Japan International Cooperation Agency (JICA)
Danang People's Committee, Vietnam

No.

The Study on Integrated Development Strategy for Danang City and Its Neighboring Area in the Socialist Republic of Vietnam (DaCRISS)

FINAL REPORT / Annex 4

DaCRISS GIS

December 2010

ALMEC Corporation
International Development Center of Japan

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JAPAN INTERNATIONAL COOPERATION AGENCY (JICA)
DANANG PEOPLE'S COMMITTEE

THE STUDY ON INTEGRATED DEVELOPMENT STRATEGY FOR DANANG CITY AND ITS NEIGHBORING AREA IN THE SOCIALIST REPUBLIC OF VIETNAM (DACRISS)

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1 GIS DATABASE DEVELOPMENT IN DANANG CITY

1.1 GIS (geographic information system), was developed in the early 1980s mainly in the United States to support regional planning. As years passed basic data processing and manipulation capability of GIS has been enhanced in parallel with advances in computer technology including graphic equipment such as digitizers, scanners, and color inkjet plotters. Many packaged GIS software aimed for use in the fields of mapping, urban planning, environmental management, natural resource management, natural disaster management and urban facility management, are now becoming popular around the world. Since GIS is being applied in a wide range of planning and management fields, many kinds of application models have been developed by GIS users in the world. Through this accumulation of knowledge and dissemination of GIS technology, GIS is now recognized widely in modern information society as the most important tool supporting planning and urban management.

1.2 Danang City also intends to develop a comprehensive GIS database which is now being promoted by the city's Department of Investment and Planning. However, the overall concept and framework of the Danang GIS database are not yet sufficiently clear. While the GIS database developed in DaCRISS is primarily for urban planning and covers socio-economic, environment, land use, urban development, transportation, urban utilities, etc. for the main beneficiaries, that is, DOC, DOT, and DONRE, it can also provide useful information for other departments and organizations in the city.

1.3 In light of the above, a simple questionnaire survey was conducted to assess the GIS needs of various departments in the city to determine the concept and framework of the Danang GIS and, at the same time, to determine the possible contribution of the DaCRISS GIS, specifically to make it an integral part of the future Danang GIS.

1.1 Current Application of GIS by Danang City Departments

1.4 As the first step to clarifying the GIS needs of Danang City departments, their (i) organizational structure, (ii) tasks related to GIS, and (iii) educational backgrounds of personnel were clarified using a questionnaire and interview survey of each department.

(a) **Organization of Danang City Departments:** There are 17 departments under the Da**n**ang City People's Committee, and their tasks are listed in Table 1.1.

(b) **Human Resources by Department:** The personnel of the departments of Danang City, including their affiliated agencies, total 4,857, based on the responses to the questionnaire. The details are listed in Table 1.1.

1.2 Opportunities to Introduce GIS

1.5 For the next step, the opportunities to introduce GIS to each department were analyzed in terms of the current IT and GIS situation, existing GIS database, and interests in GIS by the departments based on their responses to the questionnaire and interviews.

1) IT and GIS Situation of the Departments

1.6 Overall, information technology (IT) has been adopted in almost all the departments in Danang City, judging from some indices shown in Table 1.2, such as computer per person at around 0.8–1.0, e-mail accounts for all, server and ID control in every department, etc. However, its level of utilization largely differs by department. For

example, there is a department that has regularly updated newsletter delivery, shared database, and so on, while there is another department where the server is down due to a lack of maintenance budget. Therefore, it seems that their interest in GIS greatly depends on their level of IT skills and their tasks.

Table 1.1 Departmental Tasks and Human Resources under the Danang City PC

Acronym	Name	No. of Divisions	Affiliated Agency	No. of Staff (above: Divisions, below: Affiliated Agencies)	Responsibility
1. DPI	Department of Investment and Planning	8	None	56 0	Short- and medium-terms plan, program and project
2. DOF	Department of Finance	7	• Agency for Enterprise Finance Management • Danang Lottery and Printing Service Company • Price Assessment and Information Division	N.A. N.A.	Finance and prices
3. DOIT	Department of Industry and Trading	7	• Market Management Agency • Industrial Promotion-Industrial Development Consulting Center • Danang Markets Management Company • Danang Supermarket - Commercial Center • Danang Information - Commercial Promotion Center	50 N.A.	Industrial branches including mechanical, metallurgy, electronics, informatics, chemicals, geology, natural resources (mineral, natural oil, gas and precious stones), electricity and consuming industry
4. DOC	Department of Construction	6	• Water Supply Company	67 N.A.	Construction, including building industrial and civil work, materials production and design and master plan for urban and rural construction
5. DONRE	Department of Natural Resources and Environment	7	• Danang Map and Survey Center • Environmental Technology Center • Danang Land use Right Registration Office • Danang Land Management and Exploitation Company • Danang Urban Environment Company	56 177	Natural resources and environment, including land, water, mineral resource, geology, environment, hydro meteorology, map and survey , sea and island integrated management
6. DOT	Department of Transportation	7	• Vehicle Registration Division • Driver Training Center • Roads, Bridges Management • Drainage Management • Toll Collection Station • Lien Chieu–Thuan Phuoc 1A National Road PMU • Son Tra–Dien Ngoc PMU • Rural Transportation PM • Public Transportation Construction PMU	56 755	Transportation including road, water transportation, and traffic safety
7. DOST	Department of Science and Technology	6	• Standards and Quality Agency • Science and technology information Centre • Biological technology and Science Technology Application Centre	N.A. N.A.	Technology, environment, industrial property, information technology, science and technology
8. DARD	Department of Agriculture and Rural Development	5	• Inspecting Division • Forest Protection Agency • Cooperatives & Rural Development Agency • Veterinary Agency • Vegetation Protection Agency • Aquatic Product Agency • Hydraulic and Typhoon-Flood Protection Agency • Fishery-Agriculture-Forestry Promotion Center • Agricultural Breeding Center • Danang City Protective Forest Management Board • Danang–Tho Quang Management and	33 305	Agriculture, fishery, forestry, sea products, hydraulic system

Acronym	Name	No. of Divisions	Affiliated Agency	No. of Staff (above: Divisions, below: Affiliated Agencies)	Responsibility
			Exploitation Enterprise • Thuan Phuoc Fising Port Management and Exploitation Enterprise • Hydraulic Facility Exploitation and Management Board		
9. DOCST	Department of Culture, Sport and Tourism	9	• 20 Affiliates	90 410	Culture, sport and tourism
10. DOIA	Department of Internal Affairs	8	• none	49 0	Structural organization of officers, establishment of the unite
11. DOFA	Department of Foreign Affairs	4	• Danang Representative Office in Japan • Foreign Relation Services Center • Vietnam–India English Training Center	36 29	External affairs, international cooperation, foreign investment, education of foreign language, management of NGOs
12. DOET	Department of Education and Training	9	• 1 Secondary School • 20 High Schools (3 are private) • 2 Special Training Centers • 8 Vocational Training Centers	50 2177	The entire national education and training
13. DOH	Department of Health	6	• 1 City Hospital • 6 Specialized Hospitals • 11 Medical Control Center • 1 Population Bureau (Reproductive Health) • 6 District Medical Centers • 56 Commune Medical Centers	39 N.A.	Health services, manage and give professional guidance to health services
14. DOL	Department of Labour, War Invalids and Social Affairs	9	• Employment Service Center • Vocational Training Collage • SOS Children Village • Center for Caring Revolution Involved People • Hermann Gmainner School • Social Sponsoring Center (for Old People) • Educational Vocational Training Center No. 05-06 • War Grave Yard Management Board • Malnourish Orphan Caring Center • Social Evils Protection Center • Mental Patient Caring Center	68 332	Labor, war invalids and social affairs
15. DOJ	Department of Justice	6	• Legal Service Center • Property Auction Service Center • 3 Notary Public's Offices	20 42	Judiciary work
16. DOIC	Department of Information and Communications	6	• Danang Information Communication Technology Center • Danang IT Infrastructure Development Center • Information Communication Technology Project Management Unit	24 42	Culture and information, relating to the media, printing, video tape publication, movies, culture and arts, etc.
17. DOI	Department of Inspection	N.A		N.A. N.A.	Inspection and implementing inspection rights

Source: Prepared by DaCRISS Study Team based on degrees of each department.

Table 1.2 Number of Available Computers by Department (except Affiliated Agencies)

Department	Number of:			
	Divisions	Staffs	Computers	Computers / Person
1. DPI	8	56	N.A	N.A
2. DOF	7	N.A.	N.A	N.A
3. DOIT	7	50	55	1.10
4. DOC	6	67	67	1.00
5. DONRE	7	56	N.A	N.A
6. DOT	7	56	N.A	N.A
7. DOST	6	N.A	N.A	N.A
8. DARD	5	33	33	1.00
9. DOCST	9	90	N.A	N.A
10. DOIA	8	49	N.A	N.A
11. DOFA	4	36	N.A	N.A
12. DOET	9	50	40	0.80
13. DOH	6	39	35	0.90
14. DOL	9	68	64	0.89
15. DOJ	6	20	20	1.00
16. DOIC	6	24	24	1.00
17. DOI	N.A.	N.A	N.A	N.A

Source: DaCRISS Study Team.

Table 1.3 Mapping or GIS-related Applications Installed in the Departments

Operation System	Department	Currently Available Software regarding Mapping / GIS
Application	All Departments	Windows (Word, Excel, etc.)
	DPI	Original Software developed by Softech (Oracle base)
	DOC	AutoCAD
	DOT	AutoCAD, Original Software developed by Softech (Oracle base)
	DONRE	(Main) MicroStation, AutoCAD, MapInfo, ArcGIS
	DOIT	AutoCAD
	DOET	AutoCAD
	DOH	AutoCAD
	DOIC	ArcGIS

Source: DaCRISS Study Team

2) Existing GIS Database in Three Departments

1.7 Using information gathered from interviews with each department, the existing GIS databases developed by the departments have been clarified. The departments which have their own GIS database are DPI, DONRE, and DARD.

(a) **DPI (Department of Investment and Planning):** DPI was appointed by the Danang City People's Committee to develop a comprehensive GIS database for Danang City. In 2007, it developed a pilot GIS database based on a topographical map with scale 1:2,000. However, the database has not been used by other departments because: (i) no useful attribute data were included in the database, (ii) there is no expert to operate the GIS database, and (iii) the base map itself was old and needed to be updated.

(b) **DONRE (Department of Natural Resource and Environment):** DONRE is the lead agency for GIS since it is responsible for land administration and has a division on survey and mapping which allows it to organize topographical maps and modify map information by themselves. Their GIS database was developed using the coordinate system of VN2000, the official coordinate system in Vietnam developed by MONRE.

(c) **DARD (Department of Agriculture and Rural Development):** DARD manages agriculture, forest, and sea resources and is also responsible for land use. The Forest Management Agency under DARD developed a GIS database to carry out their tasks. Their GIS database was developed also using the coordinate system of VN2000.

3) Department Interests and Need for GIS

(a) **Need to Use GIS:** Based on interviews with the departments, the levels of need to use GIS can be classified as shown below.

(i) **Strong Need (DOT, DOC, DPI, DARD, DONRE):** These departments have a strong and urgent need to use GIS in their respective operations, because they routinely use maps for mapping or facility management. Some agencies have developed their own GIS database or original AutoCAD data. However, they did not adopt a uniform coordinate system or data format.

(ii) **Moderate Need (DOIT, DOFA, DOET, DOH, DOIC, DOST, DOCST):** These departments have expressed a moderate need to use GIS in their respective operations. since their tasks are indirectly related to GIS and are usually required to produce maps showing socio-economic indicators and development trends only for use in preparing development plans or as information materials about the city, especially in websites.

(iii) **Slight Need (DOL, DOJ, DOIA, DOF, DOI):** These departments have a slight need to use GIS in their operations, although they feel the necessity to map the facilities under their management, for which GIS is required. DOIA is less interested in GIS because they have no tasks related to mapping or facility management. Their main tasks are personnel administration, organizational management of other departments, and establishment of SOEs and NGOs. In addition, it supervises and manages the administrative boundaries of the city, although its is more coordinative in nature, with border survey being done by the Survey and Mapping Division under DONRE.

(b) **Conditions to Introduce GIS:** In order to introduce GIS to urban management work in Danang City, it is necessary to pay attention to the scope of GIS database and its applications. As will be described later, if the coordinate system is different among sectors, it will be difficult to share map information. In addition, the IT situation in each department affects the applicability of GIS. Not only is the networking of personal computers and servers essential: the qualifications of GIS officers or experts are also essential in developing a GIS database for Danang City and in effectively using it.

1.3 Proposed GIS Database for Danang City

1.8 Based on the analyses above, the Study Team has prepared GIS items which should be included in Danang City's GIS database. It should be noted, however, that the coverage of the DaCRISS GIS database developed by the Study Team to be used especially for urban planning, is just a part of the envisioned and more comprehensive Danang City GIS database.

1.9 To develop a comprehensive GIS database for Danang City, the following issues should be discussed and solved with the participation of all the departments in Danang City under the leadership of the DPI:

(1) Development of a Common Map Database

(a) **Coordinate System:** Differences in the coordinate and map projection systems used cause graphic discrepancies in maps, errors in aerial calculation, or any unsolvable error. Therefore, all the departments should agree on using an official coordinate system to be applied in the Danang City GIS database. The use of a common base map is necessary.

(b) **Scale:** The scale required for a common map database depends on the purpose of GIS utilization and duties of each department. For example, urban planning needs maps with scales of 1:2,000, 1:5,000, or 1:10,000, while urban facility management needs those with scales of 1:500 or 1:1,000. For physical data, such as geology, soil, climatic condition, etc., these are compiled at the rather small scale of 1:50,000 to 1:200,000. Data accuracy is dependent on base map scale; therefore, GIS users should understand this point. Data input cost is also dependent on the map scale.

(c) **Computer Specifications:** Since GIS manages huge volumes of map data, the specifications of computer should be carefully decided. It is necessary to consider the total volume of data, such as base maps, inputs of aerial or satellite images, and inputs of related database files. Besides, backup systems of the GIS database is indispensable to secure data. Data processing speeds and disk sizes of computers should also be discussed.

(2) Sharing of Database

1.10 To share the latest information on GIS databases, the way to share data among departments, within departments, and within divisions should be considered. This will depend on the frequency of data updates, priority of information, and so on. The possible data sharing style is to install one server for all departments or individual servers for each department.

(3) Updating of Database

1.11 The mechanics for updating the GIS database should be decided on. The key points are: (i) who will be responsible, (ii) how will updated information be shared among the departments, and (iii) how often should it be updated. The frequency of the updates is dependent on the capacity of GIS officers and the budget. It should be carefully discussed by balancing the objective of the GIS database and the affordability of updating it.

(4) Building Capacities of Staff

1.12 Even if a noteworthy GIS database is established, its effect on government operations and decision making is dependent on the capacity of both management and

operating staff. Therefore, training and qualifications of the experts who will operate and manage the database and the staff who will utilize it is absolutely important. The preparation of training courses and involvement of officials in GIS database development will be effective to resolve this issue.

2 DEVELOPMENT OF DACRISS GIS DATABASE

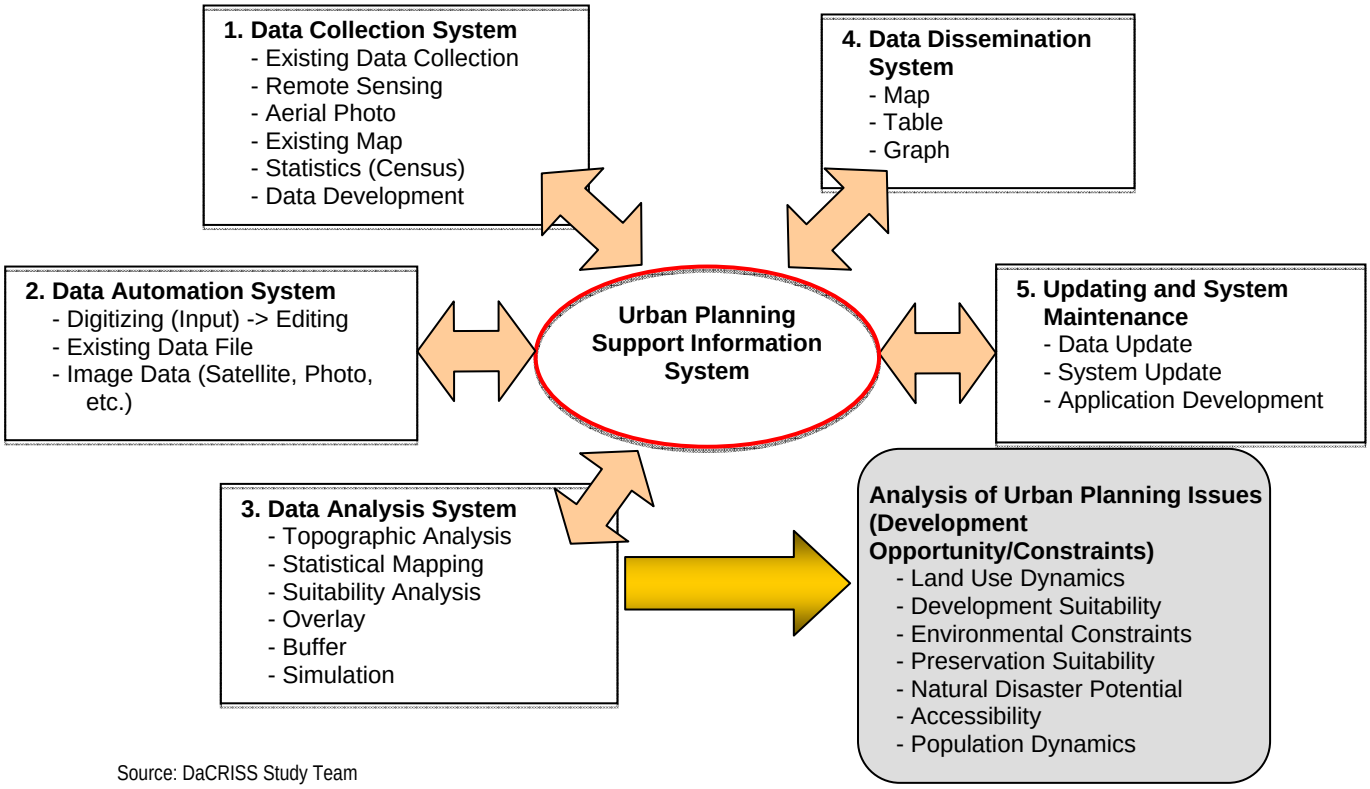
2.1 Objective

2.1 A comprehensive GIS database is being developed in DaCRISS to understand the existing conditions of the study area and to know the spatial distribution of development constraints and opportunities to support the development of a comprehensive master plan for Danang City. Based on this GIS database, two kinds of analysis were conducted. The first is development suitability analysis including environmental zoning, while the second analysis is urban land-use analysis and mapping. Procedures and results of the development suitability analysis are explained in the attached annex. Results of the urban land-use analysis and mapping based on large-scale topographic maps are integrated with the results of the Household Interview Survey conducted in districts and communes. These data and information generated the Urban Karte which reflects the problems in existing urban areas. The overall flow chart to build the GIS database is described in succeeding pages.

2.2 GIS Database Components

2.2 The components of the DaCRISS GIS database are shown in Figure 2.1. The general role of each system component is explained below and in subsequent pages.

Figure 2.1 System Components of a GIS Database



Source: DaCRISS Study Team

1) Data Collection System

2.3 In order to develop the GIS database, various types of geographic data represented by maps should be collected. These include existing paper maps, such as different scales of topographical maps, various kinds of thematic maps (e.g., geology, soil, geomorphology, land use, drainage system, vegetation, environmental conditions, etc.), which indicate existing conditions in the project area. Recently, these map data are digitized already. Therefore, the collection of existing digital data files is one of the important procedures in data collection.

2.4 The collection of image data, such as satellite images, is also part of data collection. In case images are in photographic format, the scale and basic coordinate system should be checked to determine if they can overlaid on other maps. If original image data can be collected, the user needs to process these using an image data processing system such as specter enhancement, geometric collection of each cell, and coordinate adjustment.

2.5 Aerial photography for large-scale topographic mapping is now taking place using digital aero-photo graphic cameras; therefore, the data format is digital like that of satellite images. The processing is the same as image data processing.

2.6 Recently, digital mapping system has become widely applied for topographical mapping. Mapping technology has leaped from analog to digital system including aerial photography. Every mapping element, such as contour line, river system, road network, railway, buildings, land use and administrative boundary, among others, are digitally stored in computers as a layer of line, point, and polygon data. After necessary data editing using specific cartographic software, final data files will be compiled into the computer system. Usually, digital mapping files are edited and compiled using a CAD-based system such as Micro Station or Auto-cad. These CAD-based data files need to be converted to GIS files for use in developing GIS databases. Conversion from CAD file to GIS file needs time and is a much consuming work.

2.7 Data collection for the socio-economic sector mainly requires census, annual statistical reports for the industry, agriculture–fishery–forestry, and service sectors. These statistical data are calculated based on data collection units and mapped using GIS.

2.8 Data development is necessary if basic key information is not available. Based on the necessary data item, field surveys, questionnaire or interview surveys will be conducted.

2.9 All collected data are then checked based on specific criteria, such as mapping scale, accuracy, year of compilation and methodology, responsible agency, and total volume, to determine the necessity of input for database construction.

2) Data Automation System

2.10 For database development, data automation of collected map is necessary. Maps are converted from analog to digital format using digitizers or scanners. Digitized or scanned data are checked for input accuracy using cartographers and edited for errors. In this stage, attribute data belonging to each input unit are also checked and the final clean file of each map are stored in the computer. A series of clean data file is a basic component of a GIS database. In GIS, graphic data and related attribute data of input maps are totally managed by relational database management system.

2.11 CAD-based map data files are converted to GIS files in this stage. Necessary polygon generation, connection of line or polygon data, and combination of many map sheets for seamless data creation are carried out in this stage.

2.12 Image data are also stored in GIS data file to combine with or overlay on other map data to understand the existing conditions of the study area. Image data are also used to interpret specific land use, environmentally sensitive area, or disaster-prone area.

3) Data Analysis System

2.13 The most important part in GIS database development is spatial or geographic analysis to understand the physical, environmental, and socio-economic conditions of the study area.

2.14 Spatial data analysis is conducted mainly through overlaying of related map data on one another. Attribute data of each thematic map are given a score and overlaid. Scores are summed up and classified under an appropriate number corresponding to a legend.

2.15 Boundary data, such as district, commune, census, or watershed, are overlaid on an analysis map to calculate aerial distribution of development constraints or land-use types. Necessary indicators or criteria for data analysis should be formulated before starting this analysis. Coordination between GIS experts and planners or persons responsible for planning should be ensured throughout data analysis.

2.16 Buffer zones are generated to specific point, line, and polygon data to understand spatial relationships of ecological zones or conservation areas, as an example.

2.17 Input map data are analyzed sequentially through primary, secondary, and tertiary processing. In primary data processing, contour data are processed to generate digital terrain model (DTM), slope, and aspect. These data are used as indicators for the secondary data analysis.

2.18 Statistical mapping, such as population distribution or density, is also conducted during primary data processing. Other socio-economic statistical data are also calculated and mapped in this stage.

2.19 In secondary data analysis, primary processed maps are combined and overlaid with one another. For a simple example, the slope analysis map generated by contour data processing is combined with the geological map to analyze erosion potential. Based on the type of geology, erosion potential differs by area. Geologic types are classified according to erosion susceptibility. Slope is also an important factor for controlling surface erosion. Slope class is also classified according to specific criteria for erosion analysis. These two map data are combined and overlaid again to analyze erosion potential. As a result, areas with steep slopes combined with erosion-susceptible geologic areas are shown as high erosion potential areas in the map. The physical and environmental conditions in the study area are analyzed from various points of view. Output maps as a result of spatial analysis must be interpreted carefully and evaluated from the perspective of land-use suitability or conservation. In order to evaluate output maps, specific know-how or user view for regional, environmental, or urban planning is indispensable.

2.20 Tertiary data analysis is the most sophisticated analysis. Physical and environmental data analyzed at the secondary stage are integrated to carry out an overall development suitability analysis or conservation suitability analysis. Necessary road

network and administrative boundary data are overlaid on these maps to understand the spatial distribution of development- and conservation-suitable sites in the study area.

2.21 Numeric simulation analysis for specific subjects, such as flood potential areas, earthquake potential areas, tsunami potential areas, air pollution, noise levels, and so on, is conducted in this stage using the GIS database. Any kind of simulation analysis related to spatial problems can be possible using a GIS database if an appropriate analysis model is developed by the user.

4) Data Dissemination System

2.22 One of the important roles of a GIS database is to disseminate necessary data to the right people or organization in the form of maps, graphs or tables at the right time and place. All calculated maps, including original data, can be disseminated through many methods such as local area network, internet, compact disks, or printed paper maps. Data dissemination systems can be made to flexibly respond to data requirements. A web-based GIS can be a practical way to share information with more users through the internet. Many local governments around the world have adopted this technology to share data.

5) Data Updating and System Maintenance

2.23 It is very important that the contents of the GIS database be always updated. Especially for statistical data, the latest land-use and environmental monitoring data should be stored, while natural conditions, such as geology, soil, and geomorphology, need not be updated periodically.

2.24 Updating of data on urban areas can be done through networking of individual databases such as building permission system and land property management system. These specific databases can provide daily, monthly, and yearly data to common map databases to show changes in urban land uses. If these systems operation is successfully maintained, users can access the most updated urban land-use data any time. Data on urban facility management, such as road management system, water supply system, and sewage management system, can also be transferred to common map databases.

2.25 The total GIS database system development should be discussed with relevant organizations in Danang City for effective city management and provision of public services.

2.26 Computer systems and related peripheral equipment, such as plotters, need to be upgraded after several years of use due to technological advancements. Application software for data analysis should be developed by users themselves to conduct more detailed data analysis and generate new information from GIS databases.

2.3 GIS Software and Coordination Applied to DaCRISS GIS Database

1) GIS Software

2.27 The software employed for the DaCRISS GIS database is ArcView of ESRI, software vendor in the USA. ArcView is now widely accepted all over the world as a GIS package software.

2) Projection and Coordinate System

2.28 Topographic maps covering Danang mainly used two coordinate systems depending on compilation scale. They are:

(i) Topographic data at a scale of 1:50000 used either UTM Zone 48 or UTM Zone 49, and
(ii) Topographic data at scales of 1:5000 and 1:10,000 used VN2000,

2.29 The main coordinate system adopted for the DaCRISS GIS database is VN2000, the official coordinate system of Vietnam, which has the following parameters:

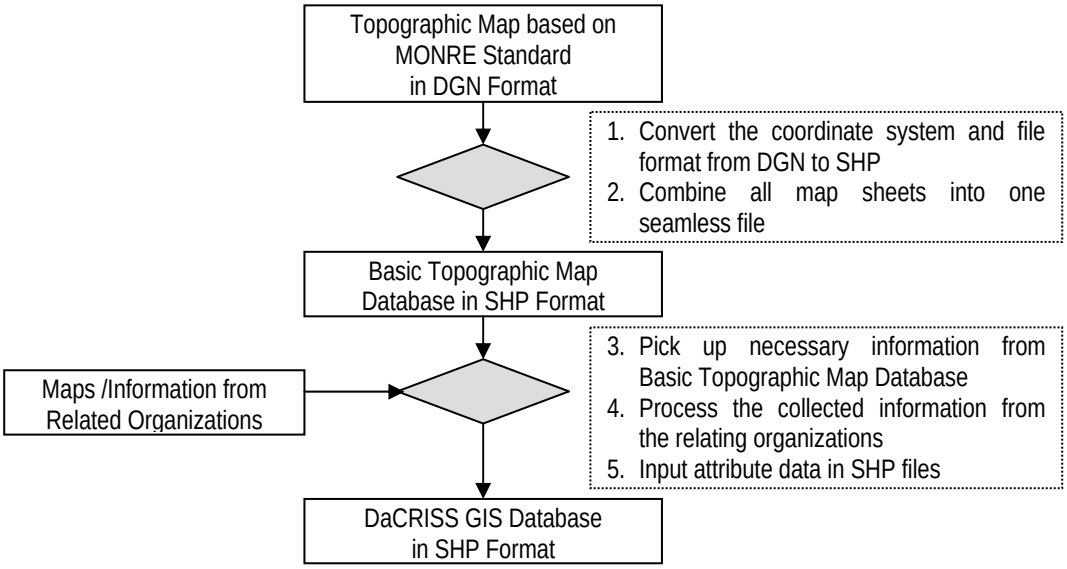
(i) Projection: Transverse Mercator;
(ii) False Easting: 500000;
(iii) False Northing: 0;
(iv) Central Meridian: 108;
(v) Scale Factor: 0.9999;
(vi) Latitude of Origin: 0;
(vii) Linear Unit: Meter;
(viii) Geographic Coordinate System: GCS_WGS_1984;
(ix) Datum: D_WGS_1984;
(x) Prime Meridian: Greenwich; and
(xi) Angular Unit: Degree.

2.4 Data Collection Methodology

2.30 The procedure which is applied for developing the DaCRISS GIS database is shown in Figure 2.2.

(i) Obtain digital topographic map data covering Danang City which are published based on MONRE standard. However, the available format is only DGN format (operational by the application of Micro Station), then, it is necessary to convert it to GIS (SHP) format which is acceptable for the DaCRISS GIS database based on ArcView;
(ii) Combine all the sheets of topographic maps into one map in order to process the object data and attach the attribute information to them. The database which is made in this step is called the Basic Topographic Map Database;
(iii) Pick up necessary attribute information, such as roads, buildings, land-use items, rivers, and so on, for the DaCRISS GIS database from the Basic Topographic Map Database and make independent SHP files for thematic analyses;
(iv) Process the collected information from related organizations at any format to SHP format; and
(v) Input attribute data in the independent SHP files with ID, name, type, quantity, and so on and make a database of urban planning information.

Figure 2.2 Procedure for DaCRISS GIS Database Development



Source: DaCRISS Study Team.

2.5 Basic Data Items for DaCRISS GIS

2.31 Basic data items for the DaCRISS GIS database are shown in Table 2.1. In this table, data source, scale, and related information are described. The characteristics of input data are briefly explained below.

(1) Topographic Map based on MONRE Standard

2.32 The topographical map which is available for Danang City jurisdiction in MONRE standard was obtained by the Study Team at the scales of 1:5,000, 1:10,000, and 1:50,000. Each scale was decided by the following objectives.

(i) 1:5,000: for detailed planning covering urban districts;
(ii) 1:10,000: for urban planning covering the whole Danang City; and
(iii) 1:50,000: for regional development planning covering the DaCRISS study area.

2.33 These are available in DGN format and compiled per map sheet. Each map sheet is converted to PDF format for printing per sheet. Then, DGN files are converted to SHP files by sheet and object type (text, symbol, point, line, and polygon). And all the map sheets are combined into one seamless map, after which the standard coordinate system adopted for the study is assigned to the seamless map.

2.34 The SHP files which are converted from DGN files are organized in the GIS database for the basic topographic map. Detailed map layers composed of topographic maps are categorized into six maps, namely, administration, residence, transportation, hydrography, vegetation, and topography.

(2) Data Collected from Other Data Sources

2.35 A topographic map shows only the geographical information and natural features of present land surface in the study area. Therefore, additional information necessary for spatial planning, such as soil and geology, natural hazard data, environmental conditions, urban land use including industrial areas, and socio-economic conditions, should be collected from responsible agencies. In addition, since the original topographic map is

compiled based on the information available in 2006, the updated information and additional attribute information, such as school name, number of students, specification of facilities, and so on, had to be collected from responsible agencies or culled from available latest information.

2.6 Data Conversion for GIS Format Creation

2.36 Data and information which are collected from other data sources are compiled into GIS format. Data processing methods differ according to the type of digital data format. The data in digital format are classified into two types, such as GIS and CAD-based format like AutoCAD. CAD-based data file can be converted to SHP file of ArcView using Arc Cad package software installed in the ArcView system. Map info file is also converted to SHP file. Attribute data related to the graphic data of the CAD-based file is also converted to ArcView system to be managed by the database management system of info. In case of paper maps, it is necessary to use scanners for digitization. Scanned data need vectorization and related attribute should be input.

2.7 Basic Data Items of DaCRISS GIS Database

2.37 The DaCRISS GIS database is developed by the above-mentioned procedure. Finally, it is reorganized in the categories which are required for urban planning in the study. The basic data items of the DaCRISS GIS database are shown in Table 2.1.

2.8 Hardware and Software Prepared

2.38 The hardware and software installed to operate the DaCRISS GIS database in the study are listed below. Hardware, software, and the DaCRISS database will be fully transferred to the counterpart agency after completion of DaCRISS.

(a) **Arc View:** 3 licenses.

(b) **Personal Computer:** 3 units (máy tính bỘ ACER L3600, CPU E4600, RAM 1G / 667, HDD 320GB VGA 256 MB share INTEL, DVD-RW).

(c) **Large-format Plotter:** 1 unit (HP Design Jet T610 44in, Color LFP, up to 44 inch, up to 2400 x 1200 optimized dpi with 6 Vivera pigmented inks, 128MB memory, roll & sheet feed, hi-speed USB 2.0 certified port & EIO slot, HP-GL2/RTL, CALS/G4, HP PCL3GUI, optimized for CAD personal use).

Table 2.1 Basic Data Items for DaCRISS GIS Database

Coverage	Particulars	Source	Scale	Year	Feature Type	Coordinate System
01_BaseMap						
Danang City Center	Geodatabase of 1:5,000 Scale Topographic Maps	DONRE	1:5000	2006	Multi	VN2000
Danang Outer Area	Geodatabase of 1:10,000 Scale Topographic Maps	DONRE	1:10000	2006	Multi	VN2000
Hue, Danang, Quang Nam, Quang Ngai	Geodatabase of 1:50,000 Scale Topographic Maps	MONRE	1:50000	1998	Multi	UTM48
Danang Outer Area	Index Map of Available Topographic Maps at 1:5,000 Scale	DONRE	1:5000	2006	Polygon	VN2000
Danang City Center	Index Map of Available Topographic Maps at 1:10,000 Scale	DONRE	1:10000	2006	Polygon	VN2000
Hue, Danang, Quang Nam, Quang Ngai	Index Map of Available Topographic Maps at 1:50,000 Scale	MONRE	1:50000	1998	Polygon	UTM48
02_AdministrativeBoundary						
Asia	National Boundaries of Neighboring Asian Countries	ESRI			Polygon	GCS
Danang	Polygon Mask of Areas outside of Danang City	Topo 10k	1:10000	2006	Polygon	VN2000
Danang	Danang City Boundaries	Topo 10k	1:10000	2006	Polygon	VN2000
Danang	Danang Commune Boundaries	Topo 10k	1:10000	2006	Polygon	VN2000
Danang	Danang District Boundaries	Topo 10k	1:10000	2006	Polygon	VN2000
Danang	East Sea	Topo 10k	1:10000	2006	Polygon	VN2000
Vietnam	Provincial Boundaies of Vietnam	VRA			Polygon	UTM48
03_NaturalCondition						
Asia	Main Rivers in Vietnam and Surrounding Countries	VRA			Line	UTM48
Danang	Contours	Topo 10k	1:10000	2006	Line	VN2000
Danang	Elevation Grid @ 250m Grid Size	JST	1:10000	2009	Polygon	VN2000
Danang	Geological Formations	GSV	1:200000	1995	Polygon	VN2000
Danang	Geomorphology	JST	1:100000	2009	Polygon	VN2000
Danang	River and Canal Areas	Topo 10k	1:10000	2006	Line	VN2000
Danang	Saltwater Intrusion Areas	DONRE	1:75000	2008	Polygon	VN2000
Danang	Spot Heights in meters	Topo 10k	1:10000	2006	Point	VN2000
Danang	All Water Bodies	Topo 10k	1:10000	2006	Polygon	VN2000
Danang	Main Water Bodies	Topo 10k	1:10000	2006		VN2000
Vietnam	River Areas in Vietnam	VRA			Polygon	UTM48
05_ExistingLandUse						
Danang	Existing Land Use	JST	1:10000	2009	Polygon	VN2000

Coverage	Particulars	Source	Scale	Year	Feature Type	Coordinate System
06_UrbanTransport						
Asia	National Road Network of Surrounding Asian Countries	VRA			Line	UTM48
Danang	Abandoned Airport Area	Topo 5k	1:5000	2006	Polygon	VN2000
Danang	Accident prone locations	STB	1:5000	2005	Point	VN2000
Danang	Airport Area	Topo 5k	1:5000	2006	Polygon	VN2000
Danang	Airport location	Topo 5k	1:5000	2006	Point	VN2000
Danang	Bus Routes	Topo 10k	1:10000	2006	Line	VN2000
Danang	Bus Terminals	Topo 5k	1:5000	2006	Polygon	VN2000
Danang	Bus Terminals	Topo 5k	1:5000	2006	Point	VN2000
Danang	Transport Survey - Cordon Line Survey	JST	No Scale	2009	Point	VN2000
Danang	Culvert locations	Topo 5k	1:5000	2008	Point	VN2000
Danang	Main Road Network	Topo 10k	1:10000	2006	Line	VN2000
Danang	Port Area	Topo 5k	1:5000	2006	Polygon	VN2000
Danang	Port Location	Topo 5k	1:10000	2006	Point	VN2000
Danang	Railway Network	Topo 10 k	1:10000	2006	Line	VN2000
Danang	Railway Staitons	Topo 5k	1:5000	2006	Polygon	VN2000
Danang	Railway Staiton Locations	Topo 5k	1:5000	2006	Point	VN2000
Danang	Road coverage ratio in percent for roads included in the DOT road inventory in 2008 (Road Area/Net Area of Commune)	JST	1:10000	2009	Polygon	VN2000
Danang	Road Network from Topo map	Topo 10k	1:10000	2006	Line	VN2000
Danang	Road Network	DOT	1:10000	2008	Line	VN2000
Danang	Transport Survey - Screen Line Survey	JST	No Scale	2009	Point	VN2000
Danang	Traffic lights	DOT	1:5000	2008	Point	VN2000
Danang	Transportation Symbols	Topo 10k	1:10000	2006	Line	VN2000
07_UrbanUtilities						
Danang	Drainage Network Catchment Area	PIIP	1:5000	2007	Polygon	VN2000
Danang	Existing Gravity Interceptor Drain	DOT	1:5000	2008	Line	VN2000
Danang	Existing Pumping Stations	DOT	1:5000	2008	Point	VN2000
Danang	Existing Rising Mains	DOT	1:5000	2008	Line	VN2000
Danang	Areas covered by both wastewater catchment area and drainange network catchment area	JST	1:5000	2009	Polygon	VN2000
Danang	Power - Existing High Tension Lines	Topo 5k	1:5000	2006	Line	VN2000
Danang	Dumping Area	Topo 10k	1:5000	2006	Polygon	VN2000
Danang	Wastewater Catchment Area	PIIP	1:5000	2007	Polygon	VN2000
Danang	Wastewater Treatment Facility	DOT	1:5000	2008	Point	VN2000
Danang	Existing Water Supply Disstribution Pipes	DOT	1:5000	2008	Line	VN2000
Danang	Existing Transfer Pipes	DOT	1:5000	2008	Line	VN2000
Danang	New Distribution Pipes	DOT	1:5000	2008	Line	VN2000
Danang	Water Supply - Water Treatment Facility	DOT	1:5000	2008	Point	VN2000

Source: DaCRISS Study Team

Coverage	Particulars	Source	Scale	Year	Feature Type	Coordinate System
08_UrbanFacilities						
Danang	Building with number of floors attribute	Topo 10k	1:10000	2006	Polygon	VN2000
Danang	Cultural Facilities	JST	1:10000	2009	Point	VN2000
Danang	Government Departments	JST	1:10000	2009	Polygon	VN2000
Danang	Government Department Locations	JST	1:10000	2009	Point	VN2000
Danang	Hospitals	JST	1:10000	2009	Polygon	VN2000
Danang	Hospital locations	JST	1:10000	2009	Point	VN2000
Danang	Markets	JST	1:10000	2009	Polygon	VN2000
Danang	Market locations	JST	1:10000	2009	Point	VN2000
Danang	Parks	JST	1:10000	2009	Polygon	VN2000
Danang	Park locations	JST	1:10000	2009	Point	VN2000
Danang	People's committee offices	JST	1:10000	2009	Polygon	VN2000
Danang	People's committee office locations	JST	1:10000	2009	Point	VN2000
Danang	Police Stations	JST	1:10000	2009	Polygon	VN2000
Danang	Police station 2km Buffer	JST	1:10000	2009	Polygon	VN2000
Danang	Police station locations	JST	1:10000	2009	Point	VN2000
Danang	Post office locations	Topo 10k	1:10000	2006	Point	VN2000
Danang	Religious facility locations	JST	1:10000	2009	Point	VN2000
Danang	Schools	JST	1:10000	2009	Polygon	VN2000
Danang	School locations	JST	1:10000	2009	Point	VN2000
Danang	Sports arenas	JST	1:10000	2009	Polygon	VN2000
Danang	Sports facility locations	JST	1:10000	2009	Point	VN2000
Danang	Tourist spots	JST	1:10000	2009	Point	VN2000
09_EnvironmentalManagement						
Danang	Coral Reef Annotation	DONRE	No Scale	2007	Point	VN2000
Danang	Coral Reef Protected Area	DONRE	No Scale	2007	Polygon	VN2000
Danang	Forest Areas	DARD		2009	Polygon	VN2000
Danang	Environmental Monitoring Stations	DONRE	1:10000	2008	Point	VN2000
Danang	Protected Animal Habitat	DARD	No Scale	2007	Point	VN2000
10_NaturalDisasterPotential						
Danang	Coastal buffer zone of 250m	JST	1:10000	2009	Polygon	VN2000
Danang	Coastal buffer zone of 500m	JST	1:10000	2009	Polygon	VN2000
Danang	Contours at 10m intervals	Topo 10k	1:10000	2006	Line	VN2000
Danang	Contours up to 5m interpreted by the JST	JST	1:10000	2009	Line	VN2000
Danang	Signs of Erosion	FSCC	1:10000	2007	Point	VN2000
Danang	Signs of Flash Floods	FSCC	1:10000	2007	Point	VN2000
Danang	Ketsana Flooded Area interpreted by JST based on Flood Survey results conducted by JST	JST	1:25000	2009	Polygon	VN2000
Danang	Flood Depth by Commune	FSCC	1:25000	2007	Point	VN2000
Danang	Flood Prone Areas from PIIP	PIIP	1:10000	2007	Polygon	VN2000
Danang	Flood Records from PIIP	PIIP	1:10000	2007	Point	VN2000
Danang	Ketsana Flood Survey results conducted by JST	JST	1:25000	2009	Point	VN2000
Danang	River buffer zone of 200m	JST	1:10000	2009	Polygon	VN2000
Danang	River buffer zone of 500m	JST	1:10000	2009	Polygon	VN2000
11_DevelopmentSuitability						
Danang	Grid System used by JST in various analyses conducted in the study. Grid Sized is 250m	JST	1:10000	2009	Polygon	VN2000
Danang	Submerged Area Analyzed by JST	JST	1:25000	2009	Polygon	VN2000
12_CurrentMasterPlan						
Danang	Planned Bridges 2008	DOT	1:10000	2008	Line	VN2000
Danang	Planned Bridges 2009	DOT	1:10000	2009	Line	VN2000
Danang	Future Land Use 2020	DOC	No Scale	2008	Polygon	VN2000
Danang	Planned Roads CP 2009	DOT	1:10000	2009	Line	VN2000
Danang	Planned Traffic Light Installation	DOT	1:10000	2008	Point	VN2000

Abbreviation

DARD	Department of Agriculture and Rural Development
DOC	Department of Construction
DONRE	Department of Natural Resources and Environment
DOT	Department of Transport
FSCC	Flood and Storm Control Committee
GCS	Geographic Coordinate System
GSV	Geological Survey of Vietnam
JST	JICA Study Team
PIIP	Priority Infrastructure Investment Program
STB	Safety Transportation Board
UTM	Universal Transverse Mercator
VRA	Vietnam Road Administration

3 URBAN LAND-USE ANALYSIS AND THEMATIC MAPPING

3.1 Urban land-use analysis and thematic mapping were conducted mainly for urban districts based on large-scale topographical maps to generate urban planning indicators. Detailed urban land-use conditions in Danang City are analyzed by commune. Population density, urban road ratio, open space ratio, park ratio, public facility distribution and related urban facilities were calculated using topographical maps through GIS. Results of calculations were compiled into maps and tables by commune unit in a Map Atlas. These data can provide objective data for the compilation of an urban karte and can be used as urban planning indicators for Danang City when compared with the basic data of other cities.

Table 3.1 Example of Calculation: Number of Public Facilities per 1,000 Population

Commune Name	PC	DN City Department	Police	Postal Service Facility	Park	Sport Facility	School	Hospital	Tourism Spot	Market	Cultural Facility	Religious Facility
P. Binh Hien	0.08	-	0.08	0.31	-	-	0.39	0.31	-	0.08	0.16	0.63
P. Binh Thuan	0.07	0.07	0.07	0.13	-	0.07	0.54	0.07	-	0.07	-	0.27
Hoa Thuan Tay	0.08	-	0.08	0.30	-	0.08	0.23	0.15	-	-	-	0.15
Hoa Thuan Dong	0.07	-	0.07	0.26	-	0.20	0.39	0.07	-	0.07	-	0.33
P. Hai Chau I	0.14	0.41	0.14	2.46	0.07	-	1.16	0.41	0.07	0.07	0.55	0.27
P. Hai Chau II	0.07	-	0.07	0.14	-	0.07	0.21	-	-	0.07	-	0.07
Hoa Cuong Bac	0.05	-	0.05	0.40	0.15	0.05	0.35	0.15	0.10	0.10	0.15	0.15
Hoa Cuong Nam	0.08	-	0.08	0.59	-	-	0.59	0.08	0.08	0.08	-	0.08
P. Nam Duong	0.09	-	0.09	0.18	-	-	0.27	0.09	-	0.09	0.09	0.44
P. Phuoc Ninh	0.22	0.15	-	1.42	-	0.07	0.37	0.15	-	0.07	0.07	0.07
P. Thanh Binh	0.05	-	0.05	0.15	-	-	0.41	0.10	0.05	-	-	0.15
P. Thuan Phuoc	0.06	-	-	0.76	-	-	0.13	0.06	-	0.19	-	0.25
P. Thach Thang	0.06	0.39	0.11	1.27	0.06	0.06	0.39	0.39	-	-	0.17	0.11
Sub-Total	0.08	0.08	0.07	0.65	0.03	0.05	0.42	0.16	0.03	0.07	0.09	0.22
P. Chinh Gian	0.05	-	-	0.25	-	-	0.15	0.05	-	0.05	0.05	0.10
P. Tam Thuan	0.05	-	0.05	-	-	-	0.16	0.05	-	0.10	-	0.10
P. Thac Gian	0.05	-	0.05	0.43	0.05	-	0.21	0.16	-	-	-	0.21
P. Tan Chinh	0.06	-	0.06	0.12	0.06	-	0.25	0.06	-	0.06	-	0.06
P. Vinh Trung	0.05	-	0.05	0.27	-	0.05	0.43	0.05	-	0.11	0.05	0.16
P. Xuan Ha	0.11	-	0.06	-	-	-	0.45	0.11	-	0.06	-	0.17
P. An Khe	0.05	-	0.05	0.33	-	-	0.27	0.05	-	0.11	-	0.16
Hoa Khe	0.08	-	0.08	-	-	-	0.38	0.08	-	0.08	-	-
Thanh Khe Tay	0.07	-	-	-	-	-	0.50	0.14	-	0.14	-	0.22
Thanh Khe Dong	0.09	-	0.18	-	-	-	0.45	0.18	-	0.09	-	0.18
Sub-Total	0.07	-	0.05	0.16	0.01	0.01	0.31	0.09	-	0.08	0.01	0.14
P. An Hai Bac	0.04	-	-	0.13	0.04	-	0.30	0.04	-	0.04	-	0.22
P. An Hai Tay	0.14	-	0.07	0.54	-	-	0.34	0.20	0.07	0.14	-	0.20
P. An Hai Dong	0.06	-	0.12	0.37	-	-	0.67	0.12	-	0.06	-	0.25
P. Man Thai	0.08	-	0.08	-	-	-	0.30	0.08	-	0.08	-	0.38
P. Nai Hien dong	0.07	-	0.07	0.07	-	-	0.40	0.07	-	0.07	-	0.34
P. Phuoc My	0.07	-	0.07	0.26	0.07	-	0.39	0.07	-	0.07	-	0.33
P. Tho Quang	0.04	-	0.04	0.04	-	-	0.27	0.09	0.13	0.13	-	0.40
Sub-Total	0.07	-	0.06	0.19	0.02	-	0.38	0.09	0.03	0.08	-	0.30
My An	0.06	-	0.06	0.28	-	-	0.45	0.11	-	0.06	0.06	0.06
Khue My	0.23	-	0.23	0.35	0.12	0.12	0.58	0.23	0.23	-	-	0.58
P. Hoa Hai	0.06	-	0.12	0.12	0.12	-	0.55	0.12	0.37	0.12	-	1.53
P. Hoa Quy	0.09	-	0.09	0.09	-	-	0.61	0.09	-	0.17	-	0.70
Sub-Total	0.09	-	0.11	0.20	0.06	0.02	0.54	0.13	0.15	0.09	0.02	0.72
Hoa Phat	0.10	-	-	0.39	-	-	0.68	0.10	-	0.10	-	0.97
Hoa An	0.07	-	0.07	-	-	-	0.30	0.07	-	0.07	-	0.15
Hoa Tho Tay	-	-	-	-	-	-	0.25	0.12	-	-	0.12	1.86
Hoa Tho Dong	0.30	-	0.10	0.50	-	-	0.60	0.20	-	0.10	-	1.00
Hoa Xuan	0.09	-	-	0.09	-	-	1.08	0.09	-	-	-	0.81
P. Khue Trung	0.07	-	0.07	0.20	-	-	0.39	0.13	-	0.20	0.13	0.33
Sub-Total	0.10	-	0.04	0.19	-	-	0.54	0.12	-	0.09	0.04	0.75
Hoa Hiep Bac	0.08	-	-	-	-	-	0.65	0.08	0.41	0.16	-	0.32
Hoa Hiep Nam	0.06	-	-	-	-	-	0.52	0.06	0.13	0.06	-	0.45
Hoa Khanh Bac	0.03	-	-	0.07	-	-	0.42	0.07	-	0.03	0.03	0.31
Hoa Khanh Nam	0.07	-	0.07	-	-	-	0.50	0.22	-	-	-	0.36
P. Hoa Minh	0.08	-	-	0.12	-	-	0.77	0.12	-	0.04	-	0.49
Sub-Total	0.06	-	0.01	0.05	-	-	0.57	0.11	0.07	0.05	0.01	0.39
Hoa Bac	0.30	-	-	-	-	-	0.90	0.30	0.30	-	-	0.30
Hoa Chau	0.09	-	0.09	0.09	-	-	0.79	0.09	0.18	0.09	-	0.97
Hoa Khuong	0.09	-	-	-	-	-	0.38	0.09	0.09	0.09	-	-
Hoa Lien	0.09	-	-	0.09	-	-	0.54	0.09	-	-	-	1.00
Hoa Nhon	0.08	-	0.08	-	-	-	0.23	0.08	-	0.08	-	0.31
Hoa Ninh	0.23	-	-	-	-	-	0.68	0.23	0.23	0.23	-	1.37
Hoa Phong	0.15	-	-	-	-	-	0.29	0.15	-	0.15	0.15	0.07
Hoa Phu	0.23	-	-	-	-	-	0.69	0.23	0.23	-	-	0.23
Hoa Phuoc	0.10	-	-	0.31	-	-	0.62	0.10	0.10	0.21	0.10	0.41
Hoa Son	0.09	-	0.09	0.09	-	-	0.55	0.09	-	0.09	-	0.92
Hoa Tien	0.07	-	-	-	-	-	0.34	0.07	-	0.07	-	0.55
Sub-Total	0.11	-	0.03	0.06	-	-	0.49	0.11	0.07	0.09	0.03	0.53
Total	0.08	0.02	0.05	0.26	0.01	0.01	0.43	0.12	0.04	0.08	0.03	0.35

Source: DaCRISS GIS Database

4 APPLICATION OF DACRISS GIS DATABASE TO DANANG CITY DEPARTMENTS

4.1 Output of DaCRISS Study

4.1 The outputs of the study were compiled in the following;

(i) DaCRISS GIS database as described in the previous section;

(ii) DaCRISS Viewer to see ready-made thematic maps in the computer;

(iii) Thematic map book called DaCRISS Atlas;

(iv) Data documentation which describes the characteristics of data in the DaCRISS GIS database.

4.2 Utilization of DaCRISS GIS Database

4.2 The DaCRISS GIS database can be classified into five categories, such as (i) base map, (ii) urban planning tools, (iii) urban utility facilities, (iv) public facilities, and (v) master plan. The expected uses and responsible agencies for data updating are described in the table below.

Table 4.1 Utilization of DaCRISS GIS Database

Category	Content of Database	Utilization	Responsible Agency for Data Updating
Base Map	Outline of the city boundary (Administrative boundary, sea, mask of the city area) and Basic items which consist the topographic condition of the city (water system, transportation system, land use (natural and urban), contour, buildings)	This data can be utilized to see the jurisdictional area and topographical condition of the target area	DONRE, DOT, DARD. DOC
Urban Planning Tools	Socio-economic condition (Population density, population growth rate), assessment of natural environmental condition (refer to chapter 3 of Part II), Transportation system, Land use, Development suitability analysis	This data can be utilized to know the spatial distribution of socio-economic conditions and natural environmental conditions and it will assist the decision making of urban planning issues. However, socio-economic condition should be updated when it is utilized for urban planning to grasp on time conditions.	DPI, DONRE, DOT, DARD, DOC
Urban Utilities	Water supply network, Drainage and sewerage network, electricity network, dumping site	This data can be utilized to know the spatial distribution of the urban facilities. However, it is necessary to collect the specific information from the responsible agencies to manage these facilities.	DOT, DOC, DOIT, DONRE
Public Facilities	PC offices, Danang City departments, police stations, postal service facilities, parks, sport facilities, schools, hospitals, tourism spots, markets, cultural facilities, religious facilities	This data can be utilized to know the spatial distribution of the public facilities and to manage the current condition of the facilities. The specific information should be input by the responsible agencies.	DOC, DOIC, DOCST, DOH, DOET, DOIT
Master Plan	DOC Maser plan, on-going construction projects	This data shows the current master plan prepared by DOC and on-going construction projects by the Departments of Danang City or Government. However, any departments can add their construction projects to share the updated information relating to construction in Danang City.	DOC, all Departments

Source: DaCRISS Study Team.

5 SUMMARY OF DACRISS GIS ACHIEVEMENT

5.1 Development Suitability Analysis

5.1 In DaCRISS, the Study Team developed a GIS database to support urban development planning. In order to attain this purpose, a wide range of natural, socio-economic and environmental data covering the whole study area were collected, automated, and processed by using GIS.

5.2 The first achievement is obtaining an understanding of the spatial distribution of development constraints in the study area. Mainly natural and environmental data maps were combined, manipulated, and processed to generate development constraint maps. As a result of data processing, maps showing: (i) flood potential areas, (ii) coastal and river buffer zones, (iii) forest areas, (iv) ecological preservation areas, (v) agricultural areas, (vi) saltwater intrusion areas, (vii) erosion potential areas were compiled. Based on these maps and information, urban planners could understand the distribution of development constraints in the future urban land use in Danang City.

5.3 The second achievement is obtaining an understanding of the suitable areas for development. Development constraint maps were overlaid in an integrated manner and generated development suitability maps which show areas suitable for development, which are basically represented by the existence of relatively flat land, free from flooding and has low erosion potential.

5.4 Preservation suitability area aims to show the location of important ecological zones, forest zones and agricultural areas. In DaCRISS, detailed information on ecological and environmental data were not collected, but macro level indication of preservation suitability is shown in the map.

5.5 Planners generated general policy guidelines for possible land-use patterns in the study area, i.e., where to develop or what to preserve. After the completion of the draft map on general land use, it was overlaid on the development suitability map or preservation suitability map to check necessary modifications to the general land-use pattern. Detailed discussions were then made on specific areas based on more accurate information.

5.2 Urban Land-use Analysis and Thematic Mapping

5.6 Urban land-use analysis and thematic mapping are another important role of the DaCRISS GIS database. Many urban planning data and information on existing urban conditions can be generated by processing large-scale topographic map. In DaCRISS, urban land use was analyzed based on a 1:5.000 topographic map provided by MONRE in a digital format. Large-scale topographic maps are one of the significant sources of data on urban conditions.

5.7 In large-scale topographic maps, many kinds of map objects, such as building footprint, road network, public facilities, parks, urban land use, open space and so on, are stored as a layer of each map sheet in digital format. Map data file is basically in CAD format; therefore, data conversion from CAD file to GIS file is necessary. After converting the map file, necessary data processing can be possible based on a specific analysis unit such as commune, district, or census boundary.

5.8 In DaCRISS, commune and district boundaries are used to conduct urban land-

use analysis, wherein specific calculation was done using GIS software function such as area by type of land use, distribution frequency, percentage, number, distance and density within an analysis unit. Results of calculation were compiled into maps, tables and lists. Based on this analysis, necessary urban planning indicators were generated such as population density, area distribution by urban land-use type, building coverage ratio, road ratio, open space ratio, distribution of public facility, urban facility, parks, and so on.

5.9 These urban land-use analysis data not only show existing conditions of urban areas, but also provide significant objective data to be compiled into an urban karte.

5.3 Final Outputs of DaCRISS GIS

5.10 The final outputs of the DaCRISS GIS are: (i) integrated GIS database, (ii) map atlas, (III) map viewer, (vi) data documentation.

5.11 In addition to the GIS database, a computer hardware system, including inkjet plotter and ArcView software for GIS operation, is also an important output. These data and operating system will eventually be transferred to Danang City.

5.4 Recommendations for an Integrated GIS Database for Danang City

5.12 In DaCRISS, an integrated GIS database was developed to support urban planning. This GIS database can be widely used for urban planning, environmental planning, disaster management such as flood control, and resource management. However, in order to realize the effective use of a GIS system, the following needs should be addressed and related information systems for city management developed:

(1) Common Map Database Development

5.13 Based on the GIS user interview survey, topographic map data is owned by the DOI and DONRE; however, the date of map compilation and projection is different. Standard map projection system in Vietnam, such as VN2000, should be applied and the map data file should be updated as soon as possible to establish a common map database for sharing map data among the city's departments. On this point, a leading agency to establish a common map database should be assigned to provide necessary map services.

(2) Conversion Services from CAD to GIS File

5.14 GIS data are an integration of many map sheets covering the whole city area as one seamless file together with related attribute files. CAD is basically a map drawing system and map file is stored in each map sheet as separate layers for retrieval, display, and hard copy plotting. However, the CAD system is useful in digital data creation and editing due to its advanced drawing capabilities. In recent digital mapping systems, the CAD system is mainly used for map data compilation. GIS users have to convert CAD files to GIS files for GIS database development. This data conversion is a time-consuming work and takes a long time depending on the total data volume. Data conversion services will be necessary to generate GIS files for map users.

(3) Data Preparation of Individual Departments

5.15 In the DaCRISS GIS database, the accuracy of map data is not high except for the topographic map. The map scales of collected data on natural resources vary from 1:10,000 to 1:200,000. Map projection systems also differ. Natural condition maps, such as geology, vegetation, and ecological zone map, should be updated in the near future by

relevant agencies for higher accuracy and standard map protection. These data provide important information for watershed management including erosion control, forest area management, and ecological zoning.

5.16 Maps of flood-prone areas should also be prepared for lowland areas.

5.17 For urban land-use management, regular monitoring systems based on satellite imagery or aero photographic interpretation should be applied to update urban land use. Especially in Danang City, many development projects are underway; hence, urban land-use monitoring and data updating are important measures to control urban growth.

(4) Urban Facility Management

5.18 GIS can also provide basic tool for facility management such as water pipeline network, sewage network, drainage network and road network. For the management of these urban facilities, large scale topographical map will be need to show the location clearly.

5.19 GIS can handle network data calculation and display problem point or district, and also display necessary history of construction, materials of facility and dimension such as diameter of pipeline. In case of water pipeline accident in the city, GIS can calculate water pipeline network data and display problem area instantly. Based on this information, relevant agency or expert knows which main bulb should be shut down to minimize a damage and keep water supply through alternative route.

5.20 Traffic control is also depending on network data. Traffic control center will install detail road network data together with observation camera system in big city such as Tokyo. For future traffic management, detail road network management database will be necessary.

5.21 Updating of large scale topographic map as a common map database is necessary to support urban facility management.

(5) Building Permission System

5.22 A building permission system should be established to manage urban land-use control. If such system is established, urban land-use monitoring becomes more effective. Accumulated building permission data should be regularly mapped, such as monthly, on a large-scale topographic map. Most updated urban land-use dynamics data can be collected.

(6) Land Property Information System and Tax Assessment System

5.23 Land property information system is necessary to manage cities. A land ownership map should be prepared based on a large-scale topographic map. Based on transactions of land property, land titles will be changed. These records should be computerized and inputted into the GIS database to help monitor land prices and urban land uses.

5.24 Tax assessment is deeply related to land property information systems. Many urban land-use data are necessary to evaluate taxes for each land property. Based on the location of each land plot, for example, figure of plot, area, land price, accessibility to public transportation, availability of piped water, sewage system and electricity, drainage condition etc., will be combined and taxes will be assessed. This system development is also an important aspect of GIS application in city management.

(7) Environment Management System

5.25 Environment management system is one of the important systems for city management. Pollution monitoring data, such as pollution sources and items, polluted area and level, should be inputted into the GIS system and necessary mapping should be conducted to disseminate it to the public. For system development, data gathering should be established to covering the whole city area. Regular data sampling and analysis system should also be established.

(8) Disaster Management System

5.26 Flood disasters occur in Danang City almost every rainy season. For flood disaster management, it is necessary to install rainfall data collection system together with a river water level monitoring system. An inventory of flood-prone areas is also necessary and should include village distribution, population, handicapped, stock of rescue operation materials and locations, evacuation sites, and necessary stock of food, water, and medicine, among others.

5.27 An early warning system for flood disasters and evacuation should also be implemented. All these disaster-related data should be included in the GIS database to promote and improve natural disaster management and response by the city.

(9) Tourism Information System

5.28 As part of the resource management system, a tourism information system should be established to manage tourism resources in the city and should include hotels, restaurants, transportation systems, and hospitals.

(10) Pilot Project

5.29 The applications of GIS databases and information systems are too numerous to explain here in detail. The requirement for data accuracy differs depending on the mandate of city administration. At present, the development of a GIS database system for Danang City seems to start soon. To assess its applicability to the daily work of various departments in the city, a pilot project should be implemented which will identify the specific users and assess their needs.

5.30 Through this pilot project, problems on data transfer to related agencies, data accuracy, operating cost, and needed staff capabilities will be clarified. An integrated GIS database system for Danang City should be designed and implemented based on the evaluation of this pilot study.

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