

ANNEX 8

GIS APPLICATION SYSTEM DESIGN AND DEVELOPMENT

**THE STUDY
ON
THE IRRIGATORS ASSOCIATION STRENGTHENING PROJECT
IN
NATIONAL IRRIGATION SYSTEMS**

ANNEX 8

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DEVELOPMENT**

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ANNEX 8 GIS APPLICATION SYSTEM DESIGN AND DEVELOPMENT

1 Existing System Design and Utilization

The JICA-funded Study on “The Strengthening of NIA's Management System” completed in October 2001 created a GIS database containing relevant details on NISs, NIPs and CISs. Each GIS database is composed of ESRI Arcview GIS 3.2 (Single User with Hardware Key), Microsoft Access 2000 and Microsoft Excel 2000. The GIS database is divided into two (2) main systems: (a) System A and (b) System B.

System A's database has as a primary source of geographic information of existing NAMRIA's 1:50,000 scale topographic maps. Approximately 330 of these topographic maps, prepared in planimetric and contour data were digitized to serve as the base data for this GIS system. System A established a uniform structured database (both graphical and tabular data) for all of the existing NISs as shown in Figure 1.1.

System B's database was also based on the 1:50,000 scale topographic maps, including a 1:4000 scale topographic and parcellary map covering a pilot area of 1,000 ha located in UPRIS Division 3. The pilot area covered detailed information on five (5) IAs was designed to monitor water management activities through ISF collection data.

The GIS database was essentially meant to centralize storage system for all relevant information pertaining to existing NIS projects. The GIS database contains the General Layout Maps (GLM) of each system, and relevant tabular data stored in one MS Access file. This single GIS database minimized non-uniformity of maps, redundant plans and reports from the different system and regional offices. NIA is expected to improve its operation by streamlining the regular and basic reporting and monitoring activities.

The appropriate trainings and the final GIS databases (hardware and software) were distributed to four (4) NIA departments. These are Corplan, SMD, PDD and the UPRIS Regional Office.

2 Current Utilization of Database and GIS Application Systems and Results on NIA-GIS Working Committee

2.1 Current Utilization of Database and GIS Application Systems

The four departments were given the needed software, but are not fully utilizing the system. Figure 2.1 shows the schematic diagram of the present system. The end-user was supposed to use the GIS database on a regular basis for updating of system information. This updated GIS database could then be used to generate the needed reports. Based on present information, no updating activities were performed due to the following:

- 1) NIA's reporting system does not rely on the MS Access database software

The present GIS database is built around the MS Access database software. NIA's reports are generally done using MS Excel and Word and therefore are not familiar with the operation of Access. This difference in software system results in minimal usage of the GIS database.

- 2) The departments which have accessed to the system do not need the full GIS database for their everyday functions.

The four departments on their own do not need all the functions present in the GIS database. Even with the given training, the present system is still a bit complicated for the common user. This difficulty then results in minimal and irregular usage.

- 3) Insufficient number of software licenses

The system is dependent on the Arcview software. A hardware key locks each software. Therefore given the present setup, at any given time only 4 people can actually use the GIS database.

- 4) Insufficient number of personnel assigned to operate the system

A database administrator is needed to maintain and update on a regular basis each of the 4 separate systems. At present, each of the 4 departments does not have a specific person to perform this task.

- 5) Not fully utilizing the existing Local Area Network (LAN) for the GIS database

The efficient use of a LAN would help in the regular updating and maintenance of the 4 systems. By placing the different reports generated by the different departments in a central file server, redundant copies of the same report can be eliminated thereby guaranteeing data integrity across the four (4) systems.

2.2 Results on GIS Committee Workshop

A GIS Committee Workshop was held on 02 October 2002 to discuss the following:

- Verify the constraints for the use of the present GIS
- Prepare action plans based on proposals of the JICA Study Team

Representatives from Corplan, PDD, SMD and UPRIIS were invited to attend the meeting to give some direct input on the existing system's usability and directions to follow to improve the overall functionality of the GIS to cater to NIA's needs.

Department	GIS Utilization	Reason Given
<i>PDD</i>	partial	Different coordinate system with their other data PDD is more concerned with new NIS
SMD	no	Not compatible with their existing reporting system
Corplan	no	Person trained on the system has resigned
UPRIIS	partial	Lack of manpower

During the discussions, it was realized that the present GIS database was built on several software packages that are not commonly being used by NIA. Database systems in NIA are not strictly databases. Tabular data are stored using Excel but they serve more for the visual presentation of the data.

In order for NIA to use the GIS database on a daily basis, the system must be made simple and software costs must be minimal if not free. An alternative solution was the introduction of a GIS viewer. There are several viewers available which can read Arcview files but ArcExplorer was recommended to the 4 NIA departments. The main reasons being free of cost and this viewer was also developed by ESRI. The following general objectives were agreed upon before adjournment of the meeting:

- 1) NIA will try to create a uniform structure for their daily reporting system.
- 2) JICA Study Team will give the 4 departments digital copies of individual MS Access Database tables exported to MS Excel so that NIA can understand the format needed to update the existing database.
- 3) The 4 departments will provide the JICA Study Team a copy of their consolidated monthly report.

The JICA Study Team requested that the 4 departments pool together their existing Arcview licenses so that users who want to use the system can do so without having to borrow the hardware key from other departments who are not using the GIS Database.

3 GIS Application System Design

The JICA Study Team integrated the following additional data on the existing system:

- 1) IA Inventory Matrix – contains general data on existing 2047 Irrigators Association throughout the country.
- 2) Facilities Status Survey – contains information on the general status of canals and structures found in each NIS.

Additional customization features was developed to properly access and analyze these data.

The GIS maintenance work can be divided into the following: The outline of the database construction and updating procedures are explained below:

3.1 Process of GIS Construction.

3.1.1 Flow of Construction of Database.

The GIS application system is built from two databases, a figure database and an attribute database.

- a) Construction of a figure database.

In order to draw the boundary line of an IA, a NIS map covering the IA is printed on paper using existing digital map data. This drawing is distributed to the

concerned NIS. The drawings in which there were additions and revisions to IA boundaries are collected and these are digitized to create the needed digital data. (Ref. to Figure 3.1)

b) Construction of an attribute database.

Two data (IA Inventory Matrix and Facilities Status Survey) are new data which will be added to the existing database. Any revisions are encoded into the database. (Ref. to Figure 3.1)

3.1.2 Construction of GIS Application System.

New functions were added to the existing system which will display and query data concerning IA boundary and the two new attribute table, i.e IA Inventory Matrix and Facilities Status Survey. The creation procedure is as follows. (Ref. to Figure3.2)

- a) The outline of the design, the flow of data processing and the logical relationships between data structures were drawn up.
- b) Based on an outline design, the detailed design for human interface such as a screen design, a list design, etc., was created.
- c) Based on the design specifications, the program was subdivided into laer structures.
- d) Based on the program design specifications, a new program was created.
- e) The program function was verified.

3.1.3 Outline of Updating.

SYSTEM A is composed of a figure database and an attribute database. The figure database is managed by Arcview which is a GIS software. Data in this GIS are separated into layers based on their type and attribute. Updating can be done using built-in deleting and editing functions in Arcview. The attribute database is managed by ACCESS which is a database software. Updating can be done using built-in deleting and editing functions in Access. Every IA item in the Inventory Matrix table can be updated using these functions. However, the use of batch processing to update this table is also possible. Updating can be done using the IMPORT and EXPORT functions found in Access. (Ref. to Figure 3.3)

3.2 Display function from Database (IA Inventory Matrix and Facilities Status)

Existing functions in System A were integrated with new database. These new functions have displaying the relationship between IA and the canal structures within its areas. The outline of the new functions is as follows:

- 1) After specifying the region from the whole Philippines, all related general layout maps (GLM) are displayed.
- 2) After specifying an IA name from a list of IA, the GLM covering the selected IA is displayed together with other related IAs.

- 3) After selecting an IA figure or canal structure from the GLM, the concerns information is displayed on the form of MS Excess file.
- 4) Based on an IA's characteristic color-coded thematic map is created and displayed.
- 5) Other relevant IA data is queried and displayed.

4 Prototype of GIS Application Outputs

One major focus of the present Study Team is to provide alternative methods that will encourage the use of the present GIS Database. There were several reasons which caused minimal utilization of the system. Limited licenses for both Arcview GIS and MS Access and incompatibility of the GIS database with existing reporting system are two major reasons.

In order to solve these constraints, that NIA use dissemination of a GIS viewer – ArcExplorer is recommended. This viewer is a license free software from ESRI which has the capability to open the existing file formats found in System A & B. It was found that digital and printed maps of the NIS were required by the head, regional and NIS offices. The ArcExplorer viewer has the following basic capabilities:

- Print Function
- Thematic legend classification
- Simple search capability (i.e. IA Name, Canal Name, NIS Name, etc.)
- On Screen Distance Measurement (i.e. actual ground distance between map features using mouse clicks)
- Export to image function (Jpeg format)

These functions will immediately eliminate the software bottleneck problem which currently hampers the GIS Database usage. The print function will enable NIA to print new and updated maps and distribute them to the regional and NIS level offices. Coming from a single source, these maps will therefore eliminate the previous problem of non-unified map specifications. The export to image function will also enable NIA to include data and map image in their daily reporting procedures that rely heavily on MS Word or MS Excel. (Ref. to Figure 4.1)

5 NIA Organizational Arrangements and Action Plan

In order for NIA to utilize the GIS database, NIA staff concerns need to be encourage using the system on a daily basis. There has been comments that not enough training was given to the users. It must be understood that training in any field is not a one-time endeavor. The training was to give the user a view of the capability of the GIS database. The database was designed initially to help improve on NIA's map management and record keeping procedures. It has many functions built into it that may not be applicable to all users. The general concept was that some users will find a function which will help him in his daily routine. In order for NIA to improve on its information management system, the following are recommended:

- 1) Each of the 4 NIA departments shall assign a database manager to file and

manage the different reports and maps that their departments produce on a regular basis. This will help eliminate a duplicate copy that often leads to data integrity questions.

- 2) Encourage the shift from manual record keeping to computer-based systems. Each department shall have a policy to encourage the use of computer systems as against manual procedures. The two methods can be used in parallel in the beginning to help the users understand the benefits of the computer-based system over his usual routine.

Daily use of a new system will lead to better understanding of its functions. The initial training for the system is only intended to give the user a view of its capabilities. The user will only learn the system if he regularly uses it even for very simple tasks. In order for NIA to use the existing GIS database, the following are recommended:

- 1) Provide an alternative to the more expensive ESRI Arcview software.

Most users of the GIS database will only need to view the existing maps that are provided in the system. However, due to the limited number of Arcview software licenses a number of users is limited at a number of licenses. An alternative to these situation is the free Arcexplorer viewer. This viewer has the basic capability to view, export and print NIS related maps from both system A & B. Analysis functions however are very limited.

- 2) Teach NIA staff a simpler way to update the GIS Database

The existing GIS Database was not updated since its introduction in 2001. It was only during the course of this follow-up Study that new data were added and revised. One reason given was that NIA staff are not familiar in using MS Access in their reporting procedures. MS Access is the main database system behind the GIS. Majority use MS Excel in their daily routines. Reviewing the digital copy of their records, it was revealed that their formats were not uniform. They were only interested in the visual presentation of their data. Everything in the database has to follow a certain format (i.e., cell location, width, number, value, etc.).

The initial suggestion given was to provide a link between existing Excel files and Access. This would be ideal if NIA did not change their Excel format. Their forms and reports kept on changing depending on the need to add or remove data. If this is the given conditions then there will be a constant need to edit the linking program when Excel file was changed. On the other hand, the existing Access database is constant in its format.

The better solution would be for NIA to follow the Access format even if the editing of data was done in Excel. Access provides a built-in Export-Import function to Excel. All tables can be exported to several versions of Excel. It is recommended that NIA staff use this exported Excel file to edit and add their new data. The exported Excel file is properly formatted following the Access table

format. This will therefore eliminate format compatibility problems between the two software. The edited Excel file can then be imported into Access. (Ref. to Figure 5.1)

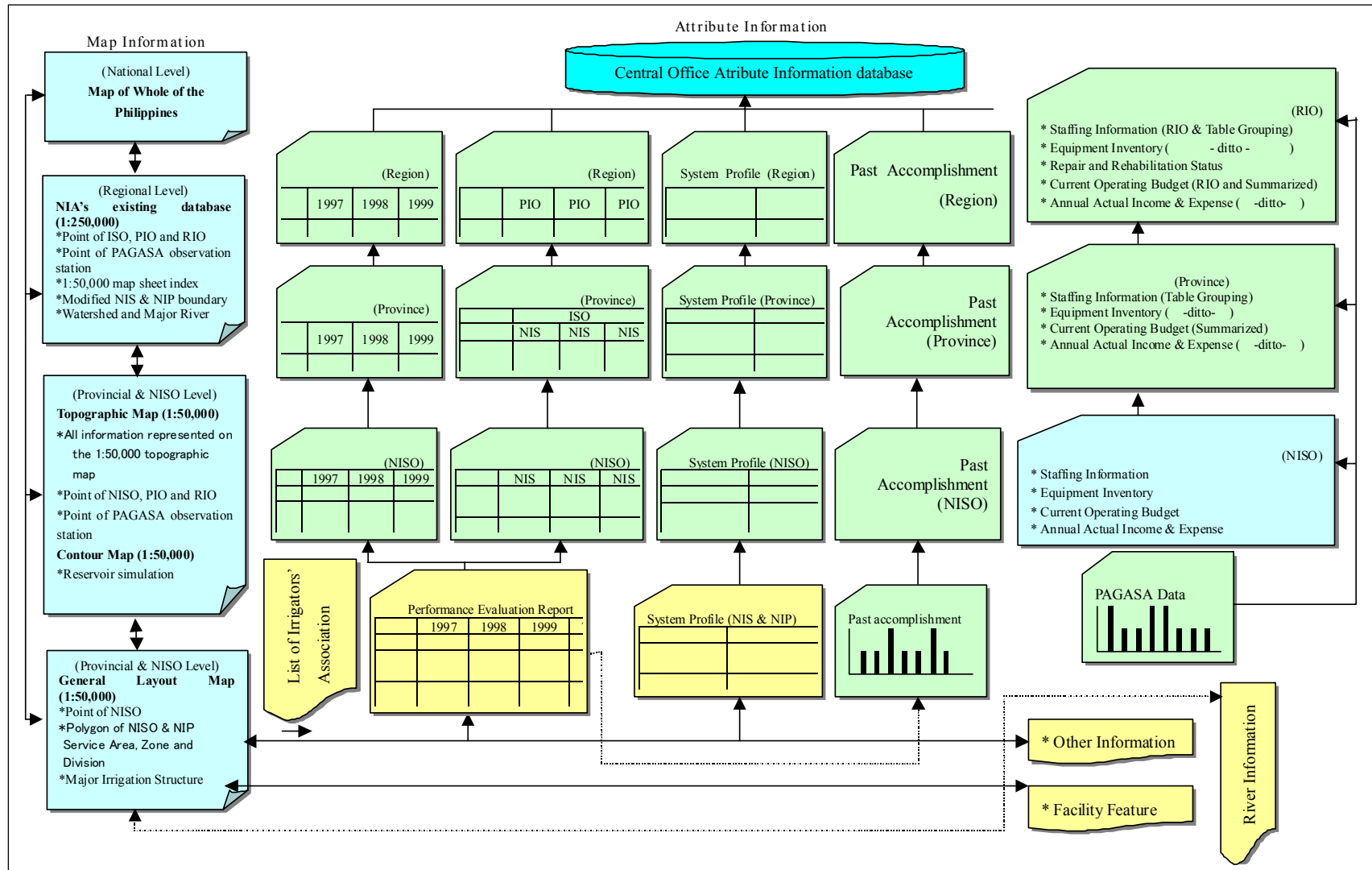


Figure 1.1 Type of Output and Schematic Flowchart of User Interface (1:50,000 GIS Database System A)

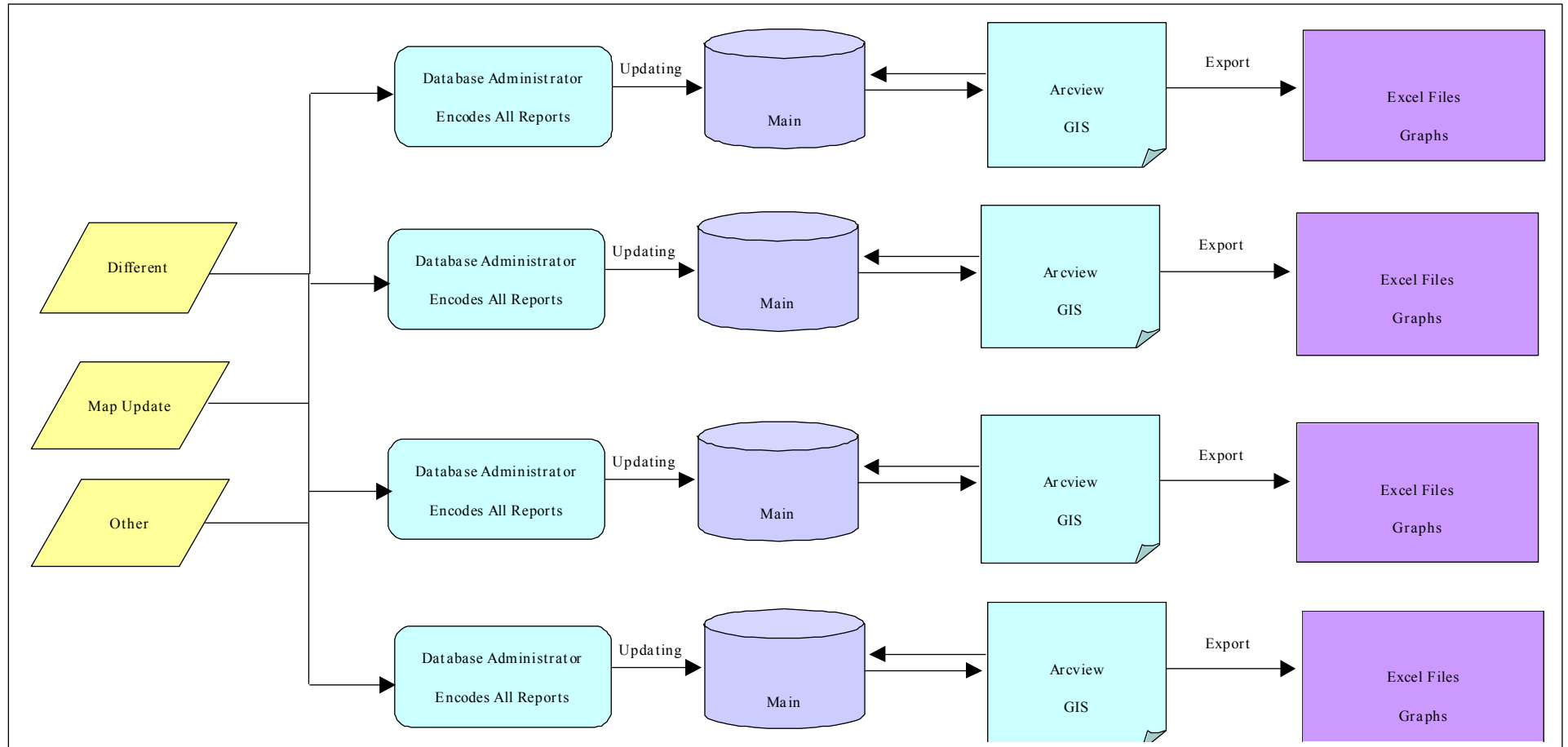


Figure 2.1 Present GIS Updating Procedure

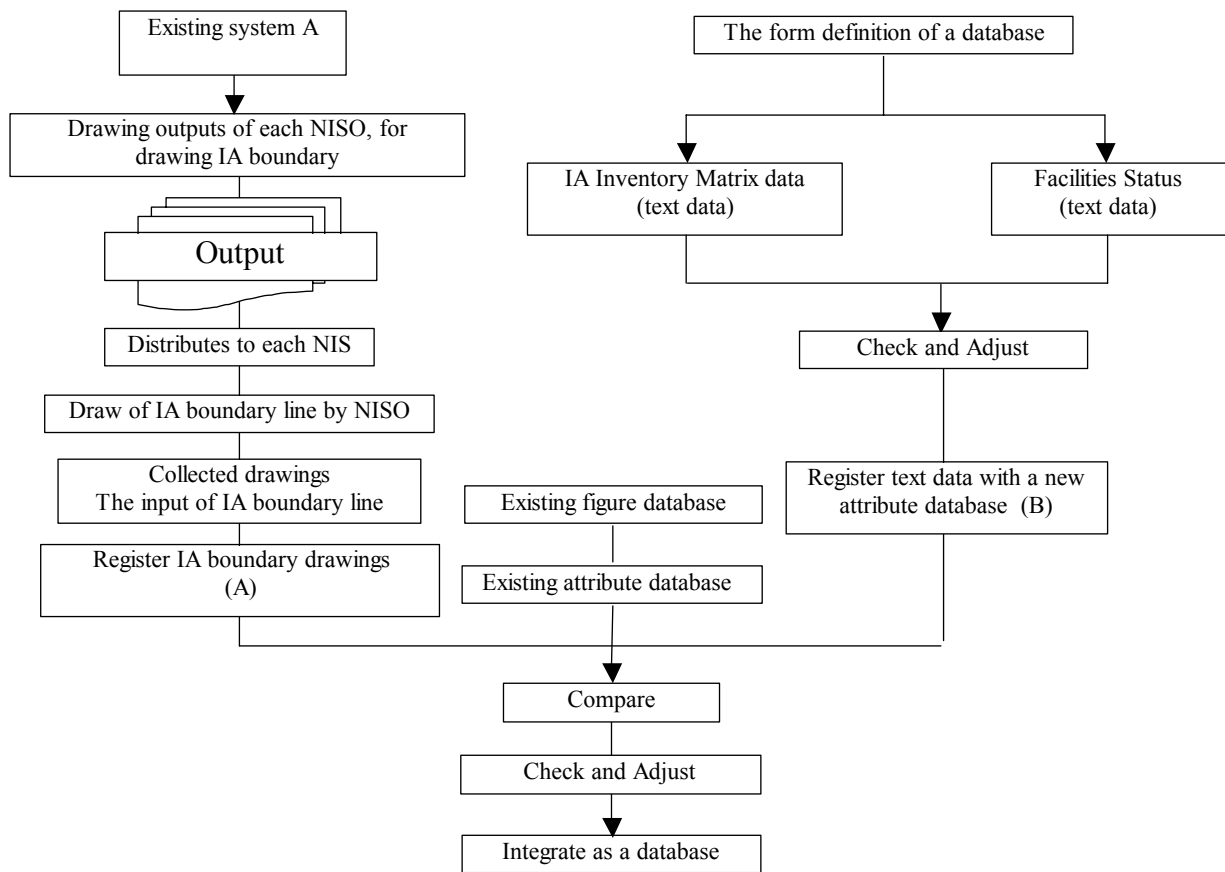


Figure 3.1 Flow of Construction of Database

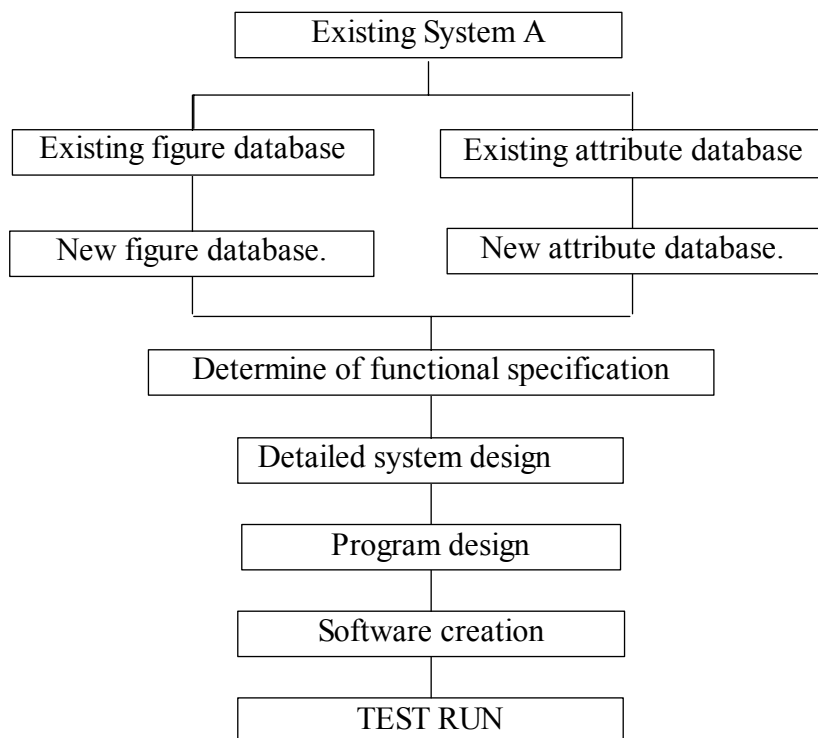


Figure 3.2 Flow of Construction of GIS Application System.

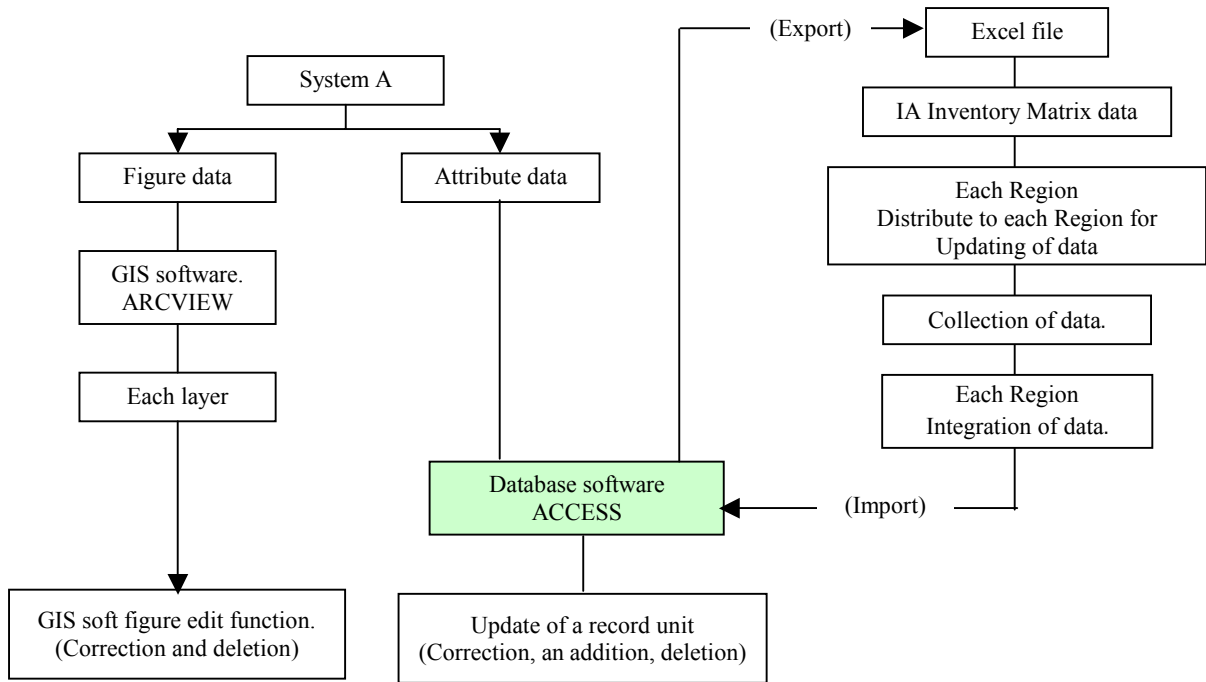


Figure 3.3 Outline for Updating

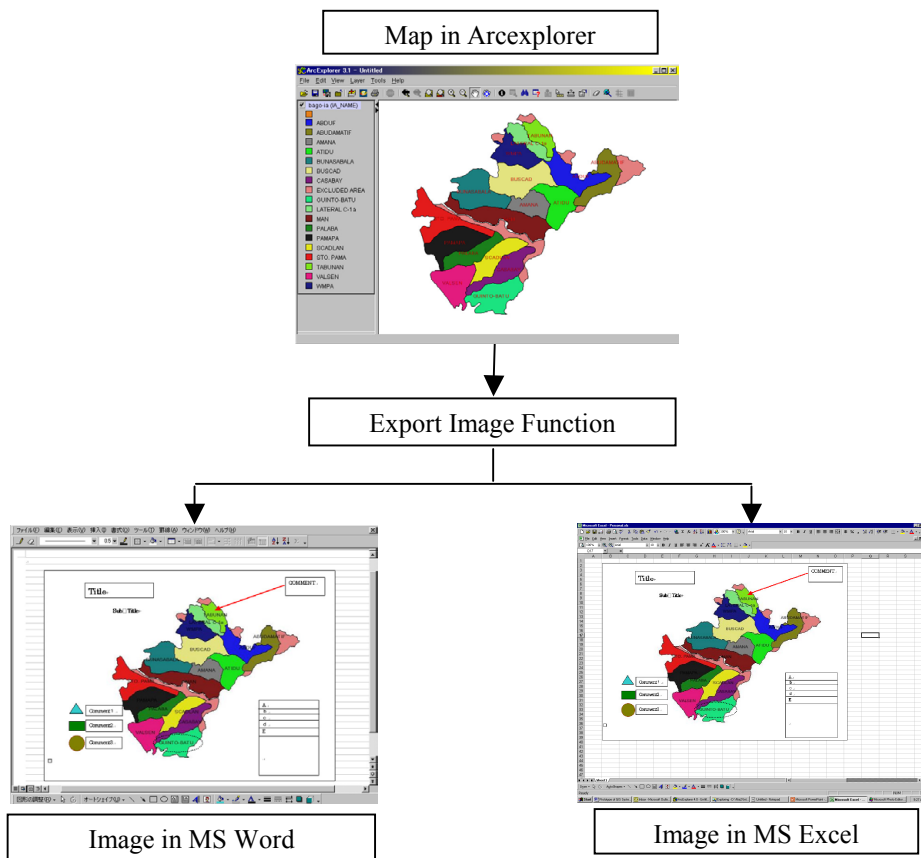


Figure 4.1 Image Export Function for Use in Other MS Office Software

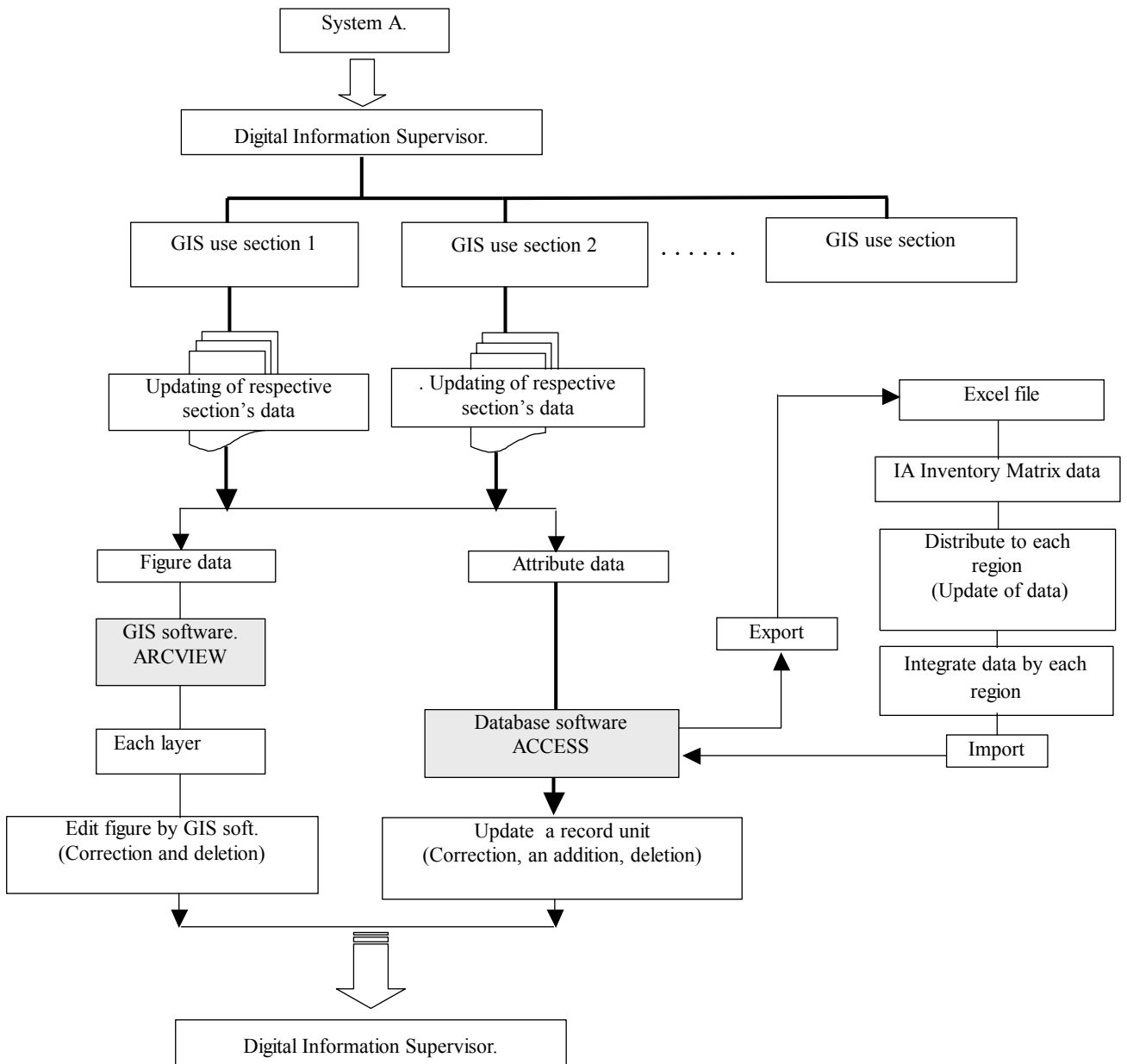


Figure 5.1 Recommended Updating Procedure