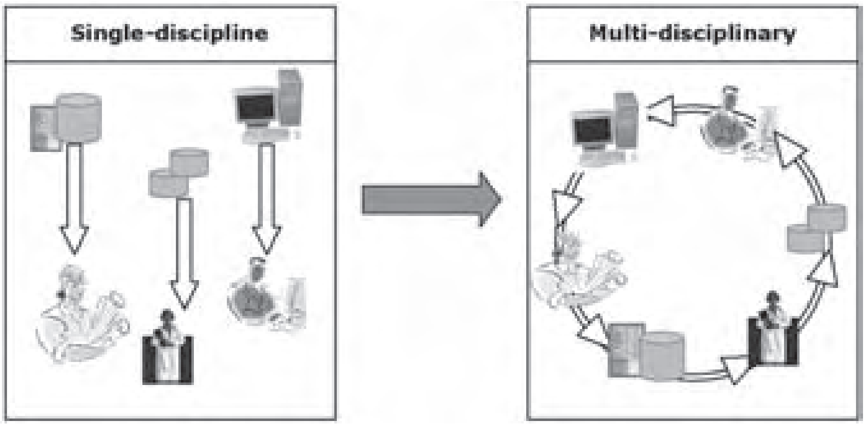
By investigating the approaches of different jurisdictions, at a national and state level in addressing integration issues, governments will achieve a better understanding of the needs and the benefits of integration and will lead the data access and SDI policies towards considering the facilitation of multi-source dataset integration as a priority. Studying different jurisdictions with different characteristics such as size, population, political structure, and spatial data policy will assist in determining "best practice" and gives a framework to evaluate the performance of the systems.

Multi-disciplinary approach versus single-disciplinary approach

Built and natural datasets, originally, have been produced to serve different specific purposes and as a consequence they have been managed under different organizational structures with different policies, divergent technical consideration, and diverse priorities. As a result of that, they have been managed to serve their designated discipline which cause inconsistency and heterogeneity when being used by different disciplines. At the same time, nowadays, multi-disciplinary use and application of spatial datasets forces the datasets to go far beyond serving just a single discipline.

To move from data management with a single-discipline interest towards multi-disciplinary approach, a holistic framework for data integration within any SDI is required to facilitate the provision the datasets to multi-disciplinary users (Figure 3).

Figure 3. Single-discipline approach versus Multi-disciplinary approach



Data Integration Issues

Most spatial applications have interests at a national level datasets, even if they are performed at local level or small regions.

With this in mind, a National SDI can provide the institutional, political, and technical basis to ensure the national consistency of content to meet user needs in the context of sustainable development (Willaimson et al., 2003).

A National SDI provides the foundation to access built and natural environmental datasets. However, in most countries, these two foundation datasets are normally managed separately to serve different purposes. The lack of uniformity across different jurisdictions within a country often creates problems in attempts to integrate the two datasets at a national level (Tsange, 2005). These issues are caused due to technical heterogeneity, institutional structure, policy issues, legal concerns and social effects of the integration.

The most prominent technical issues recognised so far comprise standards, interoperability, semantic, reference system, format, and data quality. The collaboration model (business model) between stakeholders and funding models, and data management approaches are key issues within the institutional arrangement of SDI dealing with integration.

On the Policy side, political stability, priorities of nations, legislation and awareness of the users about the existence of data have been found as major issues. The definition of RRR (rights, restrictions and responsibilities) surrounding datasets and their use, copyright and intellectual property rights (IPR), data access, privacy, pricing and licensing may differ in jurisdictions and even in different levels of a particular jurisdiction are very challenging. Cultural differences, capacity building, equity and minority, indigenous and women rights are also paramount in the social category, as shown in Table 1. These categories show distinct items, however it must be remembered that they also have effects on each other and especially on SDI components.

Conclusion

This paper discussed the importance and requirements of spatial data integration in serving users' needs and the importance of better understanding multi-source data integration within SDI initiatives. The primary goal is to design a methodological framework to facilitate the integration of built and natural datasets and will advance the knowledge of the National SDI capacity in meeting sustainable development objectives. This will be achieved through the development of new concepts and policies to integrate built and natural environmental datasets. On the other hand, the merit of the data determines the interests and willingness of the users to spend for and use the data sets. One of the key characteristics of the fit-for-use of data is the integratability of the datasets and capability of the datasets to be integrated easily and justifiably in terms of time and expense.

Table 1. Integration Issues

Technical Issues	Institutional Issues	Policy Issues	Legal Issues	Social Issues
Computational Heterogeneity (Standards and Interoperability) Semantic Reference System and Scale Data Quality Metadata Format	Collaboration models Funding Model Linkage between data management units	Political Stability Legislation Issues Priorities/ Sustainable Develop ment Awareness of Data Existence	Rights, Restrictions and Responsi bilities Copyright and Intellectual Property Rights (IPR) Data Access and Pricing Privacy Licensing	Cultural Issues Capacity Building Equity

The diversity in data providers creates a great deal of inconsistency in the integration of the datasets, including institutional, technical, social, legal and policy heterogeneity These heterogeneities hinder different aspects and components of a spatial society to facilitate data flow, access and integration.

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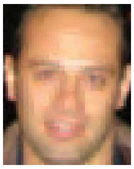

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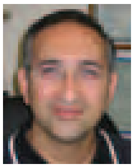

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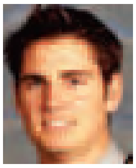

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Product

Leica MobileMatriX v1.51 launched

Leica MobileMatriX is said to support a Multi-Sensor GIS. Within a Multi-Sensor GIS field crews can attach several sensors – TPS, GPS, Levels and Laser Range Finders - at the same time and also can measure with various sensors simultaneously. Multi-Sensor GIS is an emerging trend for mobile GIS and mapping applications.

Leica also announces the upcoming release of Leica GradeSmart 3D (V5.2), a smart machine automation dozer and grader solution for the construction industry. It will introduce new features and improvements designed to enhance speed of operation, support and usability and streamlining of the data transformation process.

Leica fieldPro works directly in AutoCAD

Leica fieldPro is a complete software solution that works directly in AutoCAD® and other Autodesk® products. It adds a set of menus and toolbars to the user's existing AutoCAD toolset.

iCN 330 low cost navigation device

Navman, has announced its latest low-cost navigation device, the Navman iCN 330. Like its predecessor, the iCN 320, the new Navman is a pocket-sized navigation system designed to offer truly usable guidance technology to the masses. More powerful that ever, the iCN 330 features the latest SiRFXTrac enhancement for improved satellite signal reception. *www.navman.com*

GfK MACON updates maps of Germany, Austria and Switzerland

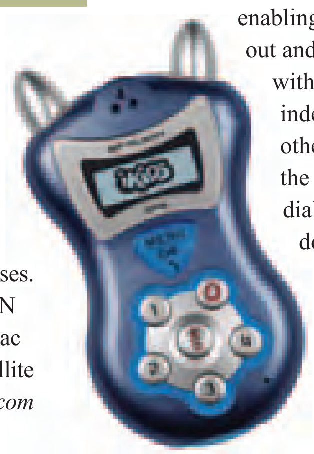
The 2006 Editions of Germany, Austria and Switzerland contain all postal and administrative units as well as many topographical map levels such as streets, railway lines, city areas and elevation levels. Furthermore, the new editions contain special branch-specific maps including Nielsen areas, geographical barriers and statutory health insurance regions as well as data on population and surface areas. The 2006 Editions are the most comprehensive map packages of Germany, Austria and Switzerland available on the market. *www.gfk-macon.com*

NovAtel ships first production OEMV receivers

NovAtel has announced that it has begun shipping the first production runs of OEMV receivers - its next generation GPS product - meeting previously announced delivery commitments. These first shipments include a custom variant to Leica Geosystems, Heerbrugg, Switzerland. Leica's latest GPS 1200 GG Series products, introduced on April 4, 2006, feature NovAtel's new OEMV GPS+GLONASS technology. *www.novatel.com*

Innovative new safety phone for kids

i-Kids is a new 'pre-teen' mobile handset with GPS functionality that has been designed to meet the needs of parents with children in primary school at the same time as enabling children to go out and play confidently with the perception of independence. Unlike other mobile phones, the handset can only dial four numbers and does not include SMS functionality, which means that parents can control and minimise usage. *www.gizmag.co.uk*



A Garmin StreetPilot for Asian Americans

Garmin International Inc. of Olathe, which uses Yao to promote its GPS products, said it is offering a version of its StreetPilot c330 that allows North American motorists who speak Mandarin Chinese, Japanese, Korean, Thai or Taiwanese to use GPS satellite navigation in their native language. *www.kansascity.com*

New Magellan RoadMate 860T portable navigation system

Thales' navigation business has announced the new Magellan RoadMate 860T portable vehicle navigation system. The Magellan RoadMate 860T provides real-time traffic capabilities with 15 months of traffic service included so drivers can easily gain detour routes to get to their destination faster. In addition, the Magellan RoadMate 860T features SayWhere(TM), a text-to-speech function that speaks the street name for upcoming maneuvers. *www.theautochannel.com*

Bentley offers municipalities software

Bentley Systems, Incorporated, provider of software for the world's infrastructure, announced its innovative software subscription for municipalities. Called the Municipal License Subscription (MLS) program, it offers municipalities all the software they need for the mapping and engineering of all their infrastructure for a fixed annual fee, based on population. *www.bentley.com*

Advanced Real-Time Monitoring Ensemble

Thermo-Electron, Inc. and VivoMetrics, Inc. have combined forces to deliver the first real-time monitoring ensemble which brings together three critical elements to aid first responders and hazardous material workers. The real-time monitoring system is worn beneath hazmat protective gear and combines the Thermo Matrix CNET mesh network with environmental hazard detection, global positioning, and the VivoMetrics LifeShirt(R) 300 system, which monitors a broad range of physiological functions. Data from the LifeShirt is integrated with a Thermo-Electron radiation dosimeter, which continuously collects radiation exposure information and a GPS radio uplink that transmits workers' geographic location. *http://sev.prnewswire.com*

Trimble 3D Grade Control Systems

Trimble introduces the GCS600 Grade Control System for excavators. Designed for excavation, trenching, grading and profile work, it is ideal for earthmoving, site preparation etc. It is an entry-level product which can be used for a wide range of applications, including excavation of basements, foundations and footers etc.

The enhanced Trimble GCS900 expands both Trimble's bulk earthworks and finished grading solutions for contractors *www.trimble.com*

Business

India's Vehicle Tracking Systems Sales to Increase

Sales of vehicle tracking systems in India is expected to increase with better awareness, increase in new commercial vehicle sales, and penetration into the market. Frost & Sullivan Industry Analyst V.Bhanu Prakash says the vehicle tracking segment of the Indian telematics market is expected to reach satisfactory levels between 2008 and 2009. Frost & Sullivan finds that the vehicle tracking systems segment of the Telematics Market in India earned an estimated revenue of US$6.4 million in 2005 and is likely to reach US$78.2 million in 2011. *www.frost.com*

Eurolink selects MapInfo Confirm to manage motorway

MapInfo Corporation has announced that the MapInfo Confirm infrastructure management solution, has been selected by Eurolink, a leading European construction consortium to manage the M4/M6 Kilcock to Kinnegad motorway, the first PPP highways project in Ireland. The construction, operation and maintenance of the 27 year PPP contract was undertaken by Eurolink at a cost of several hundred million euros. *www.mapinfo.com*

Applanix chooses INPHO suite of software

Applanix has chosen the INPHO suite of software tools as the recommended workflow to produce directly georeferenced digital orthophoto products with the Applanix DSS 322 digital aerial camera solution. The INPHO digital orthophoto production workflow in conjunction with the Applanix DSS consists of an automatic digital terrain model (DTM) from DSS stereo pair generation environment (MATCH-T), a quality assurance and editing component for DTM data (DTMaster Stereo), and an orthophoto production and mosaicking module (OrthoMaster and OrthoVista).

DAT/EM Systems and PCI Geomatics partnerships

DAT/EM Systems and PCI Geomatics announce the signing of a strategic distributor partnership. The agreement will allow both companies to market, distribute and sell each others complimentary geospatial and photogrammetric technology in certain key markets, including DAT/EM's SUMMIT Evolution™ Stereoplotter software and PCI Geomatics Geomatica® desktop software. *www.datem.com*

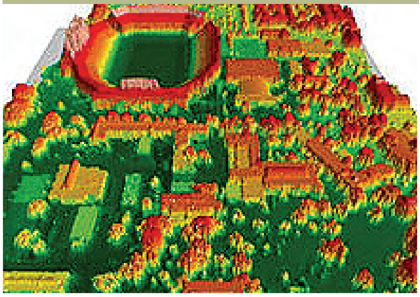
Trimble acquires assets of BitWyse Solutions

Trimble acquires the assets of privately-held BitWyse Solutions, Inc., which is a leading data management company specializing in 2D and 3D software applications for engineering and construction plant design. The purchase of BitWyse's assets is expected to extend Trimble's product portfolio of 3D laser scanning solutions by providing application-specific software capabilities within the Power, Process, and Plant vertical markets.

NATMO India chooses MAPublisher

Avenza Systems Inc. announces that the National Atlas & Thematic Mapping Organization of India (NATMO) has chosen MAPublisher for their map creation needs. This Kolkata-based branch of the Indian government is the prime architect of the National Atlas of India as well as many other major geographic and cartographic projects for the Indian government.

Blom Geomatics purchases its Second ALTM in 16 months



Optech Incorporated, the developer and manufacturer of laser-based survey instruments, announced the sale of an ALTM 3100EA Airborne Laser Terrain Mapper to Norway-based Blom Geomatics (BLOM). This system is BLOM's second purchase from Optech in 16 months. BLOM's existing ALTM 3100 will be upgraded to an ALTM 3100EA model. *www.optech.ca*

ProLink patent on Pay-for-Play approved

ProLink Holdings Corp. the provider of GPS golf course management systems, announced that the United States Patent and Trademark Office has awarded patent number 7,031,947, Method And Apparatus For Continuing Play With Cart-Based Navigation/ Information System Display, effective April 18, 2006. *www.goprolink.com*

US Air Force retracts GPS breakthrough claim

The US Air Force is throwing cold water on its claims of a scientific breakthrough in satellite navigation made at Schriever Air Force Base. An Internet-based version of the GPS is not possible, it says, contradicting a news release. What Air Force mathematicians claimed was a discovery that could have sweeping implications for the space-based GPS was an incremental improvement in the navigation accuracy, officers say. *www.gazette.com*

China to release first panda bred in captivity

A panda research center in southwest China is planning its first release into the wild of a panda bred in captivity. Xiang Xiang, a 4-year-old male raised at the Wolong Giant Panda Research Center in Sichuan province, will be released after almost three years of training and will be tracked by a GPS device. This will help scientists study how artificially raised pandas adapt to the wild. *http://abcnews.go.com*

Mine area clearance vehicle for remote operations

The Headquarters Air Combat Command Civil Engineer expressed strong interest in being able to remotely employ a vehicle system and remove the man-in-the-seat during explosive ordnance clearance operations. The Hydrema 910 Mine Clearance Vehicle MCV-2 Flail System was found to be a suitable vehicle for the task. The vehicle is a commercially available mine clearing system designed by Hydrema, a Danish commercial heavy equipment manufacturer. *www.defenselink.mil*

New Logistics Technologies in the DHL Innovation Center

Deutsche Post World Net announced the launch of research and development initiatives to be carried out in the new DHL Innovation Center. Located near Bonn, Germany, the center supports the development of cutting edge innovations in the field of global logistics, including the mail and express segments. Development work will focus on RFID (Radio Frequency Identification) technology, geodata technology for optimizing travel routes and networks, as well as logistics-related GPS applications. *http://home.businesswire.com*

Ambulance Trusts join mapping agreement

Every ambulance trust in England is to benefit from greater access to Ordnance Survey's most detailed digital geographic information (GI) from this month. It follows the launch of a pilot agreement aimed at encouraging the use of computerised mapping across the NHS. The plan is to ensure health providers have the reliable information they need to improve patient care while making the most efficient possible use of their resources. *www.ordnancesurvey.co.uk*

Mapping portals boost imagery businesses

As companies with Internet mapping portals such as Yahoo and Google compete with newer features and easier navigation, satellite imagery companies are finally seeing a commercial market for their products. Sunnyvale, Calif.-based Yahoo showed its desire to directly compete with Mountain View, Calif.-based Google when the company announced that it is incorporating satellite imagery into its Yahoo Local beta program. Google began incorporating satellite imagery into its Google Maps program back in 2005. *www.space.com*

GeoSpatial Experts Adds Google Earth Functionality

GeoSpatial Experts introduced Version 4.0 of its popular GPS-Photo Link digital image mapping software. Among the many upgrades in Version 4.0, GPS-Photo Link now allows users to display their digital photographs in the Google Earth environment. *www.geospatialexperts.com*

AND releases new maps for Turkey

AND Automotive Navigation Data, provider of worldwide digital mapping data for 'in-car' and personal navigation, has added Turkey to its Central and Eastern European map database. The new digital map are the first results of the expansion of AND's Indian production facility. The map includes all necessary navigation features and are in line with the high quality specifications as defined by AND in cooperation with its customers. *www.and.com*

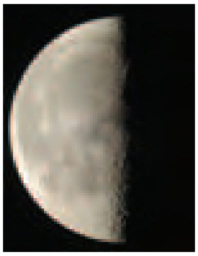
OGC requests public comment on standards

The Open Geospatial Consortium, Inc. (OGC) invites public comment on several candidate standards developed in the OGC's Sensor Web Enablement initiative. The OGC membership anticipates that these specifications will be adopted as OpenGIS® Specifications and that they will become widely used as open, international standards for Web-based registration, discovery, use and control of sensors, sensor systems, and sensor data stores. *www.opengeospatial.org*

Data quality enhances efficiency in Indonesia

Laser-Scan's reseller for South East Asia, Credent Technology, announced that Badan Pertanahan Nasional (BPN) has purchased Radius Topology™. BPN Sub Directorate Mapping and Photogrammetry is the national agency responsible for the provision of spatial data to all local governments in Indonesia. *www.credent-asia.com*

ISRO and NASA Sign MOU on Chandrayaan-1



The Indian Space Research Organization and National Aeronautics and Space Administration of USA have signed an MOU on inclusion of two US scientific instruments on board India's first mission to Moon, Chandrayaan-1. These instruments are - Mini Synthetic Aperture Radar (Mini SAR) developed by Applied Physics Laboratory, Johns Hopkins University and Moon Mineralogy Mapper (M3), jointly built by Brown University and Jet Propulsion Laboratory (JPL) of NASA. *www.isro.gov.in*

GeoEye to supply European Commission with OrbView-3

GeoEye has announced its partner European Space Imaging (EUSI) received an additional contract from the European Commission to supply OrbView-3 high-resolution map-accurate imagery. The contract was awarded in first week of April and is valued at $2.15 million (EUR 1.8 million) over the next four years. The imagery will be collected by the company's OrbView-3 high-resolution earth-imaging satellite. *www.geoeye.com*

COSMIC will track hurricanes with six satellites

A globe-spanning constellation of six satellites expected to improve weather forecasts, monitor climate change, and enhance space weather research headed into orbit on April 14, 2006, from Vandenberg Air Force Base on the central Calif. coast. The low-orbiting satellites will be the first to provide atmospheric data daily in real time over thousands of points on Earth for both research and operational weather forecasting. The satellites will measure the bending of radio signals from the US GPS as the signals pass through Earth's atmosphere. *www.technologynewsdaily.com*

NASA and partners to start ocean surface topography mission

NASA has signed an agreement with other US and international agencies to launch the Ocean Surface Topography Mission in 2008. The satellite, named Jason-2, will increase our understanding of ocean circulation and improve climate forecasts and measurements of global sea-level change. The 3- to 5-year mission will extend the ocean topography measurements collected since 1992, first by TOPEX/Poseidon and now by Jason. NASA is cooperating with the National Oceanic and Atmospheric Administration (NOAA), France's Centre National d'Etudes Spatiales (CNES) and the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) on this mission. *http://bbsnews.net*

US LBS market to grow to 1 million subscribers by 2010

Depending largely on the cellular operators actions, the US LBS business market is forecast to grow to from 582,000 to 1.1 million subscribed devices by the end of 2010, reports In-Stat. Location-enabled enterprise applications constitute a small but important segment of the market for mobile IT applications, the high-tech market research firm says. Applications for this technology include fleet management/dispatch, workforce and sales force management, as well as a variety of public sector location applications. *www.instat.com*

Verizon Wireless Expands VZ Navigator LBS to The V

Verizon Wireless announced that it has expanded its VZ Navigator(SM) service to include the popular all-in-one mobile phone, The V. With VZ Navigator and The V from Verizon Wireless, customers can access a wide array of LBS options, including mapping, audible turn-by-turn navigation and the ability to find more than 14 million points of interest. *http://biz.yahoo.com*

Webraska Navigation 6 for BlackBerry

Webraska has announced that it has joined the Research In Motion (RIM) BlackBerry® Independent Software Vendor Alliance Programme. Under the terms of the agreement, Webraska will develop a version of Webraska Navigation 6 for BlackBerry. *www.webraska.com*

MapPoint 2006 Mapping Solution

Microsoft Corp. announced the availability of MapPoint® 2006 that can help customers improve decision-making capabilities and increase new business opportunities through the use of maps and geographical information, enabling better analysis, visualization and communication of business information. It also enhances its usefulness for mobile information workers by adding rich new GPS integration and driver guidance capabilities so that users can make the most out of time spent away from the office. *www.microsoft.com*

NextBus tracks vehicles in Chapel Hill

NextBus Inc., a wholly owned subsidiary of Grey Island Systems International Inc., announced that the Town of Chapel Hill, N.C., awarded a contract to NextBus, Inc. in April to provide a real time passenger information system for Chapel Hill Transit. The contract is worth approximately US$ 950,000. NextBus uses global positioning satellites and advanced computer modeling to track buses on their routes. Taking into account the actual position of the transit vehicles, their intended stops, and the typical traffic patterns, NextBus estimates the bus arrivals. These estimates are updated constantly as the vehicles are tracked. *www.telematicsjournal.com*

TeleCommunications Systems unveils two new LBS

TeleCommunication Systems, Inc. (TCS), announced the availability of TCS Places and TCS Handset Locator, two new services that wireless carriers and Mobile Virtual Network Operators (MVNOs) can offer to their subscribers which leverage the carrier's location infrastructure. TCS Places is an innovative service that provides the means for subscribers to have instant access to their content and services while "on-the-go." *www.telecomsys.com*

Locating health and beauty retailer

Multimap has announced the implementation of its Storefinder search facility on www.boots.com. The new service enables customers of the UK's leading health & beauty retailer to search for nearby stores by both location and services provided, and to access comprehensive street-level maps showing their exact locations, in a few simple steps. *www.multimap.com*

Mine planning and design

An approach to deal with a heterogeneous limestone mine

PK Bhattacharjee

Limestone constitutes the predominant raw material for manufacturing clinker, which in turn is an intermediate product to produce cement. But if the deposit is not homogenous and the coefficient of variation (COV) of the main inherent radicals in limestone is very high then the consistency in the quality parameters of the product varies and so on the process requirements thereby affecting productivity. In such cases the deposit has to be understood statistically and a proper geological model should be designed to best fit our mine design parameters. This paper deals in detail how surpac leads in solving a similar problem.

Introduction

The mine site is located in district Raipur in the state of chattisgarh. Geologically, this mine predominantly contains limestone of marginal to sub-marginal grade. The mine has been explored at a grid interval of 100/ 200 meters at a sampling interval of 0.5-meter along depth. Moreover as the water table is very shallow in the area, core cum sludge samples were taken to improve the reliability of the samples. Structurally, the area contains massive limestone of grey/ purple/ chocolate in color very well differentiated from a separate 2 – 3 meters of boundary limestone formation mixed with soil and buff shale. The massive limestone band contains cryptocrystalline shale partings, which cannot be segregated to a much greater extent by scrubbing, screening, magnetic separation, or any other beneficiation techniques generally used. This made the mine more vulnerable for proper and judicious mine planning so as sustain the mine in terms of quantity and quality deliverables over a longer period. Hence a need was felt to redesign the geological model of our mine with proper estimation using surpac and total station to best fit our mining requirements.

Computerized mine planning

It was felt that the geological and the block model of the mine has to be re-looked upon in-house using surpac. Before moving a further one-step ahead let us think upon the probable sources that can lead us to such errors.

a) Lack of a well-defined geological model.
b) Lack of proper inputs/ basis for calculating the block estimates.

As the data has been entered by two different agencies and it was observed that there was not much of differences between the two, it was assumed that error in this stage is zero or negligible.

Re-defining the geological model

All the geological models designed earlier were more or less literally based on the extent of lithology. But during the course of winning limestone it is a normal practice that the loader/ excavator operator segregates the inter-burden/ waste material from the blasted muck and feeds the remaining material to a crusher. Hence, it is very relevant that in order to resemble our geologic model to the field, it has to be categorized assay wise in term of a specific radical. This paved the way that an assay bearing area containing on an average 41% lime and above can be a best fit domain to meet our requirements and same was done accordingly.

Basic statistics

After re-defining the geological model, basic statistics of important radicals were computed to calculate the following –

1. Average grade (mean).
2. Standard deviation (std. dev.).
3. Coefficient of variation (COV).

On detailed analysis of the coefficient of variation of the respective radicals, following interpretation were derived on the basis of below mentioned generally followed norms.

It was thereupon interpreted that excepting CaO, most of the other radicals followed a lognormal distribution.

COV	Interpretation
0% to 25%	Simple, symmetrical grade distribution.
25% to 100%	Skewed distributions. Lognormal grade distribution

Variogram modeling

The variogram is the fundamental tool used to measure spatial continuity of grade data and is a plot between average variability between samples vs. the distance between samples.

Computing an experimental variogram

Computing an experimental variogram from a set of randomly spaced data involves finding pairs of data that are oriented in the required direction, determining the distance between the samples, then summing the squared differences of the grades. Since the data are usually sparse, it is necessary to use a tolerance when locating samples in the desired direction and to use a distance increment to classify samples by distance. The distance tolerance is a fixed distance increment (cell size), selected so a reasonable number of samples fall in each cell. The steps/ procedures observed by us to compute the experimental variogram is detailed below –

1. Variograms were computed within continuous zones of mineralization without crossing different geologic domains.
2. The distance increment was approximately equal to the average spacing between samples in the direction of the variogram.
3. At least 30 pairs of samples were used to compute a valid variogram.

Resource estimation

The generally used methods for resource estimation or modeling are -

1. Traditional/ geometric methods that are done manually on plans or sections and
2. Interpolation methods such as inverse-distanceweighting and kriging that require the use of a computer.

Kriging

Kriging is the geostatistical estimation method developed to provide the "best linear, unbiased estimate" for grade based on a least squares minimization of the error of estimation, or kriging error. Important factors in the krigging estimate are

1. The average of the estimates should not be systematically higher or lower that the true value; this is established mathematically by setting sum of weights equal to zero.
2. The error of estimation, which is expressed as krigged variance is minimized using the lagrange principle to create a moidified equation that satisfies a non-bias constant, called as lagrange multiplier.
3. The equation is then differentiated with respect to each of the weights & lagrange multiplier resulting in a set of simultaneous equations.
4. The simultaneous equation is then solved by gaussian elimination method to determine the weights and lagrange multiplier.
5. The krigging error of estimation is there upon computed.
6. The individual variance of samples in the deposit and the block variances can be thereupon computed from the experimental variogram.

Following precautions were taken to facilitate the krigging process:

Block size

1. With the existing spacing of minimum 100 meters between holes a block size of ¼ th of the drill hole spacing was taken.

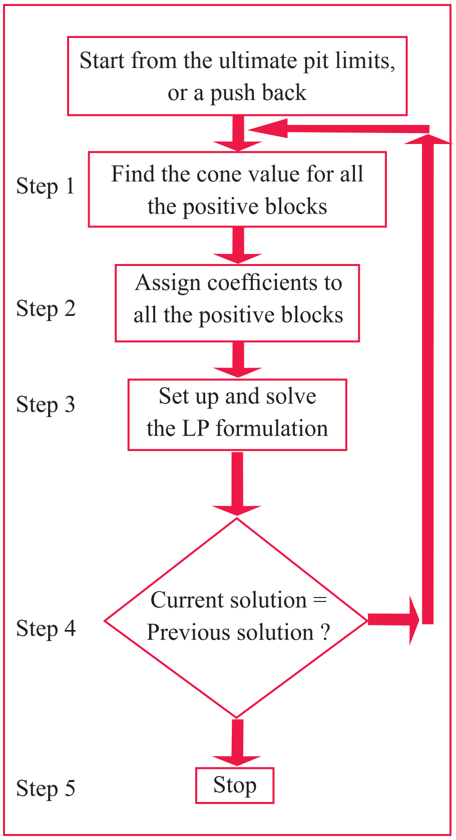
Sample selection

1. Samples were selected from geologic domain similar to the block
2. To avoid overestimation as well as under estimation a min-max of 10 – 20 samples were only taken.

Step – 1

Find the cone value for each ore block (positive block) within a given pushback, or within the ultimate pit limits. For this, the apex of a cone is set over each ore block, and the economic values of all the ore and waste blocks that are within the cone and have to be mined before mining the block at the apex are summed. This total economic value of a given block , I, is said to be the cone value of the block i, Cvi.

Mine scheduling (The essence of mine planning)



Step – 2

Assign the co-efficients to the ore blocks according to their cone value, which may also be considered as a ranking of the core blocks by bench. On the uppermost bench where one or more ore blocks exists, 1 is assigned to the ore block with the highest cone value , 2 is assigned to the ore block with the second highest cone value, and so on. If there are three ore blocks on that bench, 3 is assigned to the ore block with the smallest cone value. Then the ranking process moves one bench down. If there are some ore blocks on that bench, 4 is assigned to the ore block with the highest cone value. The process is performed for all the ore blocks within a given pushback. If two ore blocks on the same bench have the same cone value, the co-efficients are assigned randomly, and two ore blocks should not be assigned the same co-efficient.

Step – 3

Set up an LP formulation to generate

the FTs, as detailed in the next session. When the problem formulation is complete, any solver suitable for large models may be used to solve it.

Step – 4

If the number of trees obtained is the same as the number of the trees obtained from the previous solution, the solution is considered to be optimal, and the algorithm can go to the next step. If the number of trees is higher than the previous solution, keep the currently found connections between blocks and repeat all the steps as illustrated in the next section. Initially, just for being theoretical correct, assume that whole pushback is one tree.

Step – 5

Stop the algorithm.

Observations

It was observed that the estimates were now more or less tallying with the actual achieved grades. In order to further streamline the same it was further decided to experiment use of blast hole drill samples for more localized estimates and then establishing the deviations.

I express my sincere thanks to the management of Grasim Cement for allowing me to publish the paper. The views expressed in this paper are solely of the author and not necessarily of the management.

References

(1) Fundamental tree algorithm in optimising production scheduling for open pit mine design by S. Ramazan, K. Dagdelen and T. B. Johnson

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MARK YOUR CALENDAR

May 2006

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

June 2006

ICORG 2006
5 - 8 June, Hyderabad, India
ivm@ieee.org
www.icorg.org

Intergraph 2006
12-15 June
Orlando FL USA
http://www.intergraph2006.com

Navigation Europe 2006
June 19-20, 2006,London, UK
Precksha@telematicsupdate.com

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

Accuracy 2006
05 -07 July
Lisbon Portugal
mcpereira@igeo.pt
http://2006.spatial-accuracy.org

Geoinformation for Development
05-07 July
Salzburg, Austria
gi4dev@agit.at
www.agit.at/gi4dev

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

GICON 2006 - Geoinformation Connecting Societies
10-14 July
Vienna, Austria
congress@mondial.at
www.gicon2006.at

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
28-29 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