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Transformation of National Mapping Agencies: The Case of India

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With the change in technology, users' demand, market forces and different applications, the government is forced to have an introspection of its policies and practices of the national mapping agencies. India is not an exception in any way. Transformation of such institutions has become more pertinent because running these institutions have become expensive. There are committees of the parliament, ministries and users who keep on questioning the policies and practices. Similar issues have been raised in other countries as well (Kelmelis, 2002; Mcgrath, 1982; Rhind, 2000).

The Indian situation is further aggravated because on one hand the age-old system of 237 years continue to function; while, on the other hand, there has been a quantum jump in technology, particularly in software and remote sensing technology. As a result, a huge manpower is becoming redundant with the introduction of newer technologies. Field operations, conventional aerial photography, printing, geodesy and data or record management have undergone a sea of change. Further, there are several proposals for joining hands with the industry. What should the approach be under this situation? Should we go for out-sourcing for all the possible sectors? What should be the new focus of activities and the core activities? How to make the maps or the spatial data available to the users in most desirable way? Accordingly what should be the transformation model for India? These questions are very intricate and the possible answers are further complicated.

To address the above issue we have to understand the existing trend/practice of a National Mapping Agency and changing technological scenario. The data market is to be assessed. Partnerships with the university and industry are to be evolved. New arrangements are to be made for data dissemination. Manpower is to be trained in different aspects of mapping technology. The old manuals are to be changed which is of course a tedious job. Standard operative procedures are to be implemented. But the issue is from where to start the transformation procedure if it is to be done at all.

National Mapping Agency- Survey of India

Survey of India (SOI), the premier National Mapping Agency (NMA) of the government of India, contributed significantly for the growth of the nation. It has excellent technical heritage of very high value in terms of survey data sets, best surveyors, cartographers and a long history to be proud of. The organization was regarded as the forerunner in the fields of geodesy, geophysics, geodetic astronomy surveying, cartography and map reproduction. The procedure in collection, processing, storage, maintenance and dissemination was so well developed that there was very little chance for any types of error left in technical work. SOI has crossed several milestones of technological up gradation and change of role since inception. In 1905, the role of cadastral survey was transferred to state government. New photogrammetric units were opened as a part of reorganization to introduce photogrammetry in 1954. Training was imparted to the departmental staff and officers within the directorates earlier. In 1967, Survey Training Institute was established with UNDP assistance for the purpose of training, not only the departmental personnel, but also personnel from other departments and South Asian countries in all fields of surveying, mapping, reproduction and management.

Till recently, the topographical maps prepared by SOI, were mainly used by defence. The department has the mandate to produce the spatial data, but there is no mandate for data dissemination. As a result of the present requirement of information technology and growing awareness among the users about potential and applications of spatial data in developmental activities in the country, the need was felt to take corrective steps immediately, not only in terms of reorienting SOI products to customer needs, but also to evolve itself into a more customer friendly organization.

The National Informatics Policy 1999, of government of India, considered Information Technology (IT) as an enabling tool for economic development in the country. This policy envisages bringing IT to all sectors of the society. Spatial data plays an important role in effective exploitation of information technology. SOI, the national mapping agency could not produce updated maps in pace with the development due to the methodology adopted in various stages of spatial data collection and mapping. There are certain other factors, which have contributed to the present state of the organization, like:

- (i) Not been able to maintain the pace with the changing technology.
- (ii) There was no internal mechanism to review regularly the users need and organization itself.
- (iii) Accuracy had been the hallmark of SOI, its obsession with accuracy at the cost of the users.
- (iv) Gradual decline in the annual budgets.
- (v) Technological obsolescence due to poor investment in new areas.
- (vi) Lack of public relations.

SOI is known for its accuracy, quality control and strict adherence to standards. Stakeholders have faith in the data produced by the department. However, the organization required re-engineering itself due to the changing scenario in the application of geospatial data. Today, the user community is gaining experience with the use of digital maps; it became evident that users need different types of product. There is a need that the department responds to the needs of the stakeholders and act as a reliable spatial data provider, instead of only as a spatial data producer. The department needs to fulfill the role, as a government owned NMA ensuring continued availability, and as a service provider of high quality updated spatial data at a reasonable and affordable cost.

New Initiatives

In an attempt to give a face-lift to the Indian national mapping agency, i.e. the *Survey of India*, a series of discussions were initiated. The focus and priorities kept on changing while working out the transformation model. Sometimes the establishment of the *National Spatial Data Infrastructure* (NSDI) was given more importance while on the other hand the *dual map series* was considered extremely important even to make NSDI successful (Georgiadou, 2003; Hadley & Hammond, 2003). By then it was found that the 200th year of the *Great Trigonometrical Survey* or GTS was in offing. There were several activities under the umbrella of these three activities. They include writing of books, shooting of films, development of exhibitions, interactions with several agencies, understanding of the technological options and above all, endless meetings away from the survey headquarters. All these activities are running concurrently but not always complementary. Under the above situation, an attempt to take new initiatives for the transformation of over two-century-old NMA has been a unique experience. Models of other, mostly developed, countries were considered and interactions took place very extensively.

After having a series of discussions, it was found that there is a need for change. The focus has to shift considering the technology, market and government policies. As a result a new vision was worked out (Hadley & Hammond, 2003; Pande, 2003):

Mission

The new mission of the Indian National Mapping Agency will be:

The Survey of India will take a leadership role in providing customer focused, cost effective and timely geospatial data, information and intelligence for meeting the needs of defense, sustainable national development and new information markets.

The mission obviously indicates the paramount role SOI has to take in providing geospatial data. This implies that SOI has to become a leader in this field not necessarily by generating the data. Hence the new focus pertains to becoming a pivotal element in generating the data by the associated agencies as well. A corollary to this is to develop a partnership with industry and universities. Further, the focus in a way has also shifted from the conventional printed map to digital data, which should be processed for various applications. In order to understand the emerging scenario in the country, a separate type of specialization is required within the organization, which is different from topographical mapping. Hence, a window for this purpose is required as well. Officers are to be trained. Furthermore, defense has been given due priority but two new types of users have been identified: one for sustainable development, and the second for information markets. Sustainable development has been closer to the issues related to resources and the environment. This aspect has been in the forefront of the remote sensing institutions in the country, which have been given a boost with successful launches of the Indian remote sensing satellites. Under the aegis of the Department of Space, several national and state level remote sensing application centers have been dealing with such issues. The activities of such institutions are to be studied in order to have a sharper focus for SOI. In the same way, the new information markets are either linked with the industry or infrastructure, including cadastral mapping. The industry is heavily engaged with the mapping related to infrastructure while cadastral mapping is a state subject in the federal structure of the government. What leadership role SOI can take in this field is to be worked out with the concerned agencies. However, these issues will be discussed later at length.

Aims

Keeping in view of the above mission, the new aims of the institution has been worked out which are as follows:

- 1 SOI will be vibrant, i.e. responsive to the needs of user community in India.
- 2 To promote professionalism, incorporating high standards of ethics and conduct among geospatial data producers.
- 3 To provide a forum for all the professionals to share knowledge and expertise.
- 4 To stimulate, encourage and participate in research, development and application of geospatial data.
- 5 To be active in all the areas of applications for geospatial data through special interest groups, which will be dynamic to accommodate the emerging technologies and applications.
- 6 To contribute to the formulation and organizing educational and training programmes needed by professionals, users and the public.
- 7 To actively participate in and advise the public bodies including the Government in the formulation of policies affecting the professions of surveying and mapping.

It is not that the Survey of India is addressing these issues for the first time. However, in the scenario where defence requirements were given priority, the understanding of the needs of the user community got a back seat. Further, there are two specific types of requirements (a) projects surveys, and (b) the general public. Some attempts were made, for example, to produce visibility series, tourism series, town maps, trekking maps, district planning maps and the like. In some cases, seminars and discussions were conducted to understand users requirements.

The aim of promoting professionalism and ethics among geospatial data producers is not an easy task. There are agencies under the government who have their own norms developed over the years. To get them changed leads to a lot of discussion and insight. In addition, there are several industrial groups who are the new players in this field. They are engaged in market driven activities. Their activities are technology driven as well. In order to bring some semblance, the National Spatial Data Infrastructure has been established. There are special committees within NSDI appointed for this purpose. Nevertheless, the role of Survey of India in policing such activities is yet to be decided. The same set up is also meant to provide a forum for all professionals to share knowledge and expertise in the field of geospatial information.

Till now the objective has been to prepare accurate maps and now spatial data. The participation in research and development was limited to this sphere of activity. But encouragement, promotion and applications of geospatial data require more openness, more interactions and more understanding of research requirements. In order to do so, a new approach is essential in the functioning of the organization. User conferences, participation in the seminars, publishing status papers and reports and willingness to change is most essential.

Considering different various applications, the formation of a special interest group in the traditional organization like Survey of India is a new approach. Application oriented mapping has never been a priority. But it has been strongly felt that user requirements have to be understood and the policy and contents have to be changed accordingly. Data has to be user, application, technology and market driven. The training programmes for such transformation in mapping and as well as training for users are most important and an integral part of the change process. In any case Survey of India has been associated with different academic and professional bodies for the promotion of mapping technology. In fact such involvement has sometimes been more than desirable. In view of the aim and mission for NMA, we have identified the area of concern considering needs of user community in present scenario.

Transformed Goals

In an age-old institution like Survey of India, transformation process has to be initiated in all fronts (Krishna, 2003). New products, business opportunities, training, technology, collaborations and organizational structure must be considered in combination. The emerging scenario is complex but pertinent for transformation. The new options should be accepted as opportunity – not as a threat.

a) Products

The topographical maps on different scales are not meeting the requirement of planning and infrastructure development in rural and urban areas. Therefore, now it is planned that SOI would provide digital spatial data on scale commensurate to the requirements of planning for urban and rural areas. The methodology adopted in various stages of mapping is outdated. Latest methods of data capture and processing using digital techniques is the requirement of present day. In this context, all maps on scale 1:50k and 1:25k scale available on paper form, which are cumbersome to use, need to be converted into digital form to provide framework spatial data to customers in NSDI platform. Topographical maps need to be updated using inputs like high resolution imaging data or rapid ground truth checking with digital techniques on a fast track mode. It has now been targeted that SOI will be completely in the digital environment by 2005.

Till today, about 3500 geodetic horizontal control points and about 4000 plus precision and high precision height control points were established in the country. These control points were sufficient for extending topographical points for mapping on scale 1:50k but, considering the requirement of large scale mapping, there is a need to densify the precise control for getting quality digital data. SOI has planned to use the existing control as reference and densify it by using GPS techniques. Such densified control will be provided in a fashion to have about 120 points in each map sheet area of 1:250k (110 km to 110 km) with in the next two years time for entire country.

The data collected for ground truthing will have to be done by field methods but using the latest available techniques like GPS, Total station, Digital level etc. In order to speed up the office data collection, the available inputs like aerial photo, satellite imagery, Airborne Laser Terrain Mapping (ALTM) data or other acceptable sources will be used. Large scale aerial photographs on 1:5000 scale will be required for mapping urban areas and 1:15K scale for rural areas which will facilitate generating digital data on larger scale with accuracy. ALTM technique is being tested to generate geospatial data for large-scale digital mapping. SOI is planning to use Mobile Mapping techniques (palm top with GPS) for data collection instead of conventional plane table methods, so that the data updating and generating digital data can be done without much waste of time. Updation of existing 1:50k/1:25k scale maps is a huge task with the department. There are about 5000 maps on 1:50k scale covering the country. There is a plan to update all these maps using high-resolution imagery like IKONOS, SPOT etc.

The present method of going through various stages during the map reproduction in bringing out the final hard copy map requires a thorough review. The method of reproduction is changing from existing method of plate making to use presensitized plates, which works out cheaper and time saving. Proof examination in reproduction office to be dispensed with. Unit responsible for data processing will complete the process till final printing stage and then submit the material for final printing in printing presses. This will reduce the movement of material between printing offices and processing office. SOI has four dedicated printing presses.

The department has set a target to provide spatial digital data for existing 1:50k scale maps and make it available to stakeholders. It is also committed to provide precise control points at closer spacing (say 10 km) using GPS duly connected with leveling datum and monumentation.

The department has planned in the present decade to densify Ground Control Points (GCPs) using GPS and other means for large scale mapping for the areas covered by cities/towns on various scales larger than 1:5k. Initially, the GCPs will be provided at a spacing of 10 km and further densify for rural and urban areas on the requirement basis.

It is proposed that SOI will equip itself with GPS, digital levels and total stations immediately and start densifying the control. We are in the process of acquiring state of the art digital data capture and processing equipments and complete the generation of updated digital database on 1:50k scale by 2005. ALTM technology is proposed to acquire and acquisition of high-resolution digital data for urban areas shall be taken up. In the process, the department will switch over from high volume production of hard copy maps to provide hard copy map on demand or in soft copy form as per users requirement. The state level directorates will be established to take care of mapping requirement of the states. Survey Training Institute (STI) will gear up for developing capacity building.

Survey of India will develop state level SDI for generating high-resolution digital data in collaboration with state governments. It is proposed that it will actively establish expertise in public and private domain to achieve the objectives to eventually enter into strategic alliances. SOI node of NSDI is in the process of coming to the existence shortly.

b) Human Resource Development

SOI is organizing the education and training programmes needed by the children, youth, professionals and users and for the public. Survey Training Institute of SOI is in the process to identify the areas of skills required in view of IT policy of the country. It is evolving new training programs to cater for the needs of such skill development in the field of geospatial informatics in order to improve effectiveness of the system. The training of personnel in the latest art of the techniques is being taken up. STI will organize on job need based training to develop skills for acquiring spatial data and its processing. Workshops and courses of suitable duration to be organized to facilitate participation by various sections of the society.

An MOU has been signed with the International Institute for Aerospace Survey and Earth Sciences (ITC), which allows for technical up gradation of the officers and staff. Training on emerging technologies is to be conducted in India and The Netherlands. On the other hand, Indian universities are being approached for recognizing our longer duration training courses.

c) Organizational Structure

SOI is organized as Directorates, comprising of units performing different roles. These units are designed to have full components of administrative, records, stores and technical capabilities. At present, these have become unwieldy because of the reduced manpower.

In order to achieve great flexibility and redeploying existing manpower to cater for the present needs, SOI is in the process of reorganizing into state level Spatial Data centers with all components of modern methods of geospatial data acquisition, processing and marketing. In this process, each state directorate shall be fully equipped and will become complete solution providers.

d) Business Strategy

In this area, SOI is lacking at present (Nag, 2002). The guiding principles in this area will be, to account for commercial pressure and continuously improve performance and remain customer focused. In order to achieve this, SOI is required to increase contacts with customers through partnership. The partnership may be on a partnership mode or contractual mode, both within the country and abroad. There will be a strategy of regular monitoring of geospatial market, which can be done through a professional agency to assess potential market share of SOI. SOI will employ a marketing agency to improve its marketing capability as well as to understand marketing potential.

Several methods are being worked out for profit sharing, cost recovery, and on royalty basis. These initiatives are based on different models including that of the Ordnance Survey. New products are being identified and partnerships are being worked out (OS, 1999, 2001 & 2003). In fact consultants are to be appointed soon who can help us in identifying new markets, products and services.

Conclusions

Geospatial data is becoming more and more critical for effective planning and decision-making. With the availability of modern technology, it is possible to exploit technology to good advantage, obtaining new products and services faster and cheaper as compared to conventional techniques. There are several journals now coming out which implicitly or explicitly are pressing the National Mapping Agencies to provide the spatial data easily.

To switch over from age long methods and tradition of the department, there will be some reluctance from various corners to adopt new techniques due to their expertise in conventional field. However, digitizing maps in a computer environment is now routinely started in the department. The department has adopted latest state of the art technology in data collection, processing and management.

As a NMA in the country, it is now our aim that we provide geospatial solutions to all user community, timely and in a cost effective manner. At the same time we recognize that there is no monopoly in good ideas and practices. The NMA, India will benchmark itself with other national mapping organizations in the world and seek improvements in our methodology, techniques and organization. This is an ongoing process and will continue.

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