DEVELOPMENT OF SURVEYING AND MAPPING TECHNOLOGY IN VIETNAM

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ABSTRACT

This paper is focused on giving a scenario of the technology development during the last decade and sketching out a prospect for the next future in Vietnam. The technological renovation and development benefited advantages from advanced space and information sciences with which the result is the setting-up of a production line in the following fields:

- Unification and upgrading of the national control network, using precise GPS measurement techniques
- Implementation of the GPS-navigation facilities and GPS-controlled techniques in aerial photogrammetry
- Implementation of digital techniques in topographic mapping, map compilation and map production

For the next future the building-up of the GIS-infrastructure and the elaboration of a national GIS- and Land-database had been planned.

1. A BRIEF HISTORY ON SURVEYING AND MAPPING IN VIETNAM

The first map of Vietnam was compiled early in 1490 under the Le dynasty with the directive of the king Le Thanh Ton, of which the initial attempt is for military operations. Time after, the King collected maps and compiled the first atlas of Vietnam, known among Vietnamese as the Hong Duc Atlas. Since then the Hong Duc Atlas served not only for national defense but also for the land management. Thus the first cadastral system, covering the whole agricultural land was organised for this purpose.

At the dawn of the 20th century, under the French colonialist domination, the "Service geographique de l'Indochine" SGI (Indochina Geographic Service) was founded. SGI was responsible to every undertaking in surveying and mapping in Indochina, among these the most striking achievements were the establishment of the Indochina triangulation network and the completion of the Indochina 1/100 000 map series, based on the Clarke ellipsoid and the Bonne projection.

After the liberation of North Vietnam in 1954, the DRV (Democratic Republic of Vietnam) Government founded the National Department of Surveying and Mapping (NDSM) in 1959. NDSM was in charge of basic surveying and mapping implementation in North Vietnam. Up to 1975, the year of the reunification in the whole Vietnam, NDSM has succeeded in:

- building the 1st. and 2nd.-order triangulation and leveling network from the border to China down to the 17th parallel. These triangulation and leveling network were partly densified with 3rd and 4th order network for large scale and engineering mapping.

- editing a new 1/100 000 map series, based on updating the 1/100 000 map made by SGI before 1954, using the Krasowski ellipsoid and Gauss-Krueger projection as references. The Red river delta and coastal zone are covered with newly made 1/25 000 maps.

At that time in South Vietnam the triangulation network, established by French before 1954, was upgraded by the US Army Map Service (AMS), using modern radio-positioning techniques. A new map series in 1/50 000 scale, covering the whole country, is compiled. Several photography missions in 1/30 000 and 1/60 000 scale had been undertaken for this mapping purpose. The upgraded triangulation network and the new map series in South Vietnam are referenced to the Indian Datum (Everest ellipsoid, UTM projection)

During a time frame of 15 years after the reunification of Vietnam (1975-1990), the NDSM has concentrated its efforts in building a unified national geodetic network. Measurements are performed to connect and to readjust the triangulation and leveling network in the two parts of the country in a whole, based on the Krasowski ellipsoid and Gauss-Krueger projection. Elevations are referenced to the mean sea level of the tide gauge Hon Dau, 20 kilometer apart from the harbour Haiphong in the South-East direction. With the assistance of the Soviet Union, aerial photography techniques and equipments can be upgraded, with which aerial photograph supported effectively the production of the 1/50000 and 1/100 000 map series, covering the whole territory of Vietnam. These map series can be regularly updated, based on the interpretation of aerial and satellite imageries. In the same time, large scale map in 1/5000, 1/2000 and 1/1000 scale can be plotted photogrammetrically to support economic development and infra-structure construction.

In 1990, the NDSM worked out a long term planning, aiming at improving the professional capabilities, thus enabling the NDSM to assist effectively economic renovation policies in the country. The keystone of this long term planning is a technology renovation, whereby modern techniques in surveying and mapping, benefited from advanced achievement of space and information sciences, should be applied. Details on this technology development will be described in the following paragraph.

As a consequence of the acceptance of the market economy in Vietnam, agricultural land is allocated to individual farmer or household for exploitation. Thus, cadastral mapping, the only tool used for agricultural and forested land inventory, land registration and land-use certificate issuance, becomes to be of first necessity. The Vietnamese government then decided in 1994 to incorporate the NDSM into the State Department of Land Management (SDLM), thus building up the present General Department of Land Administration (GDLA). GDLA, responsible to the implementation of basic surveying and mapping and land management, is a ministerial, 4-level administrative organisation, namely:

- national level, represented by the GDLA
- provincial level, where a department of land administration (DLA) is built and responsible to surveying, mapping and land management activities in the province.
- district level, where a Bureau of Land Administration (BLA) represents.

- commune level with some two officers of land administration (OLA).
  DLA and OLA take care mostly on cadastral mapping, land use and land management in the locality.

The DGLA spreads out its activities in 3 sectors: state management sector, institutional sector and business sector.
This model of organisation enables the GDLA to mobilize local human and financial resources for the implementation of big surveying and mapping project, especially cadastral mapping project, and in the other hand to be rapidly in account of every change in land use and land management in remote county.

2. ACTUAL STATUS OF THE TECHNOLOGY DEVELOPMENT

The technology development during the last decade (1901-2000), had been intentionally conducted in various application fields for predefined goal:

1. Upgrading the existing geodetic network using precise GPS-measurement techniques
As mentioned above, up to 1990 the unified geodetic network of Vietnam was made up by merging various regional networks, built in different time frame with different techniques and different accuracy level. For example while the triangulation network in North Vietnam was made up mostly by angular measurement using precise optical theodolites, that in South Vietnam was built up mostly by radio-positioning and traverse measurement techniques. In the first phase of the upgrading process, GPS-measurement with the Trimble 4000ST and 4000SST was used to connect regional network into a whole, to test and to improve their regional accuracy, so that a rigorous global adjustment of the national network could be realized. The resulting geodetic network is referenced to the so-called Hanoi-72 Datum, with the Krasowski ellipsoid and the mean sea level of the Hon Dau tide gauge used as elevation datum.

The second phase of the upgrading process consists in building a “0 level” geodetic network, covering the whole territory of Vietnam up to the sea boundaries. The network comprises 83 control points with an average baselength of 70 km, is built up by GPS-dual frequencies measurement. 5 among these 83 control points, namely Ha Noi, Hai Phong, Da Nang, Nha Trang, and Vung Tau had been prepared to be permanent GPS station, used later on for the implementation of the DGPS technology following the MSK Trimble solution. The “0 level” network is referenced to the so-called VN-2000 Datum, with its reference ellipsoid as WGS.84 ellipsoid, its origin at the Hanoi permanent GPS station and UTM projection. The elevation origin remains at the mean sea level of the Hon Dau tide gauge. In July 2000 the VN-2000 had been adopted by the government to be the datum for every surveying and mapping work in the country.

2. Using GPS-controlled aerial photography to secure timely high quality air photos for map production and other users, including the implementation of a GPS-navigation system for photo flight and a GPS system for the determination of the coordinates of the photo projection center. The aerial photography section was equipped with high precision photo camera such as the Zeiss RMK-Top and the Leica RC-30. For photo flight navigation the T-Flight system is used. The photocenter coordinates, acquired in real-time, are post-processed using the program packet PATB-GPS and PATM-GPS

from Inpho-Stuttgart, thus enabling speeding-up the aerotriangulation process with a minimum of ground control points.

3. Implementation of the digital mapping technology, including digital aerotriangulation and digital mapping. For this purpose complete systems are imported and brought in use, such as the photoscanner Zeiss Scai II system, the Match-AT program-packet for the automatic digital aerotriangulation, Intergraph Image Station for image processing, stereo-plotting and map compilation, Intergraph Map-setter 6000 for map production. The complete production line of digital map, from the generation of digital terrain model, orthophoto to map compilation, can be realized. With this system, satellite image of SPOT, Landsat and Radarsat can also be used for map updating.

The above mentioned renovation in map production technology assists actively the generation of a map system for the country, which includes:

- Cadastral map in scale 1/500 and 1/1 000 for urban land, 1/1 000-1/2 000 for urban residential land, 1/2 000-1/5 000 for agricultural land and 1/10 000-1/25 000 for forested land.
- Topographic map in scale 1/10 000 for industrial and coastal zones, 1/25 000 for areas of important rural economy, 1/50 000 and 1/100 000 for the whole country.
- Sea bed topographic map in scale 1/10 000-1/25 000 for the coastal zone, 1/50 000 for the continental shelf, 1/100 000 for offshore fishing zone.

4. Implementation of DGPS techniques to promote hydrographic survey and cadastral mapping. For this purpose, the first permanent GPS station for MSK DGPS technology was established in Hai Phong and its control station in Hanoi. The station transmits DGPS-correction to the rover GPS-receiver, installed on the survey boat, to determine its position while the sea bed is mapped, using single- and dual beam echo-sounder from Odom. Identical permanent GPS station will be constructed this year in Vung Tau, in Da Nang and Nha Trang in 2004 to speed up seabed topographic mapping. RTK-GPS, combined with Total station, are used for large scale engineering and cadastral mapping.

3. PROPECT FOR THE INCOMING DECADE

For technology development in the incoming decade we are aiming at two global objects:

<u>1. Building-up the infrastructure for GIS implementation, including:</u>

– Perfection of the current “0 level” GPS control network, making it higher in accuracy and more robust in configuration structure. Baselenght in the network is scheduled to be lengthened (100-150 km), observed with dual-frequency GPS-receiver (Trimble 4000 SSE and 4000 SSI), post-processed using the program packet Gamit and Bernese. The network has to be rigorously connected to 06 tide gauge stations, regularly distributed along the coast line and to the surrounding IGS points, at least to the points TAIWAN, SHAO (Shanghai-China), LHASA and GUAM.

- Re-observe the 1st.order leveling loop of 5400 km and the 2nd.leveling loop of 8,400 km., connecting leveling legs to a reasonable number of GPS control points.
- Gravimetry observation have to be performed at a sufficient number of bench marks, enabling thus the correction of the non-parallelism of the geoid level and the generation of a national geoid model.
- Working out a national geoid model with a realistic accuracy, necessary to convert ellipsoid height, acquired in GPS measurement, into geoid height.
- Result of the above mentioned undertakings will naturally help to estimate and redefine (if necessary) the national elevation datum.

All these professional activities will be spread out in close conjunction with the PCGIAP (Permanent Committee of GIS Infrastructure for Asia and the Pacific) program on building the precise regional geodetic network for Asia and the Pacific.

2. Elaboration of a National GIS-database

Early in 1995 the elaboration of a national data-base had been planned and approved by the Vietnam government. As a part of this plan, a feasibility study project on the elaboration of the national GIS-database, including land-database, prepared by GDLA, was approved by the National Committee of Information Technology (NCIT) in 1998.

Following-up this approvement, GDLA started carrying out the geographic data standardisation, the GIS/LIS system and network design. The national GIS will be set-up in form of centralized system while the national LIS in form of distributed system. Thus each province (DLA) will possess a LIS for its own, which will be connected in a wide-aera network. The national GIS is scheduled to be completed in 2003, and the national LIS in 2010.

CONCLUSION

The Vietnamese professionals are satisfied with the result of the technology development, evolved in the country in the last decade. They are however firmly convinced that there will be a lot to do in the up-coming years. As mentioned in the beginning, the authors of this paper would like to give a presentation on the actual status of the technology development in surveying and mapping in Vietnam and sketch out a prospect for the near future, aiming at improving the mutual understanding among the FIG-member community, thus widening the way for useful expertise exchange and fruitful cooperation.

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