TECHNOLOGY TRANSFER IN PRODUCTION

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ABSTRACT

PT.NARCON of Bandung, Indonesia and Blom ASA of Oslo Norway, both companies being mapping and surveying companies, joined forces in 1987. The first successful bid for a mapping contract was a World Bank Financed contract for mapping parts of South and East Kalimantan for BAKOSURTANAL, The Indonesian National Mapping Authority. The contract covered Photogrammetric Compilation, Field Compilation, Cartographic Production and Offset Printing of 181 scale 1:50.000 maps.

The first mapping contract was based on analog production methods. There were three foreign experts transferring at that time "modern" mapping technologies to the Indonesia private mapping sector. During this first joined cooperation between the Indonesian and Norwegian private mapping industry a lot of experience were gained for both parties. In a sense there were transfer of technology both ways. The maps to be produced had to be completed within a limited time frame and there was no time to follow Norwegian Training Programs which takes 3 to 4 years for professionals in mapping different disciplines. The only way we could reach the production target was to specialize the operators and break down the routines for quality control into smaller entities.

1. INTRODUCTION

In 1991 BAKOSURTANAL invited the Norwegian mapping industry to make a feasibility study introducing digital basemapping in Indonesia.

The feasibility study focused on scale 1:25.000 and 1:50.000 topographic basemapping. The study concluded that the collection of geographic information should be in digital form and that it was not yet the time to invest in equipment for a digital cartographic production process.

In the last half of 1992 the project " Medium scale Digital Mapping of Jawa, Bali, Nusa Tenggara and Maluku Selatan" was defined by BAKOSURTANAL. The island of Jawa, the most populated area of Indonesia, the island Bali and the islands east of Bali including South Maluku should be mapped at scale 1:25.000. A land area of 216000 km square stretched over a distance of 3000 km was to be mapped.

1662 map sheets had to be produced to cover this area and the project time was to be eight years. The production should include ground control surveying, aerial photography, photogrammetric compilation, field compilation, cartographic processing and ofset printing.

After contract negotiation the mapping contract was awarded to Blom-Narcon Cooperation. During the contract negotiation between BAKOSURTANAL and Blom-Narcon Cooperation it was made clear that BAKOSURTANAL did not accept a partly digital and analog production process. BAKOSURTANAL expected the Contractor to establish a fully digital production line, without any changes to the finance plan for the project.

In mid-April 1993 Blom-Narcon Cooperation received approval to start the execution of the project.

An average of ten foreign experts were allocated for the project, running over 96 months. Four experts were defined as Project Advisory Group to BAKOSURTANAL and Six were defined as Technical Assistance Team for Blom-Narcon Cooperation. Four out of the ten were managerial positions.

The foreign experts working with BAKOSURTANAL were mostly recruited from the Norwegian Mapping Authority and the experts working with Blom-Narcon Cooperation were from the private industry.

The Contractor was to be paid for deliverables, being expert manmonths and units produced and approved. The only way this project could be completed to complete in time and within budget, was to train Indonesian personnel in administration, production and quality control.

2. PRODUCTION VOLUME

Control Point Surveying

188 first order ground control points were to be observed, utilizing GPS and Total Stations.

Aerial Photography

40693 linekilometres had to be flown to cover the area to be mapped with scale 1:30.000 and 1: 50.000 aerial photographs.

Photogrammetry Compilation

9378 stereo models had to be compiled. All geographic information digitized was to be registered in 3D. Nine different landuse classes had to be registered.

Field Compilation

1662 map sheets had to be verified in the field Geographic names should be collected and approved. Administrative boundaries down to "Desa" level should be included in the maps. Roads had to be classified into six different classes and symbols had to be collected for government offices, hospitals, school etc.

Database Establishment

This is an minor activity in the analog map production, but for digital geographic information it is a very significant task. For all the information collected into the database each feature have to have an unique code with reference to the quality and the data collection method used.

Cartographic Processing

The map sheet design, the text and symbols had to be digitally produced. A challenge was to produced a Cartographic product that was similar to the scale 1:25.000 BAKOSURTANAL specification for analog produced maps.

Offset Printing

The 1662 digitally produced maps had to be colour separated into six colour and films for platemaking printed out utilizing an image setter.

3. PROJECT IMPLEMENTATION

Implementation

Blom ASA of Norway chose a conservative technical approach in implementation of this big mapping project.

With a limited time frame and with limited financial recourses, only well tested equipment and software were chosen for the project. In the project there were some money for maintenance and training, but little for new investments.

For a project running over eight years it is very different to predict what shall happen in the technical development in an industry based on computer technology. If investments in new equipment should be made, it had to be proven that this resulted in a productivity gain.

At the time of the project start-up, it were the colour plotters to be used that caused the biggest concern. At the time they were very expensive and needed a lot of service.

All production had to take place in Indonesia and for most Norwegian this is an unfamiliar work environment, with high temperature and high humidity.

Hiring of personnel started in May 1993 and the first shipment of equipment arrived in Indonesia July 1993.

4. TECHNOLOGY TRANSFERE

When the first expatriate experts arrived in Indonesia in June-July 1993 they started their lessons in Bahasa Indonesia at the same time as they worked on manuals for work procedures.

Ground Control Surveying

Trimble 4000SSE GPS receives, Sokkia Totalstations and Tirta Harapan Pressure loggers were to be used. The pressure loggers were used for establishing height control for the islands east of Lombok. About 8000 kms of trigonometric leveling was performed using the Sokkia Total stations.

Prior to the start up of the on going mapping project, the Surveyors from the Indonesian partner, PT. NARCON had no experience within the field of GPS technology. However they had a lot of valuable experience from traditional field surveying, also from remote areas.

Before the start up of the field operations, a course was given comprising of GPS theory, demands for establishing the GPS points and how to make an efficient schedule for GPS observations. Based on this knowledge, the surveying teams were sent to the field to start the establishing of monuments and premark for aerial photography. Parallel to this work, the Supervisors, one for each of the fire field teams, were given additional training.

The placing of the first order ground control points were mainly determine by the flight plan. During the flight mission Kinematic GPS was utilized, this reduced the number of ground control points needed by about 90% compared with methods for aerial triangulation previously used. On the request from BAKOSURTANAL one first order control point was established close to the capital of each Kabupaten.

It was important to have the monuments and premarking in place prior to the start up of aerial photography. Later the GPS observations were made and finally the tidal measurements and the leveling for height control were performed. Before departure for field work about one week of training were given to the surveyors in each of the different activities. All the Surveyors had a lot of on the job training. The biggest challenge during the ground control surveying was the communication between the surveying teams and the transportation in remote areas with very limited infrastructure.

The whole ground control operation was completed within the two first years of the project.

Aerial Photography

The aerial photography for the project was sub-control to the Indonesian company PT.EXSA. Blom-Narcon Cooperation asked the sub-contracted to complete the aerial photography for limited geographic areas (photo blocks) at one time before moving into another area. PT.EXSA however explained that due to the climatic conditions in Indonesia, it was not possible to complete the aerial photography for such a big geographic area within a limited timeframe. Blom-Narcon Cooperation had to accept this fact and workc together with PT.EXSA to establish good routines for utilizing kinematics GPS during flight missions to get an accurate positions for each photo center.

As this in August 1993 was new technology, one expert from the Agriculture University of Norway, Department of Surveying was invited to take part in developing this new technology in Indonesia. The university was asked to support the project in the initial phase to develop quality control system for GPS calculations of the projection centers. Monitoring of the quality and approval of the negative films was a major task for about 12000 aerial photographs. A quality and photo coverage monitoring system was developed using AutoCAD software. The position of photocentres were plotted relative to the flight plan and the quality criteria for both negative film and GPS were monitored together with the photo coverage. Photo laboratory personnel and draftsmen with experience from PT. NARCON were trained to run this monitoring system for photo coverage.

Photogrammetric Compilation

The Aerial triangulation calculations were performed using PATB-RSG software, which the project received as a B release. This project was the first big project where this software was used. Two photogrammetric experts, one from Indonesia and one from Norway went to Germany to get training in using this software.

The photogrammetric section was established in July 1993, the section had four stereo instruments (Zeiss P3) and nine employees. Three of the employees were expatriate experts. Along with the teaching and training activities, production routines were established and operator handbooks written, all based upon the specifications for the project.

Two of the Indonesian employees had newly graduated from University within the field of geodesy and photogrammetry, the other local staff had background from high school or additional course within computer science.

After approximately half a year with training activities and another half year with production under close supervision, new local employees were hired and trained. At this time three additional new stereo instruments arrived, which mean that production could go parallel to the training activities.

The new staff were trained by the senior Indonesian Staff, based on the training programmes made during the initial training period.

It was noticable that the training gave better results when the instructors were fluent in Bahasa Indonesia. After half a year the new photogrammetric operators were in full production.

At peak production in the photogrammetry there were 24 specialized operators working three shifts a day on seven stereo instruments. At peak production about 45 map sheets were produced monthly.

Two photogrammetric instruments were available to the Project Advisory Group at BAKOSURTANAL to perform quality control at the digital geographic information collected.

Field Compilation

The land surveyors with experience from the scale 1:50.000 topographic mapping in East and South Kalimantan were still employed by PT.NARCON. These Surveyors were now active in hiring and training of new young surveyors in field compilation. BAKOSURTANAL have establish routines for field compilation that should be followed by Blom-Narcon Cooperation Surveyors.

The procedures were for the Surveyors to verify the map content for completeness and correctness. The basis for the field compilation was a colour plot that contained all information that were interpreted from the aerial photographs. They should collect all additional geographic information according to the map specifications.

Twenty five Surveyors are at present performing the field compilation and in addition to this five operators are digitizing the field information using AutoCad Software.

The digital information collected during this production process is the geographical names and the additional and corrected geographic information collected in the field.

Quality control routines are established for the geographic information digitized prior to the transfere of the information into the central database.

Database Establishment

This is not on production activity by itself, but a result of the collection of all the digital geographic information produced.

The project has defined different databases which again are basis for quality control, approval and invoicing.

Database "0", is a result of an automatic procedure that have been set up to transfere information collected during photogrammetric compilation to the cartographic editing process. This procedure establish a database per mapsheet. Several preprocessing programs are running to give all information its initial value for date, quality and accuracy.

The batch processing procedures runs round-the-clock, is unmanned and checks for more work every half hour. The hardcopies produced are checked by the photogrammetry section and later they are transferred to the editing archives, along with a MAIL message to notify that the cartographic editing may start. The digital geographic information collected for one map sheet it now at a production level called Database "0" and ready for approval by the Client. The Cartographic editing is divided into three phases, resulting in Database 1, 2 and 3.

They are five local employees running the computer systems in the production office, all trained by the experts on the project plus different courses they have followed outside of the office.

There are running the local network two DEC/VAX server operating under VMS operating system connecting 25 Work Stations. There are one Windows NT server connecting 30 PC's of different capacity.

All back up routines and plotting routines are handled by the computer section.

Cartographic Design

Database 1; the maps are annotated with nine different landuse types and during the batch processing for Database 1 there are generated closed polygons for all area symbols.
Contour lines are generated from a terrain model generated from all 3D information collected during photogrammetric compilation. The contours are manually labeled.
The Database 1 plot in colour shows the complete map legend with patterns and symbols.

Database 2; is generated when the digitized information from field compilation are merged with the Database 1 information. Here the real cartographic work starts with nameplacings and using the correct line signatures and line widths. When the editing of this database is completed and approved by the Client this is regarded as the final geographic database.

Database 3; is produced for the purpose of offset printing. The geographic information produced for Database 3 is sorted according to printing colour and transferred to Corel Draw for final refinements of text fonts, symbols and patters/screens. Check plots are produced for each printing colour and approved by the Client prior to being printed out on an in- house image setter at 2000 dpi.
The production of Cartographic Design employs 30 employees of whom two are expatriate experts. The training of the

Cartographic Operators have been a process over a longer period of time. After leaning the operating system and editing software they have been quickly involved in production. At first they are trained in Database 1 editing and we have found that it takes a minimum of six months to get the operators productive.

After having experience from Database 1 editing the Cartographic Operators are moved to Database 2 editing. Now they are trained in nameplacing etc.

Former Photogrammetric Operators on the project have been given training in cartographic editing and they get a very good knowledge of digital map production.

Plots from Database 2 and Database 3 are internally controlled by experienced Cartographers before sent to the Client for approval.
There are one Quality Controller in the production office that channels the comments from the Client to the responsible production section.

OFFSET PRINTING

The offset printing is sub contracted to a printing office in Jakarta that is operating 24 hours a day. From the Blom-Narcon Cooperation production office the printer receivers reverse reading positive films ready for making printing plates.
Both BAKOSURTANAL and Blom-Narcon Cooperation is active in the quality control at the printing office.