

4.4 Transfer of Technology

4.4.1 GPS precise survey

(1) Baseline Observation for Pacaya Volcano Crustal Movement Survey with GPS Survey Equipment

In this Study, two GPS units included in the equipment and materials provided by JICA were used for the technology transfer.

The contents of the technology transfer were the “national control point network survey” using GPS units, that was indispensable for IGN’s work of redevelopment of the national control point network and “GPS baseline observation for monitoring crustal movement” that was important for INSIVUMEH to acquire the basic data for evaluating an activity of Pacaya Volcano.

The survey results are described below, but this observation survey was carried out with a combination of GPS units of different manufacturers, Ashtech and Trimble, so the measured values might be inaccurate. The errors and reliability of the measured values have to be verified and improved in a future survey. However, the observation and analysis methods will be examined in more detail and will no doubt be referred to in joint with data accumulation work by IGN and INSIVUMEH in future.

In addition, the Study Team gave a lecture on the importance, principles and methods of observation, analysis and assessment in the “crustal movement survey” to IGN and INSIVUMEH. This lecture was undoubtedly useful and will be a milestone for the future study including the technology transfer. The contents of the lecture are described below.



Photo 4.4-1 Confirmation of GPS Observation Method (Jointly by IGN and INSIVUMEH)



Photo 4.4-2 Explanation of baseline observation for the survey of crustal deformation

Table 4.4-1 Survey Result of Baselines for Monitoring Volcanic Activity

Point No.	Point Name	B•L (GMS)	X•Y (m)	H (Ell)
0001	IGN	+14-35-25.448370 -90-31-12.640230	1,613,346.3103 497,826.2223	1,521.6840
1001	Mesillas Bajas	+14-24-49.668589 -90-33-52.671534	1,593,810.7725 493,031.7244	1,563.7703
1002	San Vicente	+14-25-13.927675 -90-38-02.163974	1,594,559.4319 485,560.1047	1,523.7484
1003	El Rabon	+14-21-30.158310 -90-37-22.854587	1,587,682.7782 486,733.6791	1,336.6805
1004	Los Llanos	+14-21-44.782578 -90-34-14.768813	1,588,129.7889 492,368.1894	1,363.1510
1005	Cerro Chino	+14-23-20.507821 -90-36-36.271437	1,591,072.8937 488,130.7605	2,147.2429

WGS-84 and GTM

1) Baseline Observation for Monitoring Volcanic Activity of Pacaya Volcano**< Recommendations for Future Activities >**

- It is important to accumulate observation data and it is necessary to make repeated observations on a regular and irregular basis.
- These plans will largely depend upon the personnel, budget and equipment available from INSIVUMEH and IGN. Therefore, B and C are considered realistic plans.

A General observation

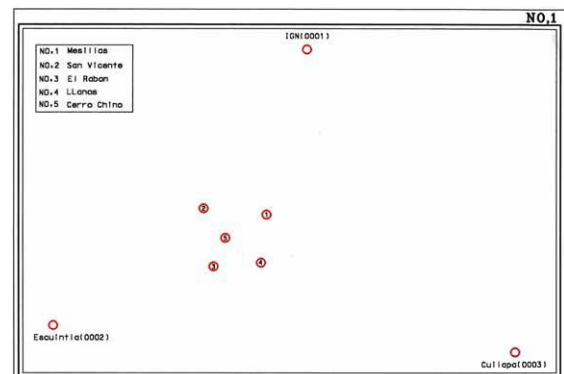
Upper center : Constant observation point
on IGN building

Lower left : Existing triangular point

Lower right : Existing triangular point

- : Observation points at the volcano

(Total: 8 observation points)

**Figure 4.4-1****Observation plan (1)**

B Observation at IGN + 5 volcanic points

Upper center : Constant observation point
on IGN building

- : Observation points at the volcano

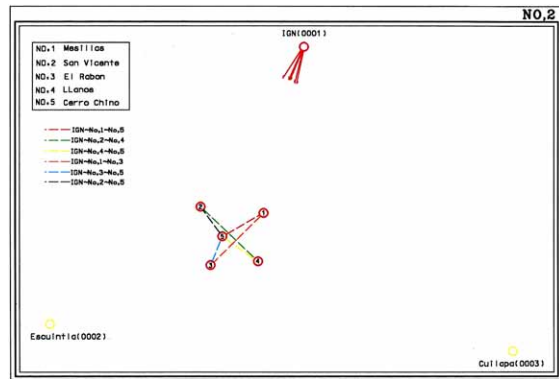


Figure 4.4-2 Observation plan (2)

C Observation at IGN + 4 volcanic points

Upper center : Constant observation point
on IGN building

- : Observation points at the volcano

- ◆ In each observation plan, it is important to use the data from the constant observation point installed on the rooftop of the IGN building.

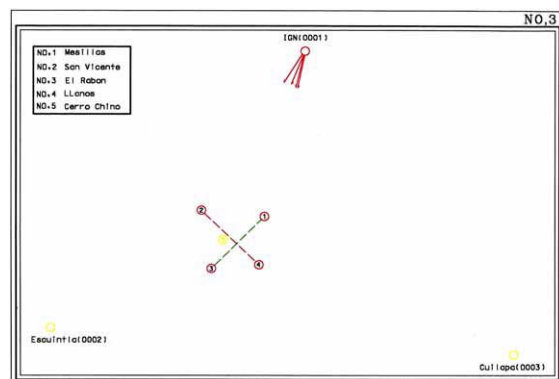


Figure 4.4-3 Observation plan (3)

(2) Recommendations for Future Observation Activities

1) Observation equipment

It is desirable to conduct future observations using the two Trimble GPS units included in the survey equipment procured by JICA and the one Trimble GPS unit installed on the rooftop of the IGN building. As it was made clear at the time of the first observation, it may lower the reliability of the observed data if different types of equipment, such as Ashtech, are combined in the GPS network.

2) Comparison of observed results

- Coordinates of observation points for the volcano obtained on the basis of the observation coordinate on the rooftop of the IGN building as the fixed point.
- Slant distance
- Horizontal distance
- Elevation

* The results of observation and analysis of the above items should be accumulated to

observe any sign of volcanic activity.

- * Differences in the data of the observation points closer to Pacaya Volcano should be observed carefully.

3) Maintenance of perfect accuracy

- Accurate installation of the antenna center (centering)
 - * If observation is performed using the control points installed in July, a tripod must be used to install the GPS antennas. In this case, it is necessary to estimate an installation accuracy of \pm several mm.
- It is appropriate to measure crustal movement with more stress on accuracy than on efficiency and to repeat long-time observations frequently at the points very close to the volcano rather than to measure many sides for a short time.
- In a normal control point survey, the shape of the observation network largely affects the accuracy, but in this baseline observation, it is more important to measure each side with high accuracy rather than to consider the network shape.
- It is important to use the data from the GPS point for constant observation on the rooftop of the IGN building and to conduct the work of observation and analysis of the data by joint cooperation between IGN and INSIVUMEH.

4.4.2 Digital plotting/data compilation

Until now, plotting work at IGN relied solely on the craftsman's skills using a conventional analogue plotter. Computer-controlled, semi-automatic plotting was introduced for the first time using the digital plotter brought in for this Study. This system allows the creation of not only simple line maps but also orthophoto maps, and it has spread rapidly throughout the world in recent years. Its high processing performance is expected to lead to the fast and inexpensive production of maps.

(1) Transfer of technology for aerial triangulation, DEMs, and contouring

The technology transfer for each process was carried out in accordance with the flowchart for actual orthophoto map preparation (Figure 4.4-4). For this purpose, the small Puerto Barrios area was selected as a sample for plotting. The reason for this choice was that in other areas the ground control points were set out with the intention of doing aerial triangulation of a large area, and taking a specific part of one of these areas as a sample was not considered appropriate for the aerial triangulation of a small area.

The Puerto Barrios area was the most suitable as a sample because it is covered by only 6

orthophoto maps and is separate from other areas, so that the ground control points were set out specifically for this area.

The technology transfer schedule is shown in Table 4.4-2. As there were many applicants wishing to participate, the program was implemented by dividing the minimum program necessary for acquisition of the technology (8 days) into 3 cycles. The technology transfer was conducted in accordance with the manual



Photo 4.4-3 A technology transfer seminar

prepared in advance by the Study Team. After each step of the orthophoto mapping process had been demonstrated, the counterparts were asked to perform the same operation.

The participants were mainly staff members of the “Photogrammetry Division”, together with several participants from the “Cartography Division” (Table 4.4-3). The skills level of participants from the “Photogrammetry Division” ranged from those with a high level of knowledge and experience in photogrammetry, to those with little experience.

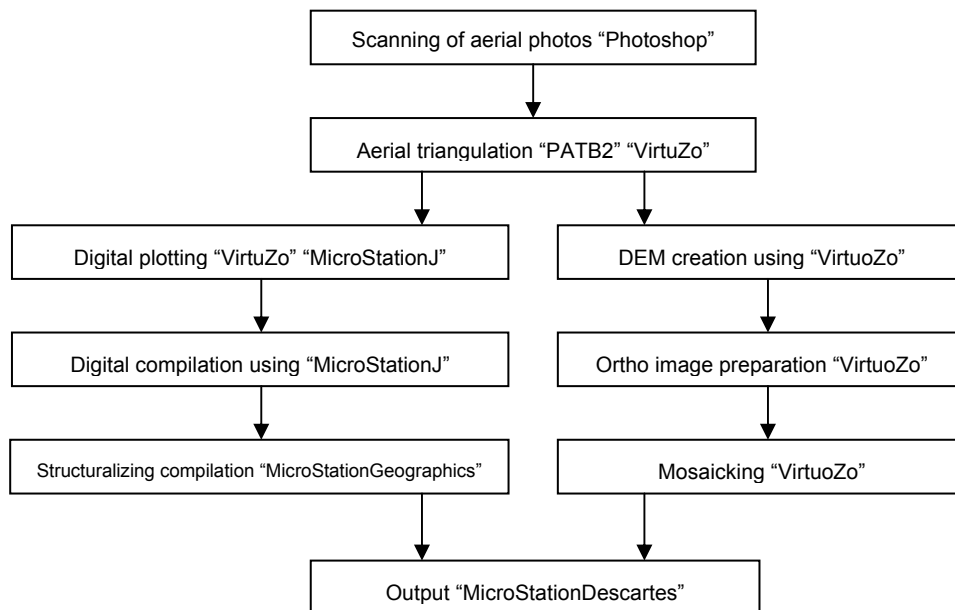


Figure 4.4-4 Flow of orthophoto map creation

Table 4.4-2 Content of technology transfer

	Description
Day 1	<p>General explanation of digital photogrammetry and explanation of this part of the technology transfer.</p> <ol style="list-style-type: none"> 1) Differences between Digital Photogrammetry and past methods, and work flow 2) Functions of the Digital Photogrammetry Workstation 3) Features and resolution of Digital Orthophoto 4) Equipment supplied in this study 5) Work flow for the preparation of the 1:10,000-scale orthophoto maps of Guatemala implemented in this study <p>OJT [Preparation]</p> <ol style="list-style-type: none"> 1) Scanning of aerial photos 2) How to use the scanner and Photoshop
Day 2	<p>OJT [From preparation to extraction of tie points]</p> <ol style="list-style-type: none"> 1) Parameter assignment as preparation for the use of VirtuoZo 2) Importing image data 3) Preparation of image list 4) Interior orientation 5) Strip offset assignment 6) Automatic extraction of tie points
Day 3	<p>OJT [Aerial triangulation]</p> <ol style="list-style-type: none"> 1) Rough adjustment computation using PATB 2) Input of control points 3) Adjustment computation by the Bundle method, using PATB 4) Accuracy control table
Day 4	<p>OJT [Image matching and preparation of ortho images]</p> <ol style="list-style-type: none"> 1) Image matching 2) Preparation for image matching 3) Compilation of results of image matching 4) Preparation of DEM 5) Preparation of ortho images 6) Mosaic
Day 5	<p>OJT [Feature collecting (plotting)]</p> <ol style="list-style-type: none"> 1) Feature collecting (plotting) using IGS 2) Input of planimetric features and contour lines
Day 6	<p>OJT [MicroStationJ]</p> <ol style="list-style-type: none"> 1) Basic operation of MicroStationJ
Day 7	<p>OJT [Plotout]</p> <ol style="list-style-type: none"> 1) Data Export 2) Plot-out using Descartes
Day 8	Q&A

Table 4.4-3 Participants in technology transfer program

	Participants
1st cycle	Luis Fidel Ajanel Mynor Mendizabal Mario E. Maldonado P.
2nd cycle	Elmer R. Estrada P. Jose G. Lopez C. Mario Orellana Regina Menendez
3rd cycle	Erick V. Moino Otto E. Fuentes Sergio A. Valenzuela T. Lesbia Carolina Herrera

< Conclusion >

By and large, the acquisition of technology relating to the creation of orthophoto maps, which was the aim of the present technology transfer program, was achieved. Content included knowledge of digital photogrammetry, aerial triangulation, DEM creation, orthophoto creation, digital plotting and simple digital compilation using the digital photogrammetry system.

Generally speaking, there was a tendency for those engineers with a long experience in plotting to be unaccustomed to operating a PC, while conversely the young engineers who were proficient in PC operation had less experience in plotting. However, this situation is the same in any country, not only Guatemala. It is essential to merge both types of engineers.

“VirtuoZo” is a digital photogrammetry system that is highly valued for its accuracy and speed in automatic matching. On the down side, a disadvantage is that images and vector data are acquired in a unique format, which must



Figure 4.4-5 Existing data + ortho, existing data + new line data, compiled line data + ortho

always be converted when the data is transferred to any other system.

(2) Transfer of technology for topographic mapping and orthophoto creation (part 1)

The technology transfer was carried out in accordance with the flowchart of correction work for the 1:50,000 scale national base maps (Figure 4.4-6). The products from the actual correction work for the national base maps were used as samples for this technology transfer program.

The technology transfer was scheduled as shown in Table 4.4-4, and it was provided in 3 cycles, each cycle taking the minimum necessary period of nine days for gaining the mastery of the technology. The first six days were allotted for the explanation and exercises in the use of the technology. In the remaining three days, the counterparts, on their initiative, reviewed and practiced the technology acquired in the first six days for mastering the technology.

There were many techniques that overlapped with those transferred in the third field survey, but these were not omitted, and were reviewed through lectures and exercises in order to deepen the counterparts' understanding.

The participants were mainly the staff members of "Photogrammetry Division" and one member of "Cartography Division". The list of participants is shown in Table 4.4-5.

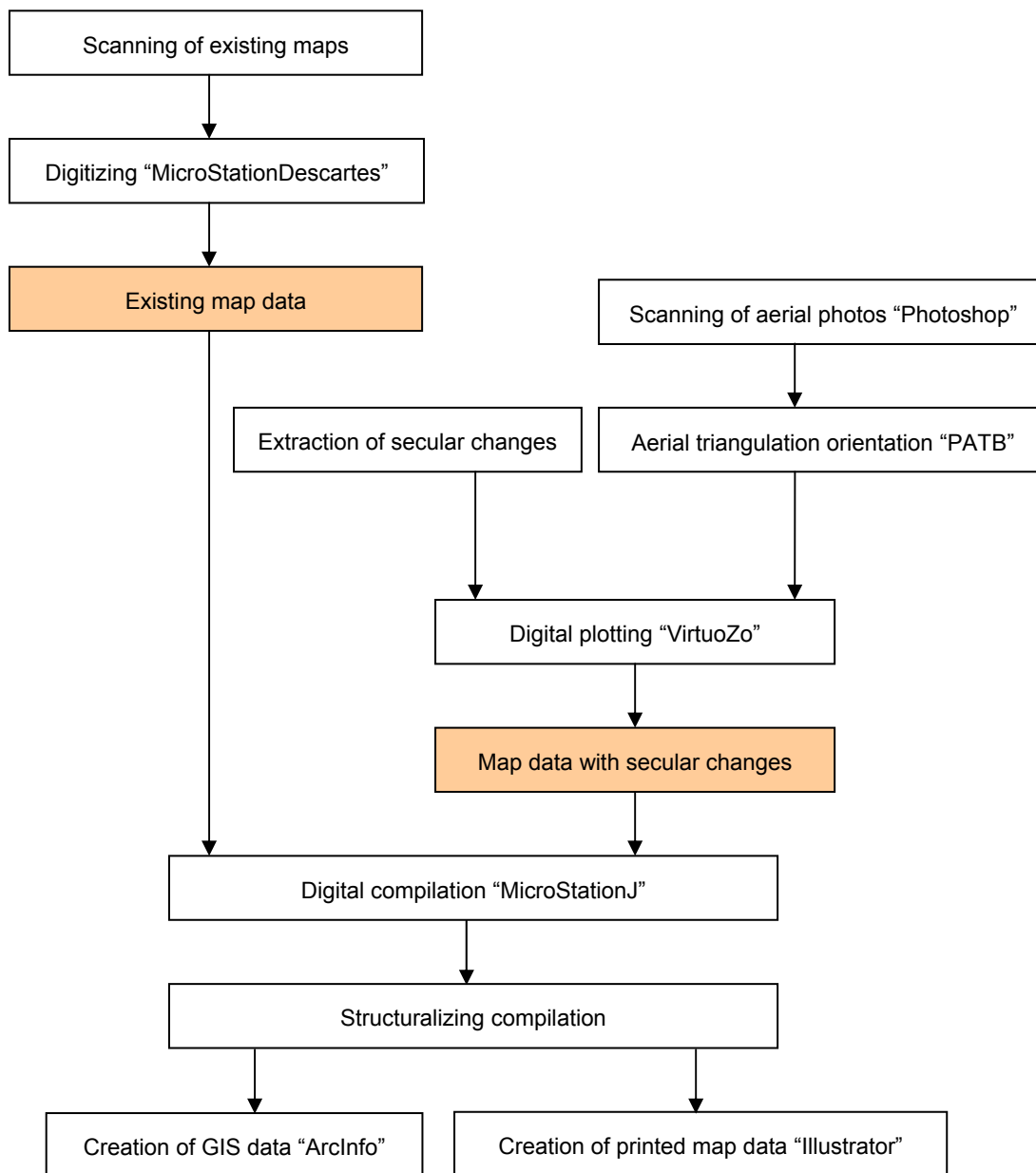


Figure 4.4-6 Flow of correction of secular changes to national base map

Table 4.4-4 Details of technology transfer

Schedule	Outline
1st day	Orientation of a single model The method of orienting a relatively small area as one model without executing aerial triangulation was explained using “VirtuoZo”.
2nd day	Orientation of a single model for the case that the product of aerial triangulation was available The orientation method for the case that aerial triangulation had been conducted was explained. In this case, the products in the work of producing the 1:50,000 scale national base maps were used. “VirtuoZo” was used.
3rd day	Operation of “MicroStationJ” The basic operation procedure of “MicroStationJ” that was acquired in the previous technology transfer was reviewed. Then, the operations necessary for using “MicroStationJ” in the practical work were explained.
4th day	Symbols and special lines The “cells” that were symbols on “MicroStationJ” were created and the method of registering the “cells” in the “Cell Library” and the method of arranging the “cells” were explained. For handling special lines (such as broken lines) on “MicroStationJ”, the method of creating and using special lines by the use of “Patterning” and the method of creating and using special lines by the use of “CustomLine” were explained.
5th day	Digitizing existing maps The method of digitizing the existing map sheets on “MicroStationJ” was explained. The practical operations of “MicroStationDescartes” such as Geo reference to raster data and vectorizing of lines, symbols and texts were explained.
6th day	Secular change corrections to 1:50,000-scale national base maps, establishment of map symbols (data acquisition standard), and digital compilation The method of correcting secular changes in the 1:50,000 scale national base maps was explained. The data acquisition standard and points of caution in producing map sheets from digital data were also explained. The method of compiling the data acquired in digital plotting was also explained.
7th – 9th days	Exercises The counterparts did repeated exercises on the processes of digital plotting, digitizing and digital compilation on their initiative and based on the results of past exercises.

Table 4.4-5 Participants in technology transfer

Course	Participants
1st cycle	Erick. V. Monio Otto E. Fuentes Jose G. Lopez C. Regina Menendez
2nd cycle	Mario E. Maldonado P. Luis Fidel Ajanel Cesar Lopez
3rd cycle	Sergio A. Valenzuela Elmer R. Estrada P. Mynor Mendizabal

< Conclusion >

The technology transfer had so many participants that one cycle was forced to be shortened to a period of nine days.

Only one unit of digital plotter was used for the technology transfer on digital plotting, so that every participant could not operate that one unit of plotter. Based on the reflected points in the previous lecture, however, the latter part of the period of the lecture was used for exercises to ensure that the participants could operate the equipment repeatedly. As a result, they could master the technique for secular change correction.

It was also impressive that the counterpart side had a strong determination to make use of the furnished training for their actual work. The Study Team received many questions after lecture hours and responded to as many as possible in order to help enhance the participants' understanding.

As so many staff members participated in the technology transfer, it was surely effective that the knowledge on digital photogrammetry spread widely among IGN and other related agencies. However, it is also necessary that the participants would pursue the practical work in their individual fields to become experts and to complement one another in their functions.

It was highly valuable that the effective use of these materials and data served to acquire the orthophotos, DEMs and topographic map data on arbitrary areas through simple work. The participants could get familiar with the operation techniques on the 2nd day and for the latter days of exercise. It is expected that various types of data provided and the technology furnished in the technology transfer will have useful effects on the future work of the counterparts.

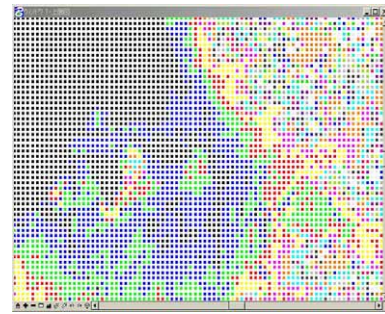


Figure 4.4-7 DEM

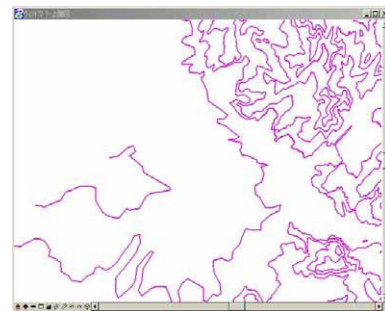


Figure 4.4-8 Contour

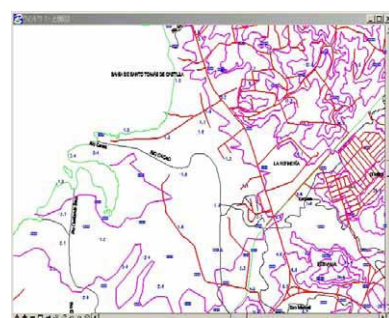


Figure 4.4-9 Vector data



Figure 4.4-10 Mosaic-processed orthophoto



Figure 4.4-11 Integration of orthophoto with vector data

(3) Transfer of technology for topographic mapping and orthophoto creation (part 2)

In this project, the aerial triangulation for multiple models was carried out and all the processes up to orthophoto production were reviewed and exercised. The lecture for these processes was finished in the first lecture, but the technology was not fixed among the counterparts because they had little opportunity of using this technology in their actual activities. Therefore, the practical trainings on the technology were repeated at the second lecture aiming at fixing the most important technology in digital photogrammetry.

In addition, the technology in the method of utilizing the vector data and raster data in the products by the use of MicroStationGeographics and TNT-mips was also transferred to the counterparts. The software used in the second technology transfer included the digital photogrammetric system “VirtuoZo”, the data compilation CAD “MicroStationJ”, the add-on software “MicroStationGeographics” having the GIS-based functions for “MicroStationJ”, the GIS “TNT-mips” and the graphic software “Photoshop”.

The schedule of technology transfer is shown in Table 4.4-6. Orthophoto production was carried out for 3 days, and the operation of MicroStationGeographics and TNT-mips was exercised for the remaining 2 days. All 8 staff members except the managers of Photogrammetry Division participated in the lecture (Table 4.4-7).

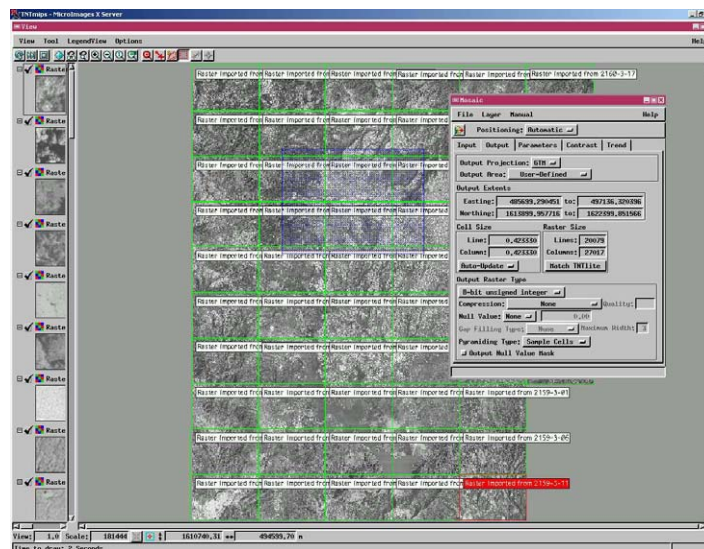


Figure 4.4-12 Mosaicking process using “TNT-mips”

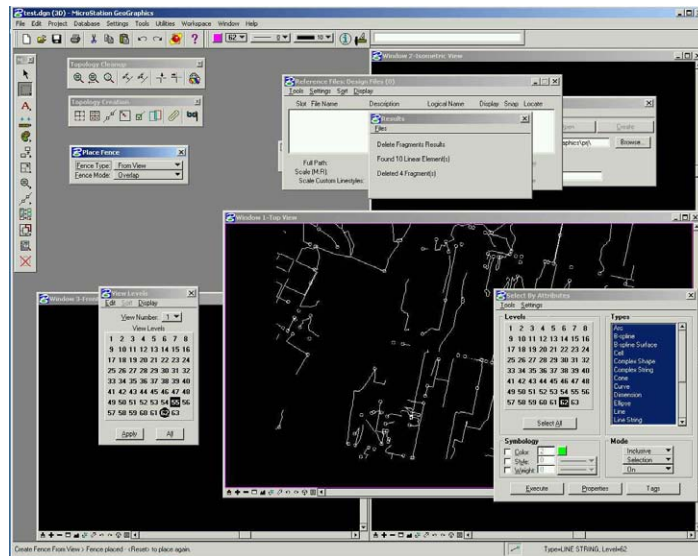


Figure 4.4-13 “MicroStationGeographics” screen

Table 4.4-6 Technology transfer schedule and items

Schedule	Lecture Item
1st day	Orthophoto map production (1) “VirtuoZo” was used in parameter setting, internal orientation and relative orientation.
2nd day	Orthophoto map production (2) “PATB” and “VirtuoZo” were used in entry of ground control points and aerial triangulation (adjustment calculation).
3rd day	Orthophoto map production (3) “VirtuoZo” was used in creation of epipolar images, stereomatching, creation, evaluation and editing of DEMs, orthophoto production and mosaicking.
4th day	Operation of “TNT-mips” (1) “TNT-mips” and “Photoshop” were used in the basic operation of “TNT-mips” and orthophoto mosaicking.
5th day	Operation of “TNT-mips” (2) and operation of “MicroStationJ” “TNT-mips”, “Photoshop” and “MicroStationGerographics” were used in orthophoto mosaicking and vector data cleaning.

Table 4.4-7 Participants in technology transfer

Course	Participant
1st lecture	Otto E. Fuentes Jose G. Lopez C. Mynor Mendizabal
2nd lecture	Sergio A. Valenzuela Elmer R. Estrada P Luis Fidel Ajanel
3rd lecture	Juan Carlos Cesar Lopez

The acknowledgment of orthophoto production technology and the understanding of the software technology for data applications that were the goals of this technology transfer project were achieved. In comparing the 1st and 2nd lectures, it was expected that the counterparts improved their sharp sense on operation and they were never perplexed how to do in the basic operation of software.

However, to fix the technology among the counterparts, it is necessary to increase their opportunity of operating the equipment repeatedly after the technology transfer. In the case of the digital photogrammetry system, only one set of equipment is available, so that the number of persons who can use the equipment is limited. However, it is desirable that they will operate the equipment as repeatedly as possible.

4.4.3 Building of database/analysis of GIS

Technology transfer regarding GIS using a new version of software was started during the third work in Guatemala.

Most of the engineers from the IGN Cartography Division and some engineers from the Photogrammetry Division participated in the GIS technology transfer program. The details of the technology transfer will be described later on.

It should be noted here that 7 engineers from INSIVUMEH, a counterpart agency for the creation of hazard maps, participated in the GIS technology transfer. This showed the strong interest in GIS.



Photo 4.4-4 GIS equipment installed at INSIVUMEH

(1) Transfer of technology for vectorizing, plotting of modifications and DEM creation

1) Level of technology

An understanding of and ability to operate the software necessary for this Project is essential, but in practical terms it is difficult to transfer all



Photo 4.4-5 Lecture participated by INSIVUMEH

necessary techniques and skills to all the counterpart staff.

In order for the participants to master all the techniques required in this project to develop the topographic maps and GIS database, ideally an intensive technology transfer program should be provided for participants who have some familiarity with computers, after which those participants would transfer the acquired technology to other participants.

However, after the situation had been explained and discussed with IGN, the Study Team received a strong request from IGN for the technology transfer to target not those participants familiar with computer operation, but beginners. The reason given was that if the technology was available to only some of the engineers it might be lost, because of the low stability of the work force in Guatemala.



Figure 4.4-14 **Samples of GIS application**

2) Conclusion

In the third field survey, technology transfer was concerned with relatively basic matters. The problem was that when the technology transfer targets all the participants, it is not possible to pass on everything, so that only a limited content was passed on. This was because it was surmised that the participants did not have much interest in the conceptual side of things. For engineers, who specialize in the conventional handicraft-type techniques and tasks, the most interesting thing seems to be jobs in which they can actually use their hands. Based on this observation, it was decided that starting from the fourth field survey, the method was changed to one promoting intuitive understanding through as much practical work as possible.

(2) Technology transfer on structuralization/GIS application

1) Outline

Based on the experiences of the technology transfer carried out in the third field survey, in the fourth field study, skills for practical operation and data compilation were transferred. The final goal of this lecture was to master the technology to convert the

MicroStation Design File into the ArcInfo Coverage format.

The process of converting the MicroStation Design File into the ArcInfo Coverage format was a very important part of this Project. For complete understanding of this process, the participants had to be well versed not only in the characteristics of both the Design File and Coverage and the differences between the two, but also in the conversion process.

2) Conclusion

Throughout the technology transfer programs so far, a real problem has been the limited time period, together with the participants' level of proficiency in and enthusiasm for computers.

In actual terms, understanding of the technology transfer differed considerably depending upon the level of proficiency.

(3) Transfer of technology in structuralization/GIS application (data correction) – conversion into printing data

1) General

The technology transfer in the fifth field survey was made for items complementary to those found in the fourth field survey and the processes till their conversion into printing data based on the technology transfer of the fourth field survey. The level of technology transferred in the fourth field survey was high and it was difficult for some of the trainees to fully understand all matters. It was thus unavoidable to review the training items in the technology transfer in the fifth field survey. As a result, the technology transfer in the fifth field survey covered a wide range of items from data structuralization to data conversion into printing data.

The training courses including the review training were prepared for all the trainees, among whom engineers with relatively high skill level were selected for the transfer of the technology in the data correction and conversion into printing data that were the original purpose of the technology transfer. The purpose was to cover any problems with data structuralization, acquiring the correction methods to solve those problems and converting the corrected data into printing data.

2) Schedule of technology transfer

a. Basic course – Review of data structuralization

The lectures were scheduled for 4 weeks in a cycle of 5 days per week. The first 3

days concerned mainly the review of the technology transfer items in the fourth field survey (understanding of ARCINFO data structure and acquisition of the structuralizing method). For the last two days, the work of converting MicroStation data into ARCINFO data was undertaken. In this course, the technology transfer was achieved so that trainees be able to recognize the difference of the GIS data from the CAD data explained in the former technology transfer training through the practical work of data conversion.

b. Advanced course – Data correction and conversion into printing data

For the last three days (full days) in the fifth field survey, the transfer of technology in data correction and conversion into printing data was carried out to 5 engineers with high qualifications.

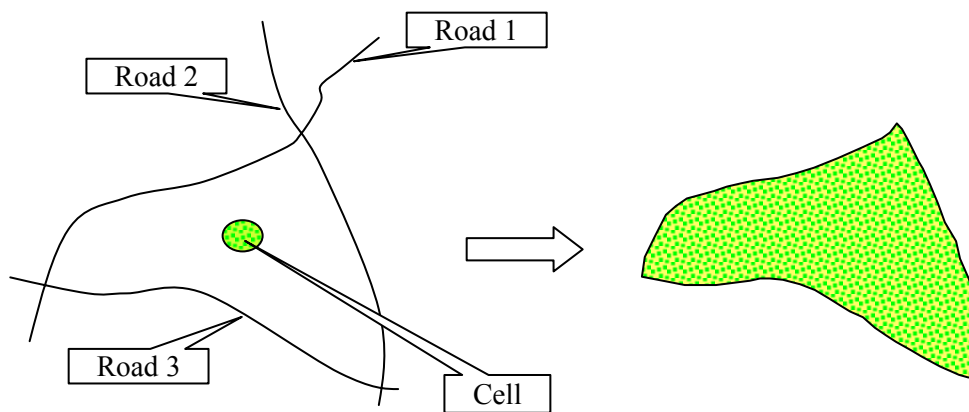


Figure 4.4-15 Reconfiguration of GIS polygon from an area on topographic map

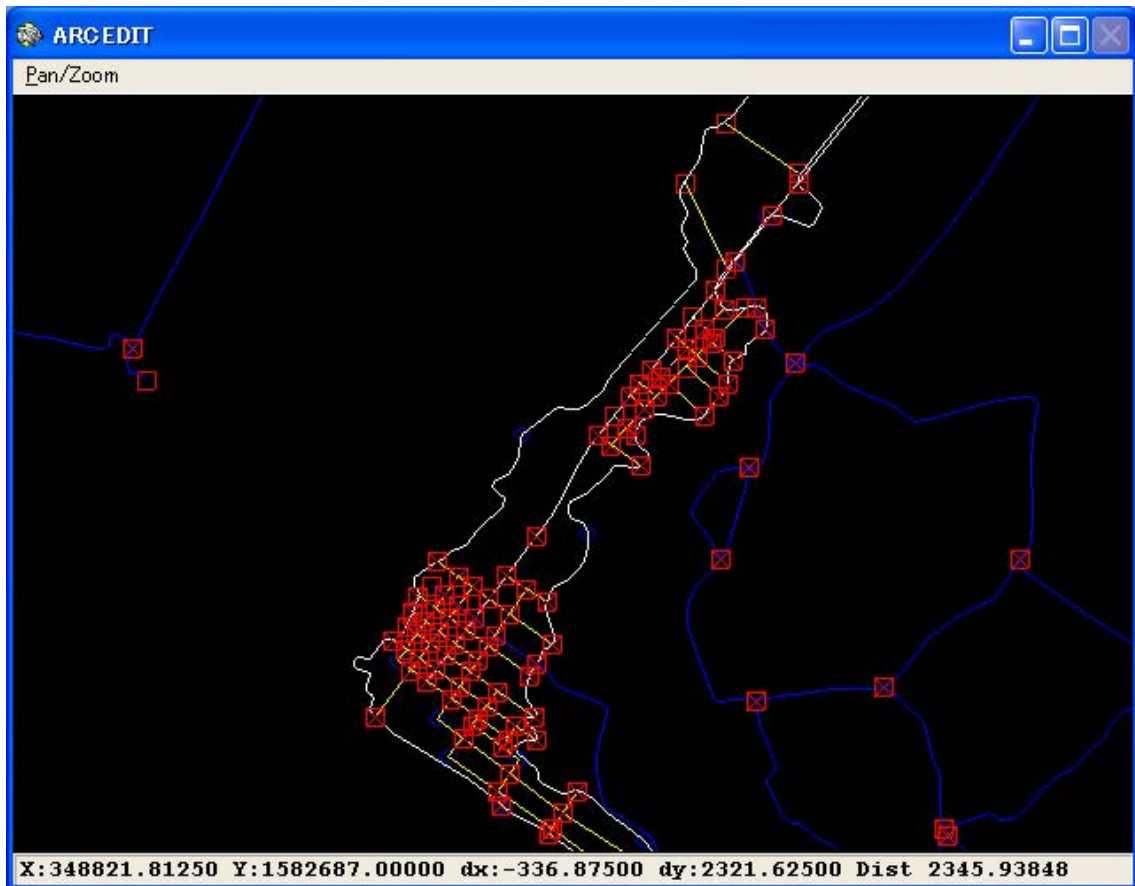


Figure 4.4-16 Error display on ARC/INFO

3) Theme

The problems occurring through this project related to the technical level of engineers and their level unmatched with the required technical level.

As described previously, the mobility of workers is high in Guatemala and it is also undeniable that a certain technology acquired by specific staff members in IGN had not been spread in IGN and run out of it often. Therefore, the Study Team was informed of the intention of the Cartography Division, as counterpart of technology transfer, to have the technology be transferred to all staff members.

The technology transfer in this project was undertaken according to their intention, but the actual progress of technology transfer depended upon the technical levels of the staff.

4.4.4 Digital printing

Twelve engineers from the IGN Cartography Division participated in this technology transfer program. Up until now the production of master plates for printing at IGN was all done using analogue technology, and the technology for the production of master printing plates

from digital data was transferred to the engineers for the first time under the present project..

In training, the engineers learned how to process printed map data converted from the spatial basic information database and to prepare the topographic map data with the same map representations as in the printed maps. Many of the participants showed a strong interest in the fact that digital processing alone made possible the same map representations as conventional methods, and they worked hard to acquire the new digital technology.

(1) Transfer of technology for map symbolization and digital compilation (part 1)

1) Outline

IGN, who had used only analog technology for printing, has no experience in this work, despite the high demand for technology transfer. To meet this demand, the technology transfer was done by preparing the practical manual and by using the hardware and software of the study equipment.



Photo 4.4-6 A technology transfer

In the technology transfer in the fourth field survey, the basic operation of Adobe Illustrator, which is the graphic software used for map symbolization and digital compilation, and an exercise to create the printed map data of the 1:50,000-scale national base maps were taken up. For the basic operation of the software, the basic software application method was explained and an exercise was done so those IGN counterparts could master the technology.

In the exercise of creating the printed map data, the data converted from the spatial basic information database was processed to create the national base mapping data, which was the same map representation as the printed map. It was the part of the national base maps except for the marginal information outside the neat lines.

The technology transfer was carried out three times within seven days. For the first period of three days, the lecture and practice exercise of the basic operation of AdobeIllustrator were conducted, and for the second period of four days, the exercise of processing the printed map data was conducted using a sample data. This technology transfer program was provided to 13 counterparts in the Cartography Division.

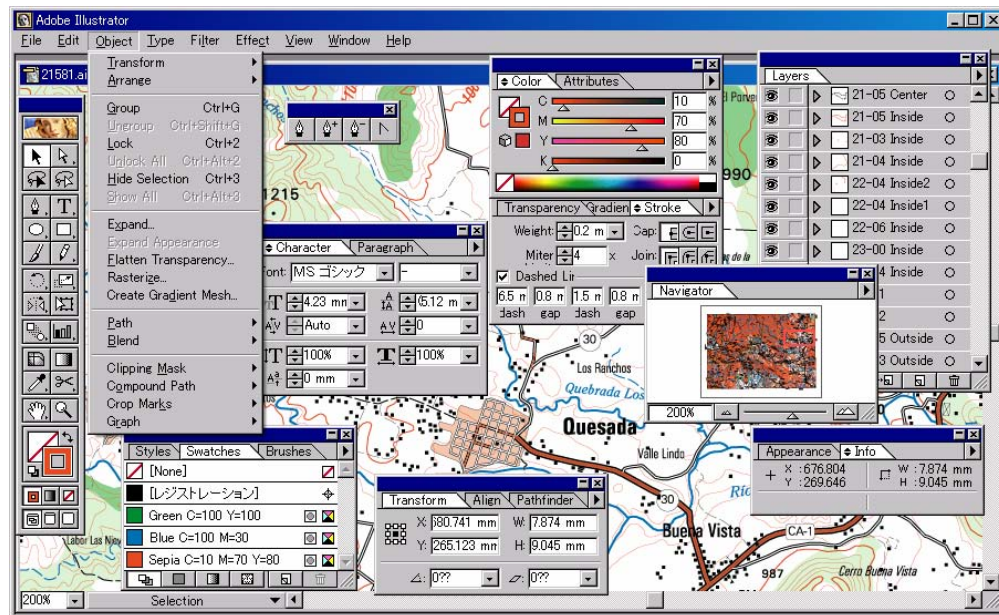


Figure 4.4-17 Data processing using Adobe Illustrator

2) Counterparts' understanding in technology transfer

In the technology transfer program in this study, it is expected that all of 13 counterparts have understood and acquired the technology, though in different levels, because 11 members of them could operate the software in the environment of one PC set per member.

Not only the engineers who had been engaged in digitization using PC, but also those who had been in charge of analog drafting using Scribe, were interested in the process of creating printing plates from digital data. The study team was impressed with their positive attitude to cope with the exercises. The participation of many staff members of Cartography Division served to establish the technology of digital mapping and map symbolization/digital compilation using AdobeIllustrator as the common knowledge to IGN.

In creating the mapping data for printed maps, the individual counterparts were different in their abilities in the work processes as described above, but it was expected that all of them could understand these processes because they accomplished all the exercises. In particular, they fully understood the layer classification and paint assignment through

repeated exercises.

(2) Transfer of technology for map symbolization and digital compilation (part 2)

1) Outline

In the technology transfer in the fifth field survey, stress was placed on acquisition of the basic operation of software together with the review of the work flow in the last lecture including the explanation of digital printing flow and environment. For a better understanding of the software, the graphic design skill was also explained.

Trainees: 13 members of Cartography Division (divided into two groups of 7 members and 6 members)

Schedule: 10 days (3 hours/day) per group for all work processes

1st to 5th day – Lecture and practical training on basic operation of AdobeIllustrator

6th to 8th day – Practical training of printing data processing using sample data

9th day – Practical training of marginal information processing

10th day – Rechecking of important items

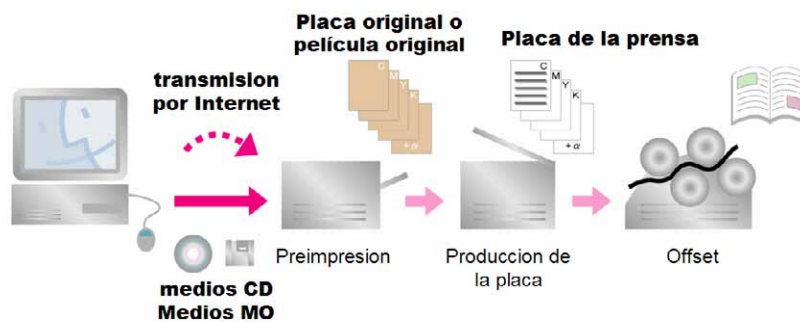


Figure 4.4-18 Digital printing process

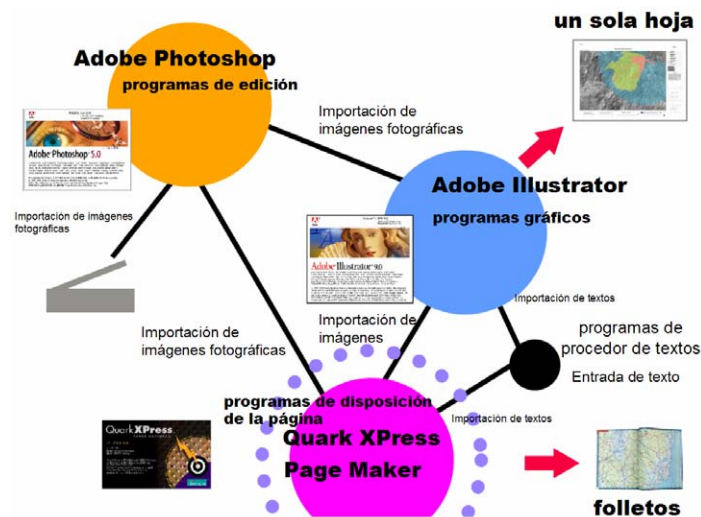


Figure 4.4-19 Main software used in DTP and data flow

2) Counterparts' Understanding on Technology Transfer

This second technology transfer was undertaken in an environment in which each participant could operate one personal computer. Thus, it was expected that the counterparts could understand the transferred technology better than in the last lecture.

As the outline and environment of digital printing by DTP was explained, it appeared that the importance of the map symbolization/digital compilation using AdobeIllustrator was well recognized by the trainees.

Their skills in PC operation on AdobeIllustrator and their speeds in acquisition are different individually, but it is sure that almost all the trainees could master the basic operation of the software through the lectures performed. However, it is the nearest way of fixing the technology among the counterparts that they will practice the technology in their actual works and repeat trial and error processes to solve various problems. Such efforts will depend upon their own attitude.

In order to solve any unclear points or problems only by using the existing manual (English version attached to the software), the Spanish-English Table of Menu Commands was distributed to them. It is expected that the table will be useful for their work.

4.4.5 Technology transfer

INSIVUMEH created hazard maps in the past. The volcanic hazard maps, in particular, include those created by INSIVUMEH on its own and those created in cooperation with donor organizations. However, it was the first time for the organization to create hazard maps through simulation on a full-fledged basis.

The JICA study team carried out the transfer of technologies for creating disaster maps, geomorphological maps, and other disaster cause maps to be used as the foundation for hazard maps to be created. Furthermore, collaborative work was undertaken to produce basic data and establish the estimation parameters for simulation. Also, a discussion was held on methods of hazard evaluation and verification of results. Finally, the team carried out the transfer of technologies for managing the collected and organized data and hazard maps using GIS. Table 4.4-8 shows the description of technology transfer concerning hazard maps.

Table 4.4-8 Technology transfer (concerning hazard maps)

Technology transfer item	Period	Transfer method
Flow of creating hazard maps	February 2001	Techniques and results using specific examples have been explained.
Photograph interpretation technique for geomorphological maps	June 2001	We determined the items to be identified through photograph interpretation for each disaster and performed the photograph interpretation while showing examples of interpretation.
Disaster history survey method	From May to July 2001, June 2002	A survey on floods on rivers due to Hurricane Mitch has been made and we showed how to produce disaster maps.
Creation of basic data to be used to create hazard maps	From May to July 2001, June 2002	We collected and organized in collaboration geomorphological, geological, seismological, volcanic, and hydrologic data.
Establishment of simulation parameters	June 2002	The algorithm of simulation has been explained and the necessary data and parameters were examined in collaboration.
Verification of hazard maps	June 2003	We introduced preliminary hazard maps and evaluated and verified the results.
Preparation for and holding of hazard map seminars	June and October 2003	JICA study team prepared for presentations on hazard maps while INSIVUMEH prepared for those on disaster environment in Guatemala, and seminars was held.
Utilization of hazard maps for disaster prevention	June and October 2003	We discussed on the method to understand and utilize the hazard maps. In particular, we helped the concerned local government staff to understand the importance of education.

4.4.6 GIS/Hazard map seminar

◆ OBJECTIVES OF THE SEMINAR

(GIS)

To make known the practical use and application of GIS of 1:50,000 and 1:10,000, for the purpose of promoting the efficient use of the data for the benefit of economic and social development of Guatemala especially in the rehabilitation of the immediate areas of the Peace Zone.

(Hazard Map)

To make the population conscious about the methods of disaster prevention and to promote among institutions of the same theme the elaboration of the strategy for the utilization of GIS and the hazard maps in the Central America with the participation of CEPREDENAC and its members.

◆ EXPECTED RESULTS

The institutions will know the existence, use and application of GIS and hazard maps for the utilization thereafter.

(1) Plenary meeting

◆ PROGRAMME

19 June, Convention Center, Rooms “Esmeralda” and “Oro”, Plenary Meeting for the Opening

09:00	Registration and Opening
10:00	Speech by Japanese Ambassador, Mr. Kagefumi Ueno
10:15	Speech by the Minister of Communications, Infrastructure and Housing, Licenciada Flora de Ramos
10:30	Speech by Vice Secretary for the Global and Sector Policies, President’s Office for Plan and Programme, Lic. Jorge Mario Calvillo Loaiza
10:45	Introduction about the Project by Mr. Hideki Yokoyama, representing JICA, Tokyo
11:00	Coffee break
11:15	Speech by Director General of Instituto Geografico Nacional-ING- Ing. Manuel Hernandez Valenzuela
11:30	Speech by Director General of Instituto de Sismologia, Vulcanologia, Meteorologia e Hidrologia –INSIVUMEH- Ing. Eddy Sanchez
11:45	“Practice of the disaster prevention and GIS in Japan” by Ing. Kazuo Furukata, Chief, JICA Study Team
12:30	Lunch

4.4 Transfer of Technology

- 14:00 Presentation on the result of Project, by Dr. Valerio Gutierrez, JICA Study Team
- 14:20 **“Proposal for the disaster prevention planning”** by Ing. Satoru Tsukamoto, JICA Study Team
- 15:00 **“Utilization of GIS for the fighting against Shagas Disease”** by Mr. Ken Hashimoto, JICA/OPS
- 15:20 **“The Mission of NIMA in Central America, the Guatemalan Model”** by Mr. Glenn T. Ramsey, Regional Officer, Agencia Nacional de Imagenes y Cartografia - NIMA-
- 15:40 **“Utilization of GIS in the poverty maps”** by Ing. Ricardo Miyares, Seccretaria de Planificacion y Programacion de la Presidencia - SEGEPLAN-
- 16:00 Coffee break
- 16:20 **“Outline of disaster prevention with hazard maps in the Republic of Guatemala”** by Ing. Alejandro Maldonado, Secretary General of CONRED
- 16:40 **“Strategy of Disaster Prevention in the Caribbean”** by Dr. Jacob Opadeyi, Asesor Tecnico Regional of CDERA
- 17:00 **“Strategy of Disaster Prevention in the Central America”** by Mr. Tsuneki Hori, JICA expert for CEPREDENAC and Geog. Douglas Salgado, JICA expert (recruited from Third Country) for CEPREDENAC
- 17:20 Closure of the 1st day seminar, by Mr. Masami Shukunobe, representing JICA in Guatemala

(2) GIS meeting

20 June, Room “Petenitza”, Cartography and GIS

- 08:30 Registration and Opening
- 09:00 Speech by Ing. Manuel Hernandez, Director General of IGN
- 09:15 **“Digital photogrammetry for GIS”** by Mr. Jorge Mansilla, Chief of the Photogrammetry Division, IGN
- 09:45 **“Establishment of database and application of GIS”** by Ing. Marcos Sutuc, Chief of the Cartography Division, IGN
- 10:15 **“Introduction to the National Strategy of GIS”** by Ing. Jorge Roldan, UVG
- 10:45 Coffee break
- 11:00 **“Utilization of orthophoto for generating disaster data base”** by Ing. Mynor Garcika y Ms. Julia Galindo, UTJ-PROTIERRA Escuintla
- 11:30 **“Methods and products of System for digital restitution”** by Ing. Noboru Fukushima, JICA Study Team
- 12:15 **“Procedures for development of GIS database from cartographics”** by Ing. Daisaku Kiyota, JICA Study Team
- 13:00 Lunch
- 14:15 Cartographic Publication. **“Procedures for producing printed maps from GIS data base”**
-

- by Ing. Yoshimitsu Fukumoto, JICA Study Team
- 15:00 Application of GIS. **“Improvement of social conditions and poverty in the high lands of the north-western region”** by Ing. Chiyo Kigasawa, JICA Study Team
- 15:45 Coffee break
- 16:00 Application of GIS. **“Development of Infrastructure and Conservation of Environment in the Peace Zone”** by Ing. Daisaku Kiyota, JICA Study Team
- 16:45 Questions and Answers
- 17:15 Closure of the seminar by Ing. Furukata, Chief of JICA Study Team

(3) Hazard meeting

20 June, Room “Atitlan”, Hazard Map and Disaster Reduction

- 08:00 Registration and Opening
- 09:00 Speech by Ing. Eddy Sanchez, Director of INSIVUMEH
- 09:15 **“Mission, disasters in Guatemala and application of GIS”** by Lic. Enrique Molina, Coordinator of Geophigics, INSIVUMEH
- 10:00 **“Utilization of GIS Data for Formulation of Strategies of Land-use Regulation”** by Ing. Jose Miguel Duro, PEDM/MAGA
- 10:45 Coffee break
- 11:00 **“Project for the coordination of hazard maps”** by Ing. Satoru Tsukamoto, JICA Study Team
- 11:20 **“Geomorphology Investigation and Disasters”** by Ing. Hiroyoshi Ishikawa, JICA Study Team

◆ Methods, results and applications of hazard maps

- 12:00 **“Seismic hazard”** by Ing. Toshiyuki Matsumoto, JICA Study Team
- 12:50 Lunch
- 14:00 **“Volcanic hazard”** by Ing. Hitoshi Takeuchi, JICA Study Team
- 14:50 **“Landslide hazard”** by Dr. Valerio Gutierrez, JICA Study Team
- 15:20 **“Inundation Hazard”** by Ing. Hiroyoshi Ishikawa, JICA Study Team
- 15:50 Coffee break
- 16:05 **“Hazard maps and counter measures against disaster”** by Ing. Satoru Tsukamoto, JICA Study Team
- 16:45 Questions and Answers
- 17:15 Closure of the seminar, by Ing. Satoru Tsukamoto, JICA Study Team

4.4.7 Evaluation of Technology Transfer Training by Participants

We requested the IGN staff participating in the technology transfer training to fill out a questionnaire to evaluate the training as a maiden attempt. We not only requested for an evaluation of the contents of training that they had just received but also asked, since the end of the Project was approaching, such questions as whether they were confident about continuously using the technologies they have learned in the past sessions.

(1) Questions in Evaluation Questionnaire

The participants were asked to answer all the questions on a 1-to-5 scale (where 1=Not Satisfied, 2=Not Very Satisfied, 3=OK, 4=Satisfied, and 5=Very Satisfied) and check-mark an appropriate symbol on the questionnaire. We also provided columns in which they could write specific comments if any. Table 4.4-9 shows the list of questions.

Table 4.4-9 List of questions

Q1: Length of the course
Q2: Depth of each of the technical topic
Q3: Variety of technical topics
Q4: Speed of the course
Q5: Lecturer demonstration
Q6: Handout materials
Q7: Exercises during the course
Q8: Translation

Questions 1 to 3 were general questions on a technology transfer training course: Whether the course duration was long enough, whether each of the technical topics was discussed deeply enough, and whether the course covered a sufficient number of technical topics. Questions 4 to 8 concerned evaluation on the lecturers in charge. These questions asked how much the participants were satisfied with the speed of the course, demonstrations that lecturers gave in class, handout materials, hands-on exercises in class, and interpretation.

(2) Respondents in the Evaluation Questionnaire

We conducted questionnaires to the participants in the following technology transfer courses and collected their answers.

Participants in the digital photogrammetry course	8
Participants in the GIS operation course	11
Participants in the digital printing course	11

(3) Results of Evaluation Questionnaire

We collected and summed up the answers for questionnaires from a total of 30 participants of all the courses. Figure 4.4-20 shows the results. The horizontal axis shows the question numbers, which correspond to Questions 1 to 8 in Table 4.4-9. The vertical axis shows the ratio of each

answer among the 30 participants in total.

In Figure 4.4-20, the longer the red and orange bars, the more dissatisfied the participants; the longer the yellow, green, and blue bars, the more satisfied the participants.

We received some specific comments stating that the course duration was too short and that the training was too fast. These comments corresponded well with the fact that the participants were relatively more dissatisfied with “length of the course” (Q1 in the questionnaire), “depth of each of the technical topic” (Q2), “speed of the course” (Q4), and “exercises during the courses” (Q7). We gathered that the participants wanted the courses to be longer, each of the technical topics to be discussed more deeply, and more exercises to be provided to them during the courses.

On the other hand, a relatively high percentage of participants were satisfied with the technical topics covered in the training. This may reveal the dilemma that, though the technical topics were interesting, they were provided with too short a duration in which they could master them.

The participants were highly satisfied with the demonstrations given by the lecturers in the courses, available handout materials, and Spanish interpretation provided during the courses.

In conclusion, the lessons given in the training and the performance of the lecturers enjoyed a high level of satisfaction but the participants thought that the training duration was too short and wanted to take time to learn technologies including more hands-on exercises. While a relatively high percentage of participants replied that the lessons progressed too fast, more than 30% of participants felt that the technical topics must be discussed more deeply. This fact indicates that the technological levels of participants have been polarized. The participants who were not very familiar with technical topics covered in the training had a difficulty to keep up with the lessons while those who had a certain level of experience and knowledge wanted the technical topics to be discussed more deeply.

To improve the level of satisfaction for all the participants, it will be necessary to group them by technical levels, provide different lessons for different levels, and give training in a longer duration. Realistically, however, it is difficult to implement this idea due to time and cost constraints of the project. Thus, we need to expect each of the IGN staff to learn the basic technologies in training and further improve their capabilities through their own efforts. Furthermore, we hope that the IGN staff members with different levels will share knowledge and experiences through their own efforts for an improvement of their overall capabilities.

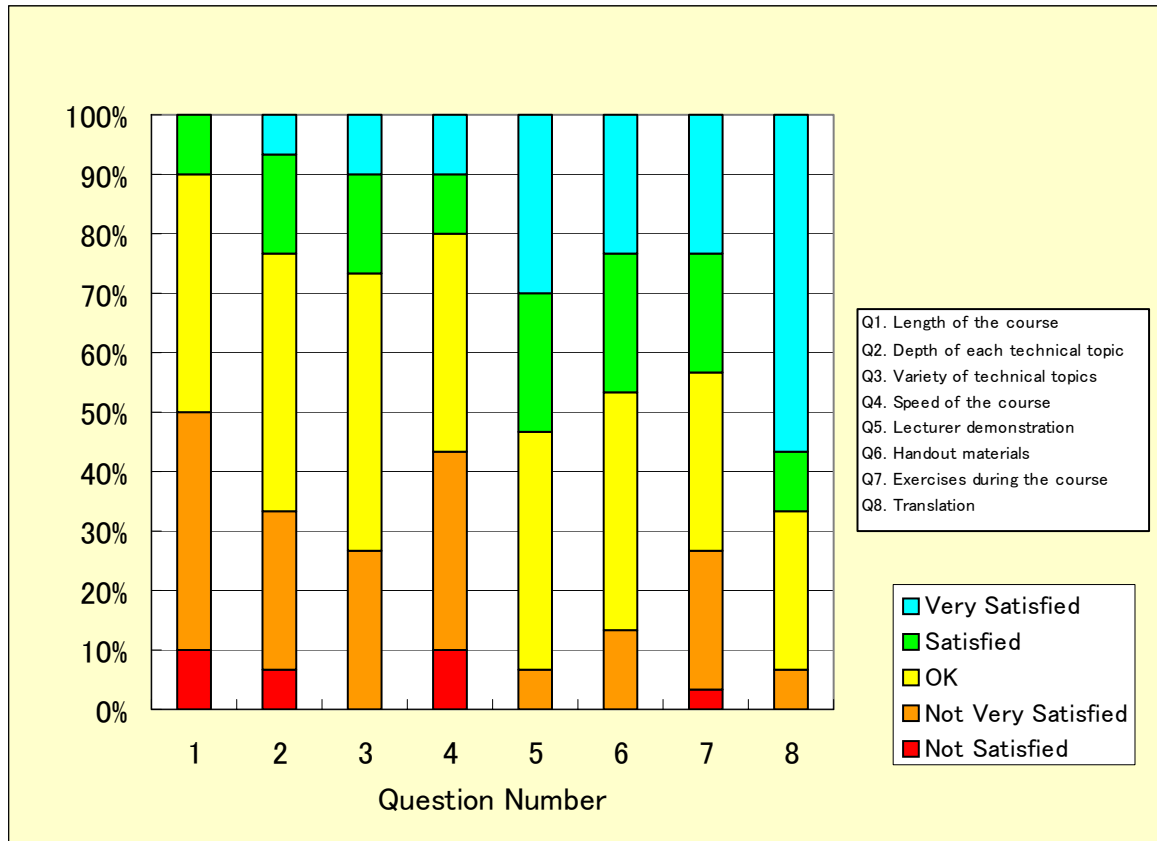


Figure 4.4-20 Technical Transfer Course Evaluation

(4) Self-evaluation of Participants

We requested the participants to evaluate themselves as well as the training by asking questions, how much they understand the content of training and whether they are confident of utilizing the content of training in their actual work. Figure 4.4-21 and Figure 4.4-22 show the results.

Figure 4.4-21 shows the result of the participant's self-evaluation of their understanding on a 1-to-5 scale: Not Well, Not Very Well, OK, Well, and Very Well. The vertical axis shows the number of respondents. This result shows that a majority of the participants thought that they understood the content of training in their self-evaluation.

Figure 4.4-22 shows the result of the participant's self-evaluation of their confidence in utilizing for themselves what they learned in training on a 1-to-5 scale: Not Confident, Not Very Confident, OK, Confident, Very Confident. The participants who answered that they were "not very confident" or "not confident" added up to eight, accounting for more than one-fourth of the total.

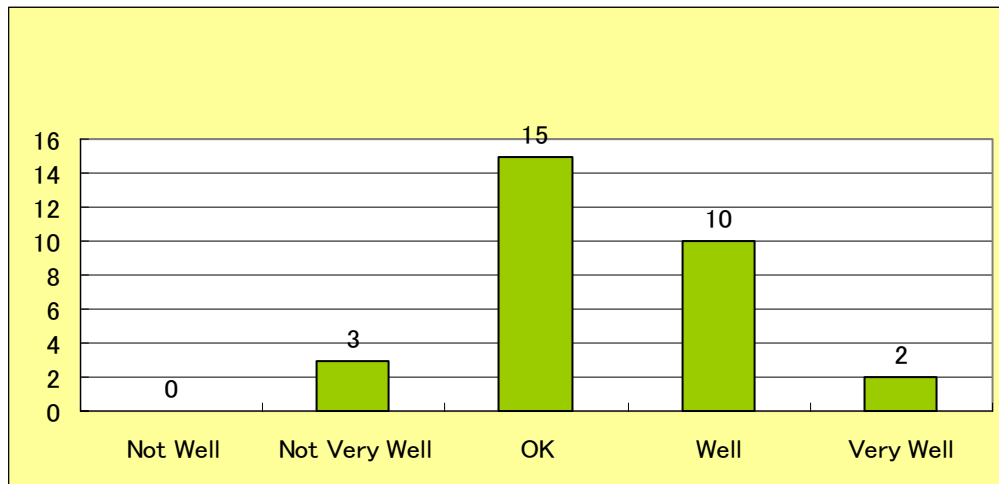


Figure 4.4-21 Self Evaluation by the participants [Your Level of UNDERSTANDING]

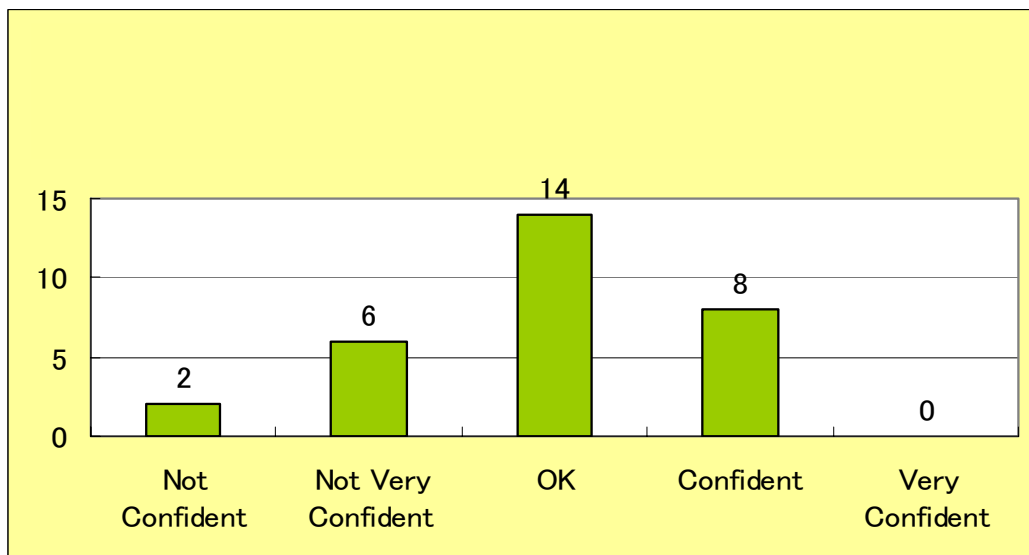


Figure 4.4-22 Self Evaluation by the participants [Your CONFIDENCE in carrying out the tasks you learnt from the trainings]

(5) Conclusion

The main purpose of technology transfer is to allow IGN, even after the end of the project, to persistently utilize equipment and software for themselves and apply and further develop the technologies that they learned in the Project.

It is thus very important for the Study Team to thoroughly examine the content of training, format of lectures, duration, and audience so that the each of the participants from the counterparts will be confident when utilizing what they have learnt in their actual work.

These results must be reflected in a technology transfer plan to be established in all the future projects.