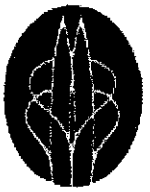

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Geographic Information System for Labuan Island

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CERTIFICATION OF APPROVAL

Geographic Information System for Labuan Island

by

Wan Mohamad Anas bin Wan Khairul Anuar

A peroject dissertation submitted to the

Petroleum Engineering Programme

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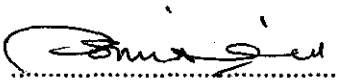
Approved by



Mr Jasmi Ab Talib

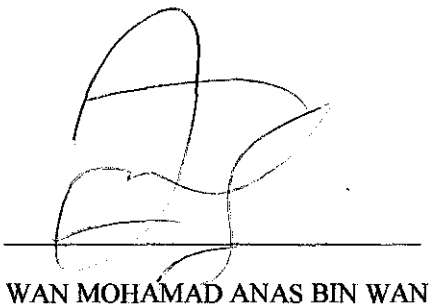
UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

April 2011

CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements and that the original work contained herein have not been undertaken or done by unspecified sources or persons.



WAN MOHAMAD ANAS BIN WAN KHAIRUL ANUAR

ABSTRACT

This project revolves around the construction of Geographic Information System for Labuan Island. The area of interest is focused on the data available for Labuan Island for be combined in a single software system. Software used in this project is ArcGIS 9.3 which includes ArcMap and ArcCatalog. Conventional map data available nowadays are all spread out and in different format thus making data gathering for decision making somewhat difficult. The map data can be lost or damaged as it is usually kept in paper format. There are also difficulties of comparing information covering the same geographic region, but on two different sources. Typically mapping data collected for, say, climate could not be compared directly with, say, soil mapping because they are reproduced at different scales and projections. The scope of study basically covers four main phases starting from the literature review, data gathering, constructing ArcMap for Labuan Island and finally published the completed data compilation for users. The methodology of this project shows how the steps need to be taken in order to construct a geographic information system for desired area. The end product consists of five layers of different data with aerial map data taken from ArcGIS explorer as base map layer for Labuan Island GIS.

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LIST OF ABBREVIATIONS

GIS	Geographic Information System
LANDSAT	Land Satellite
SQL	Structured Query Language
IBFC	International Business and Financial Centre
MSL	Mean Sea Level
UTM	Universal Transverse Mercator
GPS	Global Positioning System
JKR	Jabatan Kerja Raya
IT	Information Technology

LIST OF NOMENCLATURES

2D	Two dimensional
3D	Three dimensional
Km	Kilometre

1.0 INTRODUCTION

1.1 Background Study

Labuan Island is a multipurpose, multidimensional industrial island which is widely known for being an offshore financial centre. The island has become a thriving free port, offshore oil and gas industry base, tourist destination, and a leading international offshore financial centre.

Federal Territory of Labuan (Labuan) is a tropical island in the South China Sea located 8 km west of Borneo, approximately 123 km southwest of Kota Kinabalu, Sabah and 35 km northwest of Brunei. Labuan consists of Labuan Island and six smaller islands (Pulau Burung, Pulau Daat, Pulau Kuraman, Pulau Papan, Pulau Rusukan Kecil, and Pulau Rusukan Besar), which have a combined total area of 92 km^2. The islands lie 8 km off the coast of Borneo, adjacent to the Malaysian state of Sabah and the independent state of Brunei Darussalam, on the northern edge of Brunei Bay facing the South China Sea. Labuan Island is mainly flat and undulating and the highest point is only 85 meters.

Geographic Information System (GIS) is a system composed of locational information also called spatial graphic data with tabular information called attribute data, linked to that location. In GIS the geographic spatial locations are represented as one of the three primitive geometric object types namely point, line and polygon. Any spatial objects like a well, pipeline, pole, road, river, forest, city, country etc. can be reduced to either a point, line or polygon graphic feature/s based on mapping scale at which it is to be represented. GIS stores the spatial data in a coordinate system with a topological adjacency relation based on coordinate space, direction, left, right, length, perimeter, area etc. The potential use of GIS lies in making accurate maps with thematic content, it allows spatial query based on the linked attribute data, it allows modelling of spatial data layers with complex numerical analysis.

In essence, GIS can be defined as a computer system for capturing, storing, querying, modelling, analyzing, and displaying thematic geographic data as eye savouring visual info maps.

1.2 Problem Statement

Traditionally all of the information for Labuan Island is collected, collated, managed, and reproduced in paper format, and whilst paper has many qualities, it cannot match the flexibility offered by modern technology. Some of the potential problems were:

- An inability to reproduce large scale coloured paper rescored in-field.
- Data is collected from different sources and stored in different formats (paper, databases, photograph, video, etc.) which can make it difficult to analyse and compare.
- The difficulties of comparing information covering the same geographic region, but on two different sources. Typically mapping data collected for, say, climate could not be compared directly with, say, soil mapping because they are reproduced at different scales and projections.
- Paper- based records can be damaged or lost – forgotten with the myriad of other paper records.

1.2.1 Problem Identification

In order to get the best set of data for GIS for Labuan Island, various map data are needed as it is essential in building a well constructed GIS. In order to acquire the data needed, thorough search must be done to prevent any incomplete map section when the project finished. All of the data gathered must be compatible with each other to achieve a set of completed GIS for Labuan Island that can be improvised in the future.

1.2.2 Significant of Project

The Idea of the project is basically to come up with a design of GIS for Labuan Island that can cover up the map data available in one single software. The GIS-based solution can search, link and integrate technical data, such as drilling and seismic data, and data from business functions, such as property ownership, infrastructure, and emergency response, the key is to make available "the right information, at the right place and right time." The information obtained can be

visualized, analyzed and reinterpreted and saved-providing significant gains for daily `fact finding` activities.

1.3 Objectives

- Integration of various map data into Geographic Information System-software based for Labuan Island

1.4 Scope of Study

The scope of study will revolve around programming on ArcGIS for the design of GIS for Labuan Island. This include learning on how to integrate access to all logical information and databases having geographic significance and thus simplify the task of searching and retrieving information.

1.5 Relevancy of Project

The conventional 'silo' approach is where the information exists; however it is located across application databases and scattered across geographical locations. This approach makes much of the information inaccessible to peoples can search and obtain data from just about any part of the world and thus reduce the effort it takes to get hold of accurate critical data. GIS layer provides a comprehensive view of data, activities, transactions etc across geographies of Labuan Island.

1.6 Feasibility of the Project within the Scope and Time frame

The project will be conducted starting with the collection of related materials such books, journals and technical papers specifically on Labuan Island and ArcGIS application. Research will be done from time to time as to get a better understanding on the subject. This project will then focus on the modelling and simulation of the Geographic Information System of Labuan Island using ArcGIS software. It follows with the integration of data from various systems on a GIS platform. Based on the activities stated above, given 5 months for the researches and studies to be done as well as experiment activities and for the other 5 months for the finalization of the design, the author feels that the project can be completed within the given time frame.

2.0 LITERATURE REVIEW

2.1 Geographic Information System

GIS is a computing and an integrative tool of the information that belongs to the first level of the scale of the business or base information (in the petroleum industry this information will be, for example, Projects documents, Geology documents, Reservoirs documents, etc.).

Figure 14 shows the overview of the GIS structure (Appendix).

The information volume used in an organization by the different hierarchical levels can be represent in pyramidal form. The inferior level, or base level, is the technical level of the organization. The diversity and quantity of information that manages this level of the organization are considerable, due to the specialization originated by the different professions, and diminish as the hierarchical level increases, due to the use of consolidated data of strategic sense.

In each case the content (thematic original index of the GIS project) and the environment in which will be applied are the characteristics that will differentiate it of others. A GIS applied to the petroleum industry will be able to manage information of all type, reservoir, geological, of surface facilities, etc., however all GIS project has at the same time characteristic and benefit that is scalable (its content can modify without originating losses of the pervious information) and its development will continue as much as it is wanted by adding the topics that are necessary to incorporate.

Another characteristic of a GIS is that the information administered by this system is usually share among a group of people so the work environment will be a client-servant ambient that will belong to the internal net of the organization that develops it. At the present time this tool is beginning used in the internet environment and the information will be available for the public and its use will be massive, like it would happened with a country's data that will be available for all its inhabitants.

GIS has many uses:

Land use - Helps determine land cover, zoning, environmental impact analysis, locational analysis, and site analysis.

Natural environment – Identifies delineates, and manages areas of environmental concern, analyzes land-carrying capacity, and assists in environmental impact statements.

Energy – Examines costs of moving energy, determines remaining available energy reserves, investigates the efficiency of different allocation schemes, reduces waste, reduces heat pollution, identifies areas of danger to humans and animals, assesses environmental impacts, sites new distribution lines and facilities, and develops resource allocation schemes.

Human resources – Plan for mass transit recreation areas, police unit allocation, and pupil assignment and analyzes migration patterns, population growth, crime patterns, and welfare needs. It also manages public and government services.

An area of environmental concern – Facilitates identification of unique resources, manages designated areas, and determines the relative importance of various resources.

Water – Determines floodplains, availability of clean water, irrigation schemes, and potential and existing pollution.

Natural resources – Facilitates timber management, preservation of agricultural land, conservation of energy resources, wildlife management, market analysis, resource allocation, resource extraction, resource policy, recycling and resource use.

Agriculture – Aids in crop management, protection of agricultural lands, conservation practices, and prime agricultural land policy and management.

Crime prevention, law enforcement, criminal justice – Facilitates selection of sites or premises for target-hardening attention, establishment of risk-rating procedures for particular locations, tactical patrol allocation, location selection for crime prevention analysis, crime pattern recognition, and selection of areas or schools for delinquency prevention attention.

Homeland security and civil defense – Assesses alternative disaster relief plans, needs for stockpiling of foods and medical supplies, evacuation plans, and proper designation of disaster relief areas.

Communications – Facilitates siting of transmission lines, location of cellular equipment, and education.

Transportation – Facilitates alternative transportation plans, locational analysis mass transit, and energy conservation.

In order to deliver the information visually with a modelling framework based on the proposed geography, GIS need to support several view for working with geographic information.

The geodata view: A GIS is a spatial database containing datasets that represent geographic information in terms of a generic GIS data model— features, rasters, attributes, topologies, networks, and so forth.

The geovisualization view: A GIS is a set of intelligent maps and other views that show features and feature relationships on the earth's surface. Various map views of the underlying geographic information can be constructed and used as "windows into the geographic database" to support query, analysis, and editing of geographic information. Each GIS has a series of two-dimensional (2D) and three-dimensional (3D) map applications that provide rich tools for working with geographic information through these views.

The geoprocessing view: A GIS is a set of information transformation tools that derive new information from existing datasets. These geoprocessing functions take information from existing datasets, apply analytic functions, and write results into new derived datasets. Geoprocessing involves the ability to program your work and to automate workflows by assembling an ordered sequence of operations.

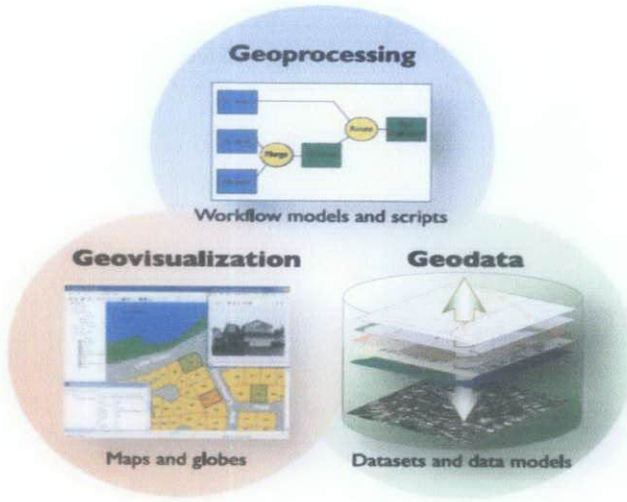

Figure 1: Three views of a GIS for working with key elements of geographic information

2.1.1 Landsat processing procedure

There is no single procedure in capturing spatial data for a GIS database, however, Burrough (1986) has identified six different methodologies for entering data, these are:

1. Manual input to a vector system
2. Manual input to a grid system
3. Digitizing
4. Automated scanning
5. Spatial data already in digital form
6. Other sources of digital spatial data

Of the above six methods, this paper deals primarily with capturing data from the LANDSAT spacecraft which is spatial data already in digital form (method 5).

There are two phases involved in processing LANDSAT data for GIS applications, the first pahse is the manipulation and extraction of vectors from the satellite image. This consists of the preliminary processing of the data set(s) and generating the

vector points for graphical production. The second phase is concerned with the organization of the GIS database. Here, two major components are considered, generation of graphics and the categorization of these features based upon their significance.

2.2 ArcGIS Desktop 9.3

ArcGIS Desktop is a comprehensive set of professional GIS applications used to solve problems; to meet a mission; to increase efficiency; to make better decisions; and to communicate, visualize, and understand geographic information.

In conducting this work, users perform a number of tasks using ArcGIS Desktop, including

- Working with maps
- Compiling, editing, and maintaining geographic data
- Automating work tasks with geoprocessing
- Analysis and modeling using geoprocessing
- Visualization and display of results in maps; 3D views; and dynamic, time-based displays
- Managing and maintaining multiuser geographic databases
- Serving GIS resources and results to a broad range of users for a multitude of applications
- Building custom applications to share GIS
- Documenting and cataloging their results—their geographic datasets, maps, globes, geoprocessing scripts, GIS services, applications, and so on

ArcGIS Desktop is the primary platform for GIS professionals to manage their GIS workflows and projects and to build data, maps, models, and applications. It's the starting point and the foundation to deploy GIS across organizations and onto the Web.

ArcGIS Desktop includes a suite of applications including ArcCatalog, ArcMap, ArcGlobe, ArcScene, ArcToolbox, and ModelBuilder.

Using these applications and interfaces in unison, users can perform any GIS task, from simple to advanced level.

ArcGIS Desktop is scalable and can address the needs of many types of users. It is available at three functionallevels:

1. **ArcView** focuses on comprehensive data use, mapping, and analysis.

2. **ArcEditor** adds advanced geodatabase editing and data creation.

3 .**ArcInfo** is a complete, professional GIS desktop containing comprehensive GIS functionality, including rich geoprocessing tools.

Additional capabilities can be added to all seats through a series of ArcGIS Desktop extension products from ESRI and other organizations. Users can also develop their own custom extensions to ArcGIS Desktop by working with ArcObjects, the ArcGIS software component library.

Users develop extensions and custom tools using standard Windows programming interfaces such as Visual Basic® (VB), .NET, and Visual C++®.

2.2.1 ArcMAP

ArcMap is a comprehensive map authoring application for ArcGIS Desktop. ArcMap is the main application in ArcGIS and is used for all mapping and editing tasks as well as for map-based query and analysis. It's the primary application for all map-based tasks including cartography, map analysis, and editing.

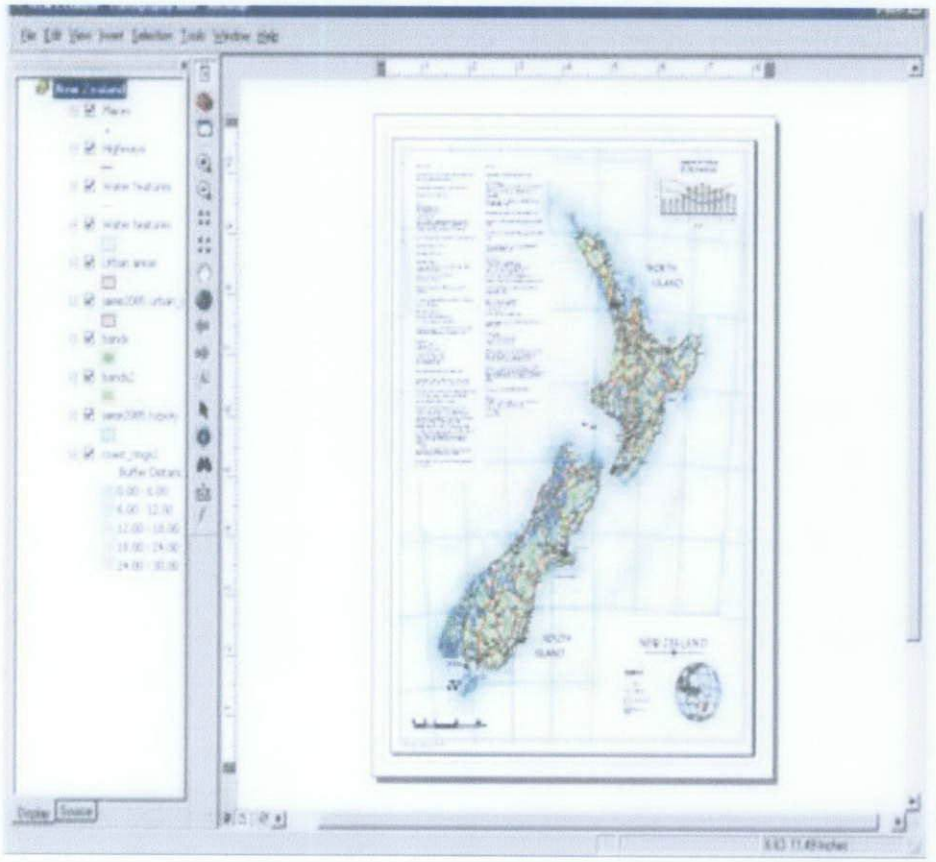

Figure 2: Design and create publication-quality maps

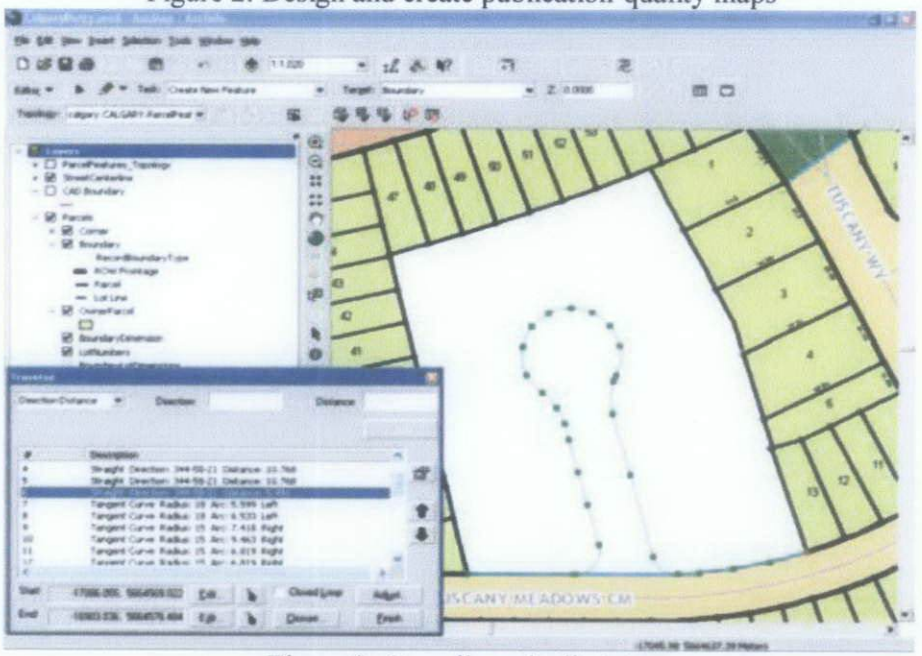

Figure 3: Compile and edit data.

ArcMap represents geographic information as a collection of map layers and other elements in a map view.

Common map elements include the data frame containing map layers for a given extent plus a scale bar, north arrow, title, descriptive text, and a symbol legend.

There are two primary map display panels in ArcMap— the data frame and the layout view. The data frame provides a geographic "window," or map frame, in which you can display and work with geographic information as a series of map layers. The layout view provides a page view where map elements (such as one or more data frames, a scale bar, and a map title) are arranged on a page.

ArcMap is the application used to compose maps on pages for printing and publishing.

2.2.2 ArcCATALOG

The ArcCatalog application helps users organize and manage all geographic information, such as maps, globes, data files, geodatabases, geoprocessing toolboxes, metadata, and GIS services. It includes tools to:

- Browse and find geographic information.
- Record, view, and manage metadata.
- Define, export, and import geodatabase data models.
- Search for and discover GIS data on local networks and the Web.
- Administer and manage ArcSDE geodatabases running in SQL Server Express.
- Administer and manage file and personal geodatabases.
- Administer and manage a series of GIS services.

Users can employ ArcCatalog to find, organize, and use GIS data as well as to document data holdings using standards-based metadata.

A GIS database administrator uses ArcCatalog to define and build geodatabases. A GIS server administrator uses ArcCatalog to administer the ArcGIS server framework.

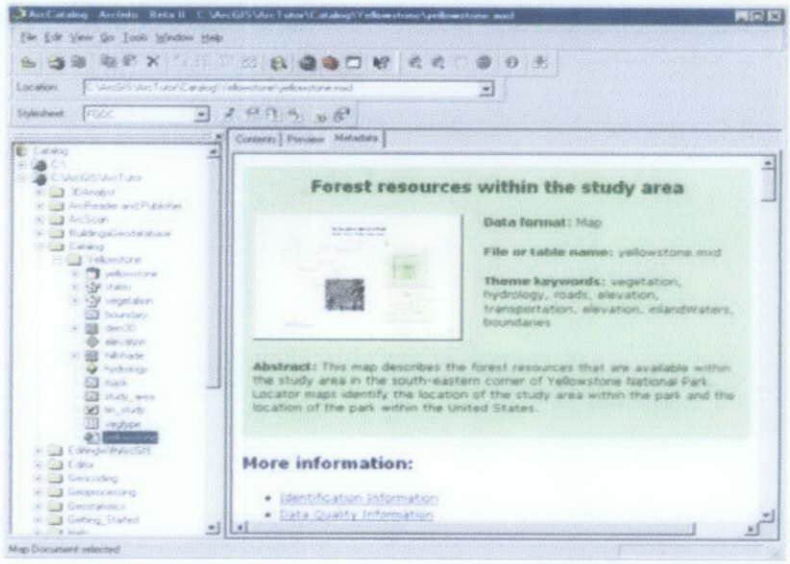

Figure 4: Metadata in ArcCatalog

2.3 Labuan Island

Labuan is the main island of the Malaysian Federal Territory of Labuan. Labuan is best known as an offshore financial centre offering international financial and business services via Labuan IBFC since 1990 as well as a tourist destination for nearby Bruneians and scuba divers.

Figure 15 shows the two dimensional view of Labuan Island (Appendix).

The Federal Territory of Labuan comprises Labuan Island (75 km^2) and six other smaller islands (Pulau Burung, Pulau Daat, Pulau Kuraman, Pulau Papan, Pulau Rusukan Kecil, and Pulau Rusukan Besar), which have a combined total area of 92 km^2. The islands lie 8 km off the coast of Borneo, adjacent to the Malaysian state of Sabah and the independent state of Brunei Darussalam, on the northern edge of Brunei Bay facing the South China Sea. Labuan Island is mainly flat and undulating and the highest point is only 85 meters. Over 70% of the island is still covered with vegetation. Bandar Labuan, formerly known as Victoria, is the major town and faces Brunei Bay; access is via ferry service to Brunei and Kota Kinabalu, as well as Labuan Airport. Due to the fact that land utility is geared more towards property and industrial use, there is less agricultural activity in the area. Most of the island's prime land, waterfront and suburbs are utilised for residential and tourism development. A sizeable area on the south western side of the island is utilised by shipbuilding, manufacturing and oil and gas industries.

2.4 Coordinate Systems

A coordinate system is a way of determining where points lie in space. In this project, the areas of work are in two dimensional (2-D) space and three-dimensional (3-D) space. In general, it takes two numbers to assign a position in 2-D space and three numbers in 3-D space.

2.5 Spherical Coordinate Systems

A spherical coordinate system is another way to reference a point in 3-D space. It also requires three numbers. Two are angles and the third is distance.

The latitude-longitude graticule (a gridded reference network of lines encompassing the globe) is based on a spherical coordinate system. As usual, referencing navigation and earth location issues requires a different system from the one mathematicians use in more abstract systems. The origin is considered to be center of the earth. The equator serves as intersection of the x-y plane and the hypothetical sphere of the earth. To determine the coordinates of a point, one angle (latitude) is measured from the x-y plane. The other angle (longitude) is contained in the x-y plane and is measured from the meridian that passes through Greenwich, England. The third number in a mathematical spherical coordinate system is the distance along the ray from the origin to the point. When added to the latitude-longitude system, altitude is usually defined instead to be distance to the point along the ray from mean (average) sea level (MSL) or from gravity defined pseudo-ellipsoid used with the NAVSTAR Global Positioning System, to be dicussed shortly.

2.6 Two Projected Co Coordinate systems: UTM and STATE Plane

A coordinate system called Universal Transverse Mercator was developed base on a series of 60 projections onto semi-cylinders that contact the Earth along meridians. UTM projections are further subdivided into areas, called zones, covering 6 degree of longitude and, for most zones, 8 degrees of latitude. A coordinate system is imposed on the resulting projection such that the numbers are always positive, always increase from left to right, always increase form bottom to top

3.0 METHODOLOGY

3.1 Research Methodology

In order to achieve the aim of the project, researches had been done on several resources from books, technical papers and internet. For the first step, gathering information needs to be done on the Geographic Information System and all logical information having geological significance of Labuan Island. After all the studies have been done, the next stage will be the simulation stage whereby the design for the Geographic Information System in order to integrate all the available data of Labuan Island using ArcGIS software.

3.2 Project Work Flow

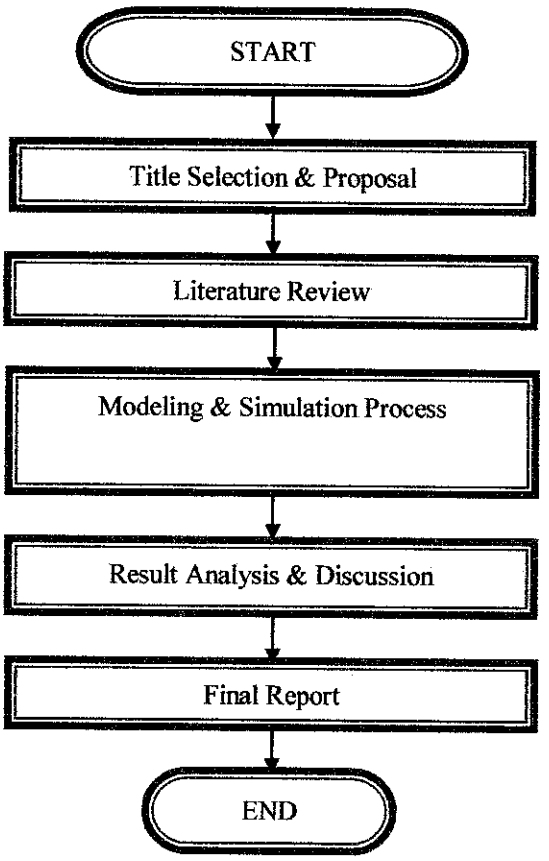

Figure 5: Project activities flow

3.3 Gantt Chart

The Gantt chart (Table 1) is provided together with the report in the Appendices section. Noted that the Gantt chart is a guideline for the project timeline. It can be changed from time to time depending on certain circumstances.

3.4 Tools Required

The Project will solely rely on ArcGIS in building a platform that can integrate and visualize all available data of Labuan Island for further usage.

3.5 GIS structure design

GIS structure is a directory that will be created starting from the analysis of the facilities operation and will embrace the limits environment of the present Project.
The structure of a GIS, this of Surface Facilities or other, must execute certain premises so as users can obtain easily information from their terminals, will be not aspects of the facilities without analyzing and the beginning fixed limits do not stop the extension of the study to other areas (e.g. another Field) or new topics (e.g. underground, etc).

GIS structure will possess the following characteristics

- To be simple.
- To be comprehensible.
- To cover all the users expectations.
- To be enlargeable.

It is important that all GIS can extend, that is to say that the defined original environment for the Project can be enlarged, either on the same topic as likewise that it incorporates new topics, or in another sciences applied to the development of the Company.

Figure 17 indicate the conventional structure of a GIS with the object of study (the Surface Facilities), extended in their different elements.(Appendix)

The directory has subdirectories, or work spaces, that will contain the information.

Table 2 describes the content of the directory. The abbreviations "Cov" and "Dir" means Covering and Directory respectively.(Appendix)

3.5.1 Data capture

This step involves the work of matchmaking the Installation with the existing documents, introducing in them the corresponding changes and making the Surface Facilities Earth Referenced according to work documents.

The field work consist in mathing the Installation with the existing documents at the same time of being determined coordinates of two or three characteristic points of each one. They will be registered, for example with GPS. Also pipelines, electric lines, well lines, etc., as they have been defined in the limits of the Project, will be registered.

Bring up to to date work files will be carried out at the same time of implementing a campaign of Earth-referenced of representative points of the same ones.

3.5.2 Load of Data

The gathered and converted information to the appropriate formats required by the implementation software it will be loaded in the corresponding physical places. One will work with graphic data (Earth-referenced or non Earth referenced) and alphanumeric.

- Earth-referenced Graphics: With this graphics coverings will be generated.
- Non Earth-referenced Graphics: Documents that correspond to typical of facilities, views and details, pictures, etc., in paper will be scanned and stored in format TIF. Documents that belong to P+I Diagrams category, Functional Outlines and Electrical uniline Diagrams will be digitized and kept in format DWG. Files in digital support with formats DWG, TIF will be loaded to the system directly preserving its original format.
- Load of alphanumeric data: Alphanumeric information is a written information, but when being associated to objects of maps that have a defined location in the land for transitive character adopts this information. This situation makes possible doing "hotlinks" to objects of this type to apply the capacity of the

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implementation software to communicate with other applications. The written information can be presented in different styles according to the description type that carry out. Can it find as Digital Files (Excel Charts, Ascii Documents, Word Documents), Charts of other databases and Files in paper support. The information in digital support can be loaded directly to the system, while the information in paper support will be loaded taking it to text files informats of Word, Excel, or Ascii manually as it corresponds or they will be scanned and stored in format TIF.

3.5.3 GIS Integration with other tools:

This stage takes into account GIS linking with external databases (e.g. to publish inside GIS information managed by external databases like connection with ORACLE and SYBASE databases). Due to the possibility of executing hotlinks is possible to activate sub-windows with additional information. Because of ArcView communication capacity with other applications, is possible to execute different programs and to present the information it manages from ArcView

Bring up to date of the GIS:

Modifications that are outside of the frequency of the preset bring up to date, which are product of new projects, will be loaded to the system. For this information type the bring up to date must be established and this work will be carried out centralized or will be carried out non centralized if it will be delegated to the users in function of the authorization levels fixed for them.

The centralized information has a disadvantage like it is a great distance between the field information and the servant that can give place to possible errors in the bring up to date for ignorance of the Surface Facilities. In the present Project the bring up to date was resolved by delegating the users the responsibility whom will be able to carry out the modifications according to their profile.

3.6 GIS Operation Design:

GIS way of operation design arises from the objectives and necessities regarding the administration of the information incorporated into it.

In the case of the domestic GIS people that manage the information are those belonging to the Project Office for what the group of users decreases to an or some few people, the environment of application of the Project is local for what is required only a software of handling regional maps being the one selected originally for this application, AutoCAD 14 Map.

In the case of a corporate GIS after having implemented the Project the information will be centralized and since the users are generally several people the operation of this GIS will be a Client-servant type. The software selected for this application was:

- ArcInfo (for the servant): GIS implementation Software; AIX runs.
- ArcView (for the clients): Exploration, analysis and extraction of geographical data software. It allows to consent to the graphic databases generated by ArcInfo and to charts of related external databases; Windows runs.

For Labuan Island GIS, ArcMap is used to develop the base layer needed for the project.

In the original project ArcView is the front-end of the database, however at the present time, and for practical reasons, is been migrant to the use of this tool like GIS implementation software.

In this outline each user is entitled an access to the databases that it is for writing or for single reading according to the responsibility that corresponds each case. This responsibility is related with the information bring up to date, likewise with the generation of new projects. In the programming level model means the development made by the GIS implementation software. Likewise is defined object of the pattern the environment of the Project.

Because the environment of the Project is the Labuan Island and also the managed GIS information is Earth-referenced, each element object of the pattern will correspond a direction in the implementation software and in turn to this it will

correspond a coordinate point of the Earth surface. In other way the correspondence is also verified so that it is possible the linking of all and each one of the objects of the pattern with the digital map.

In the implementation software each element of the Surface Installation can be represented by different topologies like being: arch, node, polygon and attribute. These representation forms are denominated "Coverings". These coverings will be associated to the "Charts of attributes" that are the databases that contain the information of each element of the Installation. According to the previous paragraph, and also that each element of the object of the pattern is represented by a covering, that is associated to a chart of attributes, the implementation software will generate a relationship among "Coverings", "Charts of attributes" and "Coordinated Earth surface point" in such a way that will correspond a covering, a chart of attributes and a coordinate Earth surface point to each element of the object of the pattern.

All the information that can be obtained from external databases will be able to incorporate to the Project by means of Databases Integrative. Figure 6 shows the form in which the graphic elements and the corresponding attributes are related to offer the complete information of the field and represents the hypothetical case of a visualization of wells in production and Batteries in a Field where each element has a group of associate attributes, distributed in different databases (local and remote), those that will been able to connect to each other because of the existence of Databases Integrative.

3.7 GIS Model

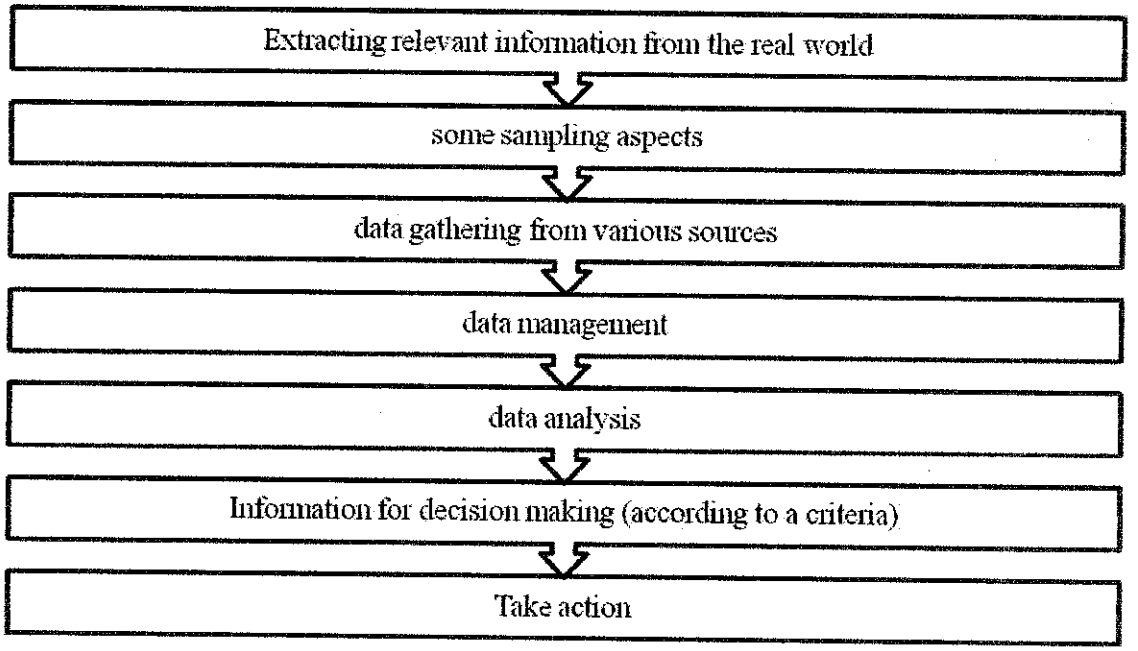

Figure 6: GIS Model

Each of the various aspects mentioned in the flowchart above would be further detailed in the nex few paragraphs.

3.7.1 Extracting data from the real world

Aerial photography, land surveying information, remote sensing from external agencies are a few areas where data can be sourced. There are a lot of data available from agencies like geological surveys, JKR, Universities among others. In this project aerial photography and land surveying are of relevance in determining the illegal hosing or structures.

3.7.2 Some sampling aspects

In designing the sampling programme, random sampling can be initiated. But this may not be effective for GIS analysis. It is recommended in the literature that there be both random sampling and systematic sampling. Other aspects to be considered are point sampling, line sampling, and exhaustive sampling. Each has it advantages and disadvantages. Initiating a pilot study in the field of interest can have its limitations. Pilot study can act as a guide to determine the length the detailed sampling can take for the whole area of interest. For example, presently Petrotrin is carrying a pilot study in one of its field to achieve ISO 14000 certification. This pilot

study is assisting in developing the Environmental Management Survey programme for the other fields

3.7.3 Data gathering from various sources

Because of its evolution from 1912 to present, some of the data from early history were not available. Predecessor companies were not in the habit of having documents in an orederly manner for handing over after they left. As a result early well file data, which provided important information on particular wells, are not available.

In the problem defined above the information needed for the use of GIS are as follow:

- Well locations
- Roads
- Topography
- Watercourses
- Coastline
- Pipeline
- Gas line
- Buildings
- Water table depth

For this project, five essential data have been gathered to establish a good foundation for Labuan Island GIS. The lists of data are as follows:

- Village
- Contour
- Main Road
- Main River
- Lithology

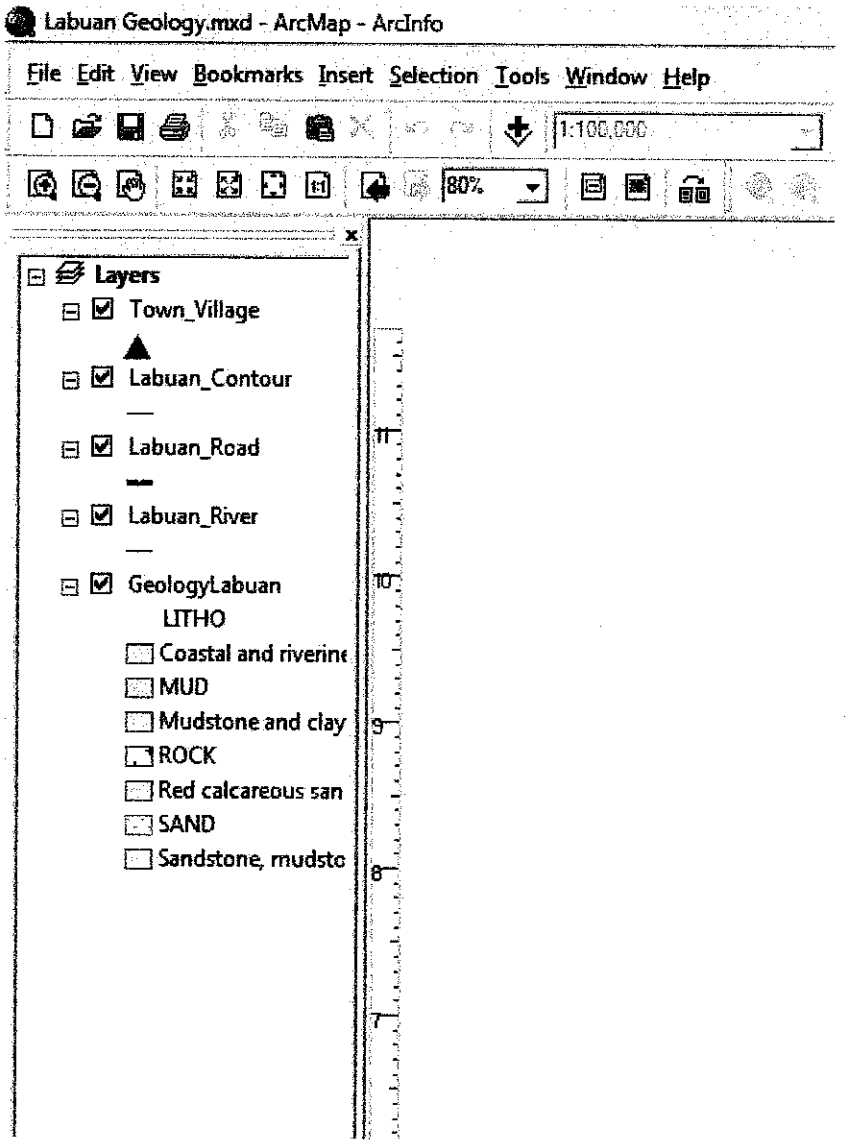

Figure 7: List of data

The attributes of each data are carefully compiled from each district in Labuan Island to be presented in a new layer.

Attributes of Labuan_Road

FID	Shape *	FNODE_	TNODE_	LPOLY_	RPOLY_	LENGTH	JALAN_	JALAN_ID	LAYER
0	Polyline	16	17	0	0	1538.661079	14	14	FOOTPATH
1	Polyline	18	17	0	0	76.819279	15	15	FOOTPATH
2	Polyline	17	19	0	0	627.883874	16	16	FOOTPATH
3	Polyline	20	21	0	0	11.273013	17	17	INDIFF_3
4	Polyline	24	25	0	0	260.709188	19	19	INDIFF_3
5	Polyline	28	29	0	0	225.478453	21	21	INDIFF_3
6	Polyline	30	31	0	0	173.494778	22	22	INDIFF_3
7	Polyline	32	33	0	0	379.023761	23	23	INDIFF_3
8	Polyline	36	37	0	0	85.730789	26	26	INDIFF_3
9	Polyline	54	55	0	0	46.309366	40	40	CARTRACK_
10	Polyline	56	57	0	0	28.206293	41	41	CARTRACK_
11	Polyline	58	59	0	0	74.361604	42	42	CARTRACK_
12	Polyline	64	65	0	0	76.882241	46	46	SCAR_1W1B
13	Polyline	66	64	0	0	92.342855	47	47	SCAR_1W1B
14	Polyline	66	64	0	0	26.562738	48	48	SCAR_1W1B
15	Polyline	67	66	0	0	103.963806	49	49	SCAR_1W1B
16	Polyline	68	69	0	0	53.645782	50	50	SCAR_1W1B
17	Polyline	68	70	0	0	33.892254	51	51	SCAR_1W1B
18	Polyline	71	72	0	0	229.763118	52	52	SCAR_1W1B
19	Polyline	73	74	0	0	90.820766	53	53	SCAR_1W1B
20	Polyline	75	73	0	0	141.443462	54	54	SCAR_1W1B
21	Polyline	73	76	0	0	40.762733	55	55	SCAR_1W1B
22	Polyline	77	76	0	0	91.472377	56	56	SCAR_1W1B
23	Polyline	76	78	0	0	122.367785	57	57	SCAR_1W1B
24	Polyline	79	80	0	0	245.028546	58	58	SCAR_1W1B
25	Polyline	81	82	0	0	102.981731	59	59	SCAR_1W1B
26	Polyline	83	84	0	0	253.82331	60	60	SCAR_1W1B
27	Polyline	85	86	0	0	144.123231	61	61	SCAR_1W1B
28	Polyline	85	87	0	0	303.398126	62	62	SCAR_1W1B
29	Polyline	83	85	0	0	135.796758	63	63	SCAR_1W1B
30	Polyline	88	89	0	0	112.372933	64	64	SCAR_1W1B
31	Polyline	90	91	0	0	162.108725	65	65	SCAR_1W1B
32	Polyline	92	93	0	0	36.357883	66	66	SCAR_1W1B
33	Polyline	94	95	0	0	187.116124	67	67	SCAR_1W1B
34	Polyline	95	99	0	0	68.210749	70	70	SCAR_1W1B
35	Polyline	100	101	0	0	167.096726	71	71	SCAR_1W1B
36	Polyline	100	102	0	0	113.940283	72	72	SCAR_1W1B
37	Polyline	102	103	0	0	52.703934	73	73	SCAR_1W1B
38	Polyline	104	100	0	0	51.022852	74	74	SCAR_1W1B

Figure 8 Sample of attribute data combined

3.7.4 Data Management

This has to take the form in which it would be best utilized in the GIS format. The data gathered as mentioned in the previous section would entail a close examination for errors. For example if pipelines are being replaced the data must be submitted immediately for entry in the GIS database. Likewise well information has to be entered immediately. Some aspects the data management would have to consider are:

- Formatting
- Data being specific
- Editing
- Laboratory analyses

Wells and pipelines are considered as sensitive areas in the oil industry. Accuracy of information is of paramount importance. Also the use of digital cameras in field visits is allowing accurate data to reach the GIS database faster than before.

3.7.5 Data Analysis

Data analysis can be considered simultaneously to data management. As fast as the data is acquired it can be analyzed. GIS allows that flexibility to analyze the data while at the same time other aspects are taking place

Analysis can either be descriptive or tabulation. Both set of information would have to be converted into the GIS format for use.

3.7.6 Decision Making

The decision making will base on the data analysis using GIS beforehand. For example:

- The map showing all the structures within the 100 feet radius of the wells and other installations would need redress by the Legal Department
- Watercourses within the 100 feet radius, would indicate that no effluent can leave the well or installations and go into these watercourses.
- Pipelines within 100 feet of buildings would have to be protected from any leaks so as not to affect persons.

3.7.7 Take Action

It is a known fact that management would have to take action based on the analyses carried out. Another decision that can be taken if no action is relevant is to return to the real world and start the process all over again. This would depend on whether the information originally provided was sufficient.

4.0 Results and Discussion

A layer references the data stored in geodatabases, coverages, shapefiles, rasters, and so on, rather than actually storing the geographic data. Thus, a layer always reflects the most up-to-date information in your database. Geographic data collected will be represented as layer for each set and compiled using ArcMAP. These layers can be organized according to their priority and edited using Editor Toolbar provided by ArcMAP.

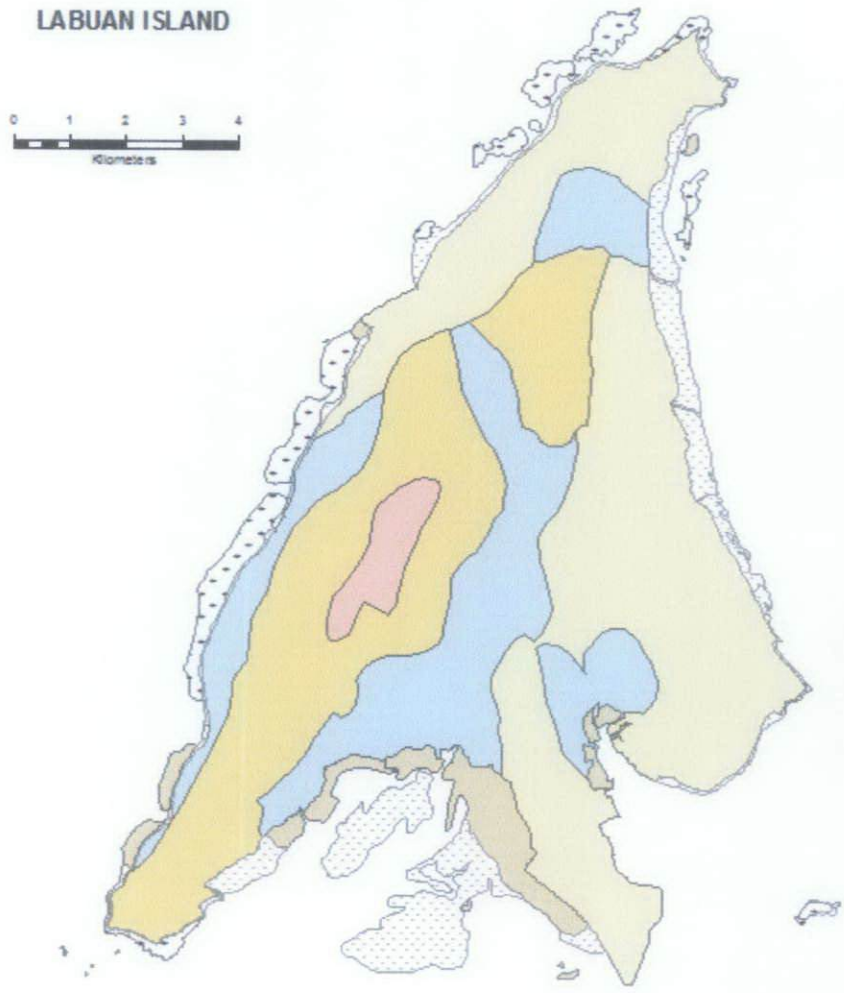

Figure 9: layer of geology

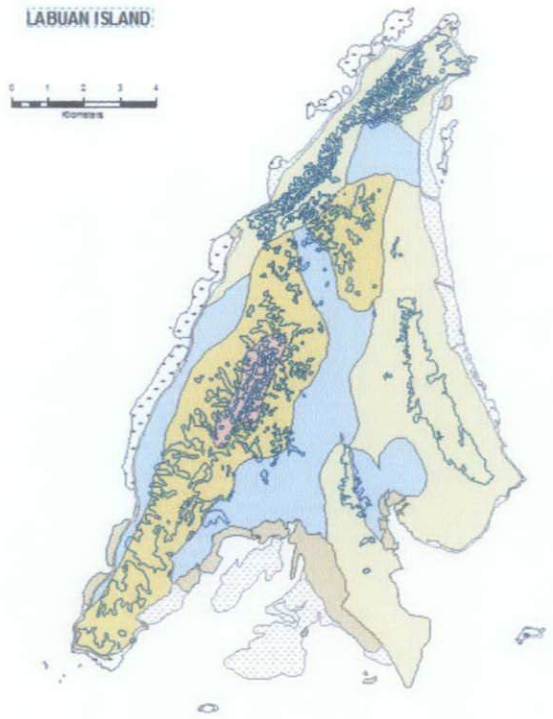

Figure 10: Layer of contour

Figure 11: Layer of road

Figure 12: Layer of village

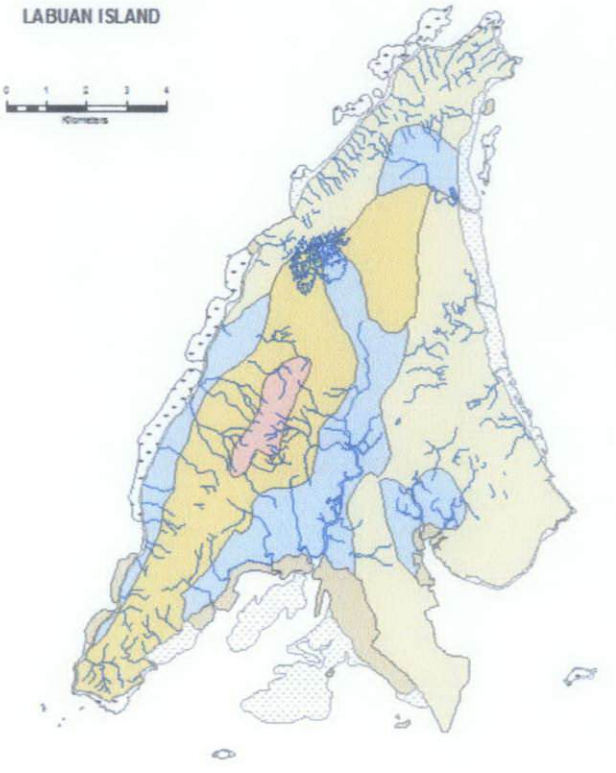

Figure 13: Layer of river

In addition to the above data constructed for Labuan Island, aerial map data for Labuan Island has been captured using ArcGis explorer to be set as base map for our GIS database.

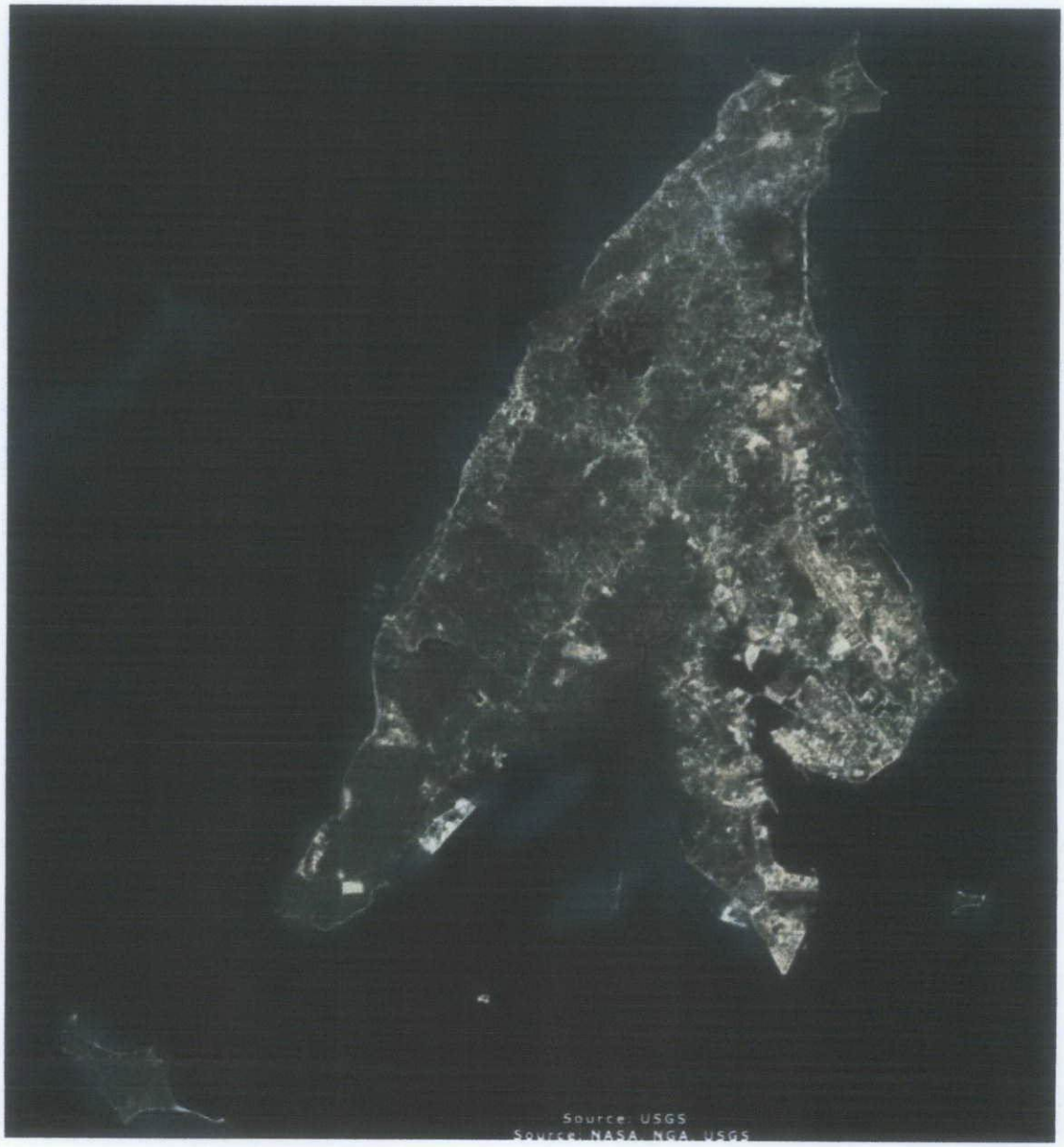

Figure 14: Base map for Labuan Island ArcMap

All of the layer above can be toggle on and off to help us in viewing the map. The user also can review the detail of each layer for any additional info using the function available in ArcMap as shown in figure 15.

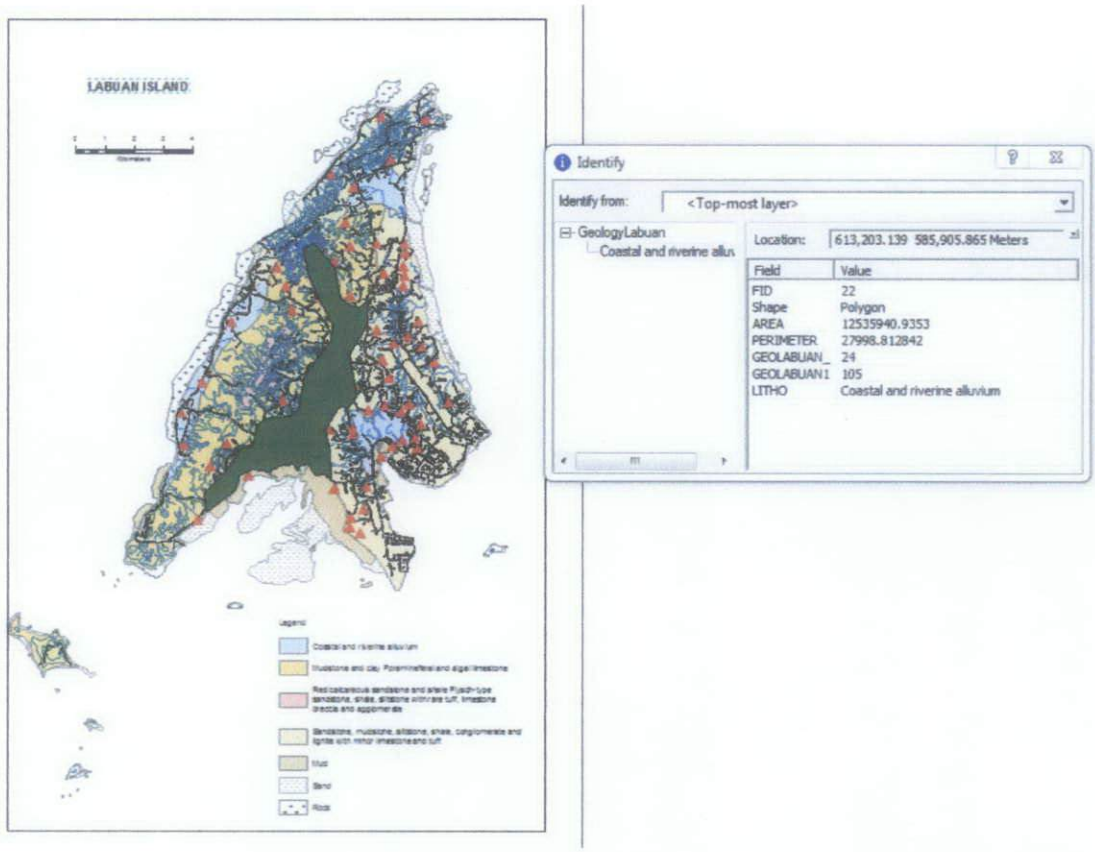

Figure 15: Detail info of each section

5.0 Conclusion

With growth in scale, geographical spread and increased competition, the complexity of running the business has increased. IT applications can bring great value by enhancing operations within a company, assisting users in running the business, and reducing the hassle of decision making and reporting processes. Over the years, IT and engineering vendors have developed state-of-the-art applications to address these business issues. As a result, functional experts, in addition to concentrating on their core domains, are expected to be well trained in the use of these IT applications. Considering the value of these experts, having them spend time on acquiring the skills to run the IT tools is effectively taking them away from their core competence. The introduction of common GIS-based platform for Labuan Island can significantly reduce the time in decision making and assist these experts in applying their time in their core function.

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APPENDICES

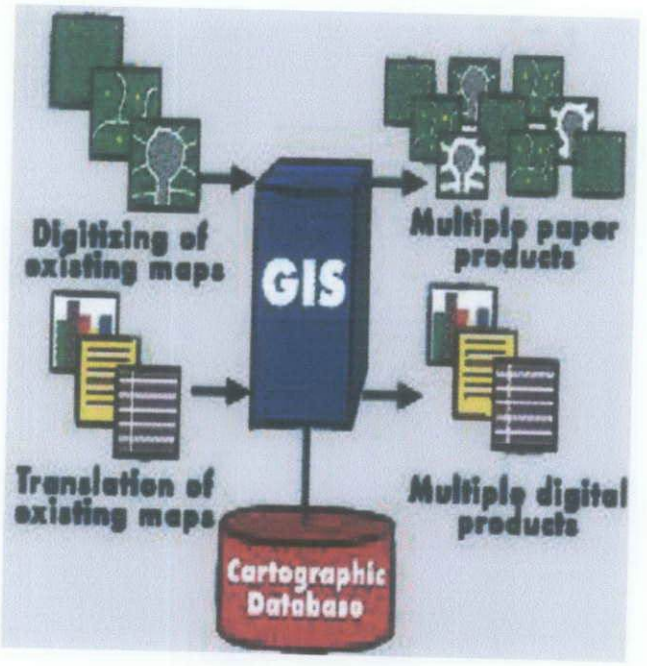

Figure 16: Overview of GIS structure

Figure 17: Two Dimensional view of Labuan Island

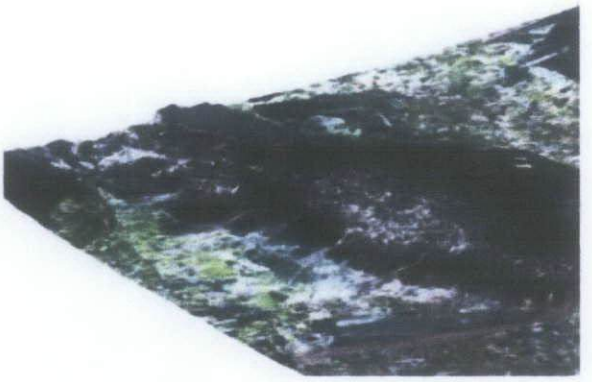

Figure 18: Example of Land Digital Model

SUBDIRECTORY OR WORKSPACE	COVER & SUBDIRECTORIES		CONTENT
.../FIELD	/UBICACION	Cov	Límites del área, Límites del Yacimiento, Límites de bloques y fallas de atributos asociados
	/CAMINOS	Cov	Caminos y rutas de acceso
	/POZOS	Cov	Todos los pozos
	/PIPEVAC	Cov	Todas las líneas de conducción y ubicación de instalaciones a nivel del Yacimiento
	/LINEMM	Cov	Trazado de líneas sísmicas de distintos años
	/ENERGIA	Cov	Líneas eléctrica, estaciones y subestaciones transformadoras, etc.
	/HIDROGRAFIA	Cov	Información hidrográfica de la zona
	/TOPOGRAFIA	Cov	Puntos con cotas conocidas
	/VEGSUELOS	Cov	Tipos de vegetación y suelos del área Yacimiento
	/RIESGOS	Cov	Areas delimitadas como de riesgo de contaminación o distintas escalas
	/SCADA	Cov	Sistema de control automático instalado a nivel de Yacimiento
	/IMAGENES	Dir	Imágenes (landsat, spot, radar, DEM) a nivel de Yacimiento
	/FOTOS	Dir	Fotos (.tif) a nivel de Yacimiento
	/DIAGPI	Dir	Diagramas P+I de las instalaciones a nivel Yacimiento
	/ESQFUNC	Dir	Esquemas Funcionales a nivel de Yacimiento
	/ESQUNIF	Dir	Esquemas Unifilares a nivel de Yacimiento
.../OBRAS			
	/BATERIA 2	Dir	Información de Ingeniería de Obras de la Batería 2
	/BATERIA3	Dir	Información de Ingeniería de Obras de la Batería 3
	/BATERIA4	Dir	Información de Ingeniería de Obras de la Batería 4
	/BATE RIA5	Dir	Información de Ingeniería de Obras de la Batería 5
	/BATERIA6	Dir	Información de Ingeniería de Obras de la Batería 6
	/BATERIA7	Dir	Información de Ingeniería de Obras de la Batería 7
	/PTATRAT	Dir	Información de Ingeniería de Obras de la Planta de Tratamiento
	/CTRLVAP	Dir	Información de Ingeniería de Obras de las Centrales de Vapor
	/EDIFICIOS	Dir	Información de Ingeniería de Obras de los Edificios
	/DIAGPI	Dir	Diagramas P+I de las distintas instalaciones
	/ESQFUNC	Dir	Esquemas Funcionales de las distintas instalaciones
	/TIPICOS	Dir	Subdirectorios con Tipicos de las distintas instalaciones
/BATERIA1			
	/PIPEBATn	Cov	Información de cañerías y líneas de conducción y de instalaciones internas de la Batería en cuestión
	/GEOTECNIAn	Cov	Puntos con datos de estudio de suelos para construcciones civiles.
	/CIVILn	Cov	Información de plataformas de sustentación de instalaciones y líneas de suministros
	/ RUIDOS	Cov	Información de los estudios realizados en relación al nivel de ruido en las instalaciones
	/TIPICOSn	Dir	Subdirectorios con tipicos de los elementos existentes en la batería
	/HOJADATOn	Dir	Subdirectorios con hojas de datos de cada instalación
.../ENERGIA			
	/BATERIA 2	Dir	Toda la información de energía georeferenciada correspondiente a la Batería2
	/BATERIA3	Dir	Toda la información de energía georeferenciada correspondiente a la Batería3
	/BATERIA4	Dir	Toda la información de energía georeferenciada correspondiente a la Batería4
	/BATE RIA5	Dir	Toda la información de energía georeferenciada correspondiente a la Batería5
	/BATERIA6	Dir	Toda la información de energía georeferenciada correspondiente a la Batería6
	/BATERIA7	Dir	Toda la información de energía georeferenciada correspondiente a la Batería7

Figure 19: Architecture of a GIS

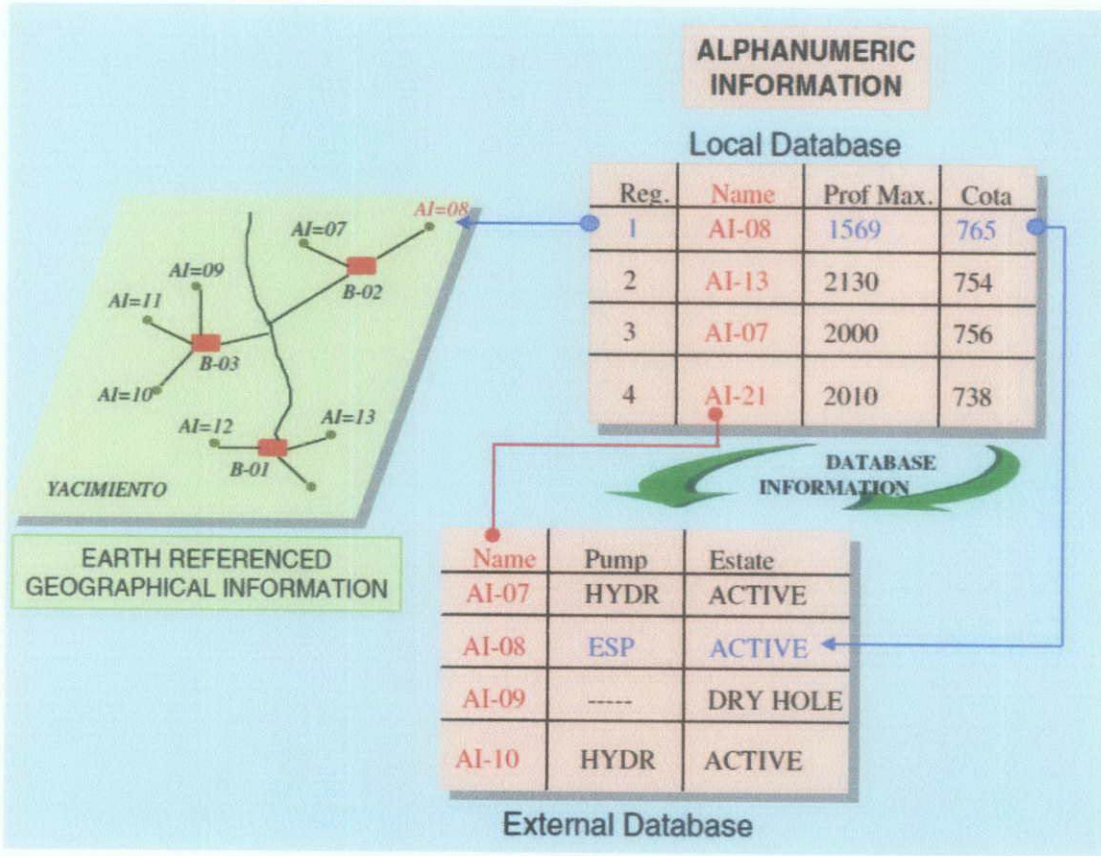

Figure 20: Graphic element and corresponding attributes of GIS

No	Details	Week													
		1	2	3	4	5	6	7		8	9	10	11	12	13	14
1	Selection of Project Topic															
2	First meeting with supervisor															
3	Preliminary Research work															
	a) Research on construction of GIS															
4	Preliminary Report preparation															
5	Submission of Preliminary Report (1 Sept 2010)															
6	Seminar 1 (optional)															
7	Progress report preparation															
8	Submission of Progress Report															
10	Ready a report on Geographic Information System for Labuan Island															
11	Data Gathering on case study well #1															
12	Analysis well test data															
13	Discussion and Project Alteration															
14	Seminar 2 (compulsory)															
15	Submission of Interim Report Final Draft															
16	Oral Presentation preparation															
17	Oral Presentation (Week 14)															

MID SEMESTER BREAK

Table 1: FYP 1 Gantt Chart

No	Details	Week													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Data compilation for Labuan Island														
2	Data management using ArcGIS														
4	ArcGIS modeling														
6	Dissertation preparation														
7	Submission of dissertation														
8	Final presentation preparation														
9	Final presentation														

Table 2: FYP 2 Gantt Chart

COVER: PIPEBATn

ARC TOPOLOGY: PIPEBATn.AAT	LINES
ROUTES & SECTIONS	De general De control De vapor De aire De gas De gas de producción De gas de aprovisionamiento propio De gas de aprovisionamiento extra De gas a quema De gas a exhaustores De drenaje De gasolina De agua De agua de incendio De agua de aprovisionamiento De agua de reinyección De agua para recuperación secundaria De espumígeno De petróleo De petróleo de producción De petróleo motriz De corrosión
TOPOLOGIA DE NODOS PIPEBATn.NAT	Puntos de unión cañería-cañería Puntos de unión cañería-instalación Accesorios en generales, etc.
TOPOLOGIA DE POLIGONOS PIPEBATn.PAT	Instalaciones en general
EVENTOS - ATRIBUTOS	**EVENTOS LINEALES DISCONTINUOS** Regulador de temperatura Sleeper longitudinal Elemento de expansión **EVENTOS PUNTUALES** Accesorios Válvulas Trampas Brida Adjuntos Sleeper

Table 3: Architecture of GIS